APPLICATION

Study field "Environmental Protection" for assessment

Study field	*Environmental Protection*
Title of the higher education institution	*Rīgas Tehniskā universitāte*
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Self-evaluation report

Study field "Environmental Protection"

Riga Technical University

Table of content

I - Information on the Higher Education Institution/College

1.1. Basic information on the higher education institution/ college and its strategic development directions, including the following information:

Riga Technical University was founded in 1862 as Riga Polytechnic, later Riga Polytechnic Institute, and is the oldest technical university in the Baltic States. Following the restoration of the Republic of Latvia in March 1990, Riga Polytechnic Institute was renamed Riga Technical University (RTU). Over years RTU has become the leading center of higher engineering education and science in Latvia, obtained a positive assessment of international experts, and has been accredited by the Supreme Education Council of the Republic of Latvia.

RTU values include academic freedom, quality, stability, integrity, sustainable development, and cooperation.

At the beginning of the academic year 2020/2021, nine faculties (Faculty of Architecture, Faculty of Civil Engineering, Faculty of Computer Science and Information Technology, Faculty of E-Learning Technologies and Humanities, Faculty of Electronics and Telecommunications, Faculty of Electrical and Environmental Engineering, Faculty of Engineering Economics and Management, Faculty of Mechanical Engineering, Transport and Aeronautics, Faculty of Material Science and Applied Chemistry) and four regional study and science centres in Cesis, Liepaja, Ventspils, and Daugavpils employed around 1024 persons as academic and scientific staff performing high-quality study work and scientific research in line with modern requirements. RTU is the second-largest university in the Republic of Latvia in terms of student number and has educated and trained more than 160,000 graduates in total.

RTU carries out active study and research work, acquiring new partners worldwide, working together on project implementation, student exchange, and the development of joint study programs. Active development of a student campus is underway in Kipsala, where new faculty buildings are being built, while those built in earlier years are getting a new look, modern content, and design.

Many research and scientific projects are being carried out in cooperation with RTU partners, which result in both new patents and successful business activities. RTU successfully develops cooperation to strengthen its role in the development of higher engineering education in the world and in the development of Latvia.

The mission of RTU is to provide the Latvian national economy and society with internationally competitive high-quality scientific research, higher education, technology transfer, and innovation.

Vision: Riga Technical University - an internationally competitive, dynamic, and modern university of science and technology. In order to implement this vision, the RTU Strategy defines four university objectives: (1) excellent science; (2) quality studies; (3) sustainable valorisation, and (4) institutional excellence. These three objectives define specific performance indicators that will allow RTU to realize its vision by the end of 2025.

Study directions and a number of study programs implemented by RTU in May 2021:

Study directions	Number of study programs

Architecture and Construction	20
Economics	3
Energy, Electrical Engineering and Electrical Technologies	14
Physics, Materials Science, Mathematics and Statistics	7
Internal Security and Civil Defense	6
Information Technology, Computer Engineering, Electronics, Telecommunications, Computer Control and Computer Science	37
Chemistry, Chemical Technology and Biotechnology	9
Mechanics and Metalworking, Thermal Energy, Thermal Engineering and Mechanical Engineering	27
Production and Processing	6
Translation	2
Management, Administration, Real Estate Management	23
Environment Protection*	6
Total:	**158**

* Three study programmes are submitted for evaluation and accreditation.

The offer of RTU study programs is in compliance with the forecasts with regard to the needs of the labour market in both Europe and Latvia in the coming decade. The RTU study program offer ensures education and training of specialists in information and communication technologies (ICT), engineering, management, and humanities, for which a significant shortage in the labour market is predicted.

In recent years, the number of foreign students studying to obtain a degree or qualification in Latvia has increased. In addition, the Organization for Economic Cooperation and Development (OECD) predicts that the number of people willing to acquire higher education could reach 8 million in ten years. In the academic year 2019/2020, there were 25% more foreign students studying at RTU in comparison with the academic year 2018/2019. Taking into account the above mentioned, RTU has great opportunities to further increase the number of foreign students, however, the dynamics of attraction of international students in 2020/2021 may be considerably affected by the travel restrictions caused by COVID-19. It also provides an appropriate offer of RTU study programs in English – 16 Bachelor level study programs, 27 Master level study programs and 13 Doctor level study programs, moreover, this list is variable and is updated from year to year.

Dynamics of the number of students in the RTU during the evaluation period:

Academic year	**Total number of students**

2013./2014.	14,452
2014./2015.	14,797
2015./2016.	14,997
2016./2017.	14,672
2017./2018.	14,322
2018./2019.	14,383
2019./2020.	14,006

In November 2020, 14,006 students studied at RTU. 9,711 students studied at undergraduate study programs, 2,951 students studied at Master degree programs, and 500 – at the Doctoral study programs.

RTU has approved the Strategy and Development Program for 2021-2025.

The keynote of the strategy of the Riga Technical University is the proactive link
between the activity of the university and the needs of the national economy, focus on high quality and effectiveness. The basis for the activity of RTU is the study process built on science, innovation, and in cooperation with the industry, which ensures the preparation of specialists required by the Latvian national economy, thus serving as a foundation for the sustainable growth of Latvia.
The RTU's strategy for the new programming period is a consecutive continuation is the previous strategy of the university for 2014-2020. It has been developed in compliance with the objectives and priorities defined in Latvian development planning documents, including:

- Latvian Sustainable Development Strategy up to 2030 (Latvia 2030);
- National Development Plan of Latvia 2021-2027 (NDP2027);
- UN Sustainable Development Goals (2030 Agenda).

The RTU Strategy includes the main objectives for the development of RTU for the period up to 2025, as well as the allocation of activities and responsibilities to be carried out for the performance of the planned tasks.

According to the National Development Plan of Latvia for 2021-2027, fundamental changes are planned in the near future in four directions – *Equal rights*, *Quality of life*, *Knowledge society*, *Responsible Latvia*, the achievement of which is seriously based on the quality study process, excellent research, and sustainable innovation and commercialisation activities that are important elements of the RTU's vision to become the leading University of science and innovation in the Baltic States.

The purpose of a high-quality study process is internationally competitive, analytically and creatively thinking specialists educated and trained in the course of prestigious, internationally recognized high-quality studies, who are able to ensure the development of the Latvian national economy and who have the capacity for life-long learning. The aim of excellent research is high-quality scientific studies that meet the needs of the Latvian and international economy, widely involved in international, national, and sectoral research programs and integrated into the study process. Sustainable valorization aims at creation of an efficient environment for technology transfer and innovation development, which promotes the establishment of new technological companies and the creation of new products.

Six key priorities of the University include internationalization, smart digitalization, interdisciplinarity, organizational, financial, and infrastructure efficiency, which pursue the four main objectives mentioned above. RTU uses horizontal priorities as a prism to review the achievement of its objectives and to ensure internationally competitive high-quality scientific research, higher education, technology transfer, commercialization, and innovation for the Latvian economy and society.

The aim of internationalization is to ensure internationally competitive University activities in the fields of research, innovation, and education. The aim of smart digitalization is to use modern technologies to improve efficiency of University activities. Interdisciplinarity aims at promoting cooperation between different sectors and specializations as a basis for the creation of new and innovative products and the development of a modern study curriculum. Organizational efficiency aims at promotion of effective University management, ensuring development and implementation of modern education and research processes. The aim of financial efficiency is to ensure the financial autonomy of the University and to establish a motivating internal financial system that promotes University development. The purpose of infrastructure efficiency is a development of a modern academic, research, and innovation environment with modern buildings and technical equipment.

The implementation of the RTU Strategy is approved by a decision of the RTU Senate. Following the approval of the Strategy, RTU Rector once a year ensures the definition of the annual RTU aims and tasks with clear performance indicators set at the level of each RTU unit. RTU Strategy is implemented and the results achieved are analysed annually with regard to the defined tasks.

RTU Strategy for 2021-2025 is published at Strategy | Riga Technical University (rtu.lv)

1.2. Description of the management of the higher education institution/ college, the main institutions involved in the decision-making process, their composition (percentage depending on the position, for instance, the academic staff, administrative staff members, students), and the powers of these institutions.

The structure and administration of RTU are established in compliance with the University's vision, mission, and objectives and taking into account the specifics of the University management. The administrative structure is based on a decentralized decision-making process and obligations arising from the Law on the Higher Education Institutions, the Constitution of RTU, resolutions of RTU Senate, the orders issued by the Rector, as well as other RTU documents. The functions of various organizational units have been approved in their regulations approved by the Senate. Overall, RTU management can be divided into three levels: university level, administration level, and faculty level.

At the University level, there is the Constitutional (Academic) Assembly (200 representatives – 120 academic personnel representatives (60% of the total number), 40 student representatives (20% of the total number), and 40 general staff representatives (20% of the total number). The Assembly includes all members of the RTU Senate. The conditions for the formation of the Assembly are defined in Article 30 of the RTU Constitution – see the file of Annex 01 of the list of Internal regulations), the Senate (50 Senators – 38 academic personnel representatives (75% of the total number), 10 student representatives (20% of the total number) and two general personnel representatives (5% of the total number). The conditions for the election of the representatives of the Senate are defined in the attached Article 7 of the Regulation of the Senate of RTU - see the file

of Annex 02 of the list of Internal regulations), Scientific Council (composed of Deputy Deans in for research, Vice-Rector for Research, Deputy Vice-Rector for Research; the Rector, Vice-Rector for Academic Affairs, Vice-Rector for Strategic Development, Vice-Rector for Finance and the Chair of the Senate also have the rights of membership of the Council).

In response to the announcement of the emergency caused by COVID-19, on 13 March 2020, a rector's order on the establishment of the RTU Crisis Management Council was issued. The Crisis Management Council is established and is operating only in a crisis situation or in emergency conditions to resolve problems. In the context of the study process, the task of the RTU Crisis Management Council is to develop recommendations for RTU crisis operation management in academic, scientific, and economic work matters and to supervise their implementation.

At the level of administration, the operational management of the university is exercised by the Rector, whereas the Board of the Rector plays an advisory role in the adoption of such decisions, with the participation of the Rector, Chair of the Senate, Vice-Rectors, Administrative Director, Deputy Rector for International Academic Cooperation and Studies, Director of the Legal Department, Director of Infrastructure Development Department, President of the Student Parliament; the Deans Council comprising the Rector, Deans, directors of studies and research centres, Director of Riga Business School, Chair of the Senate, Vice-Rectors, Deputy Rector for International Academic Cooperation and Studies, Director of Infrastructure Development Department, President of the Student Parliament; operational management meetings uniting the Rector, Administrative Director, Deputy Vice-Rector for Research in Scientific Work, the heads of administrative departments (department directors, unit managers). At the faculty level, the highest decision-making bodies are faculty councils whose composition depends on the size of the faculty.

External partners and stakeholders are involved in the University management through the RTU Advisory Board (27 members). It provides an opportunity to receive an independent opinion on important issues and possible solutions from various perspectives. Each faculty also has its own Advisory Board, which provides its own vision for improving the supply of study programs in line with sectoral needs and market trends.

Each faculty also has its own Student self-government, while RTU Student Parliament coordinates faculty Student self-governments. Students are represented in all RTU decision-making bodies and can therefore participate in the University's strategic decision-making.

The Rector, Vice-Rector for Research, Vice-Rector for Academic Affairs, Vice-Rector for Finance, and Vice-Rector for Strategic Development are the senior officials of RTU. The **Rector** implements the general administrative management of RTU and represents RTU without a specific mandate. The Rector is elected by the Constitutional Assembly for a period of five years for no more than two consecutive terms for the same person. The Rector is elected, approved in office and removed from office pursuant to the regulatory enactments governing higher education institutions.

The operational management of RTU is exercised independently, in accordance with the delegation of the Rector, by the Vice-Rector for Research, Vice-Rector for Academic Affairs, Vice-Rector for Strategic Development, and Vice-Rector for Finance. The Senate elects the Vice-Rector for Research, Vice-Rector for Academic Affairs, Vice-Rector for Strategic Development, and Vice-Rector for Finance based on the recommendation of the Rector for the term of office of the Rector. The Rector may also delegate certain functions to other RTU officials and, on the basis of the Rector's proposal; other Vice-Rector positions may be created by a Senate decision

The Vice-Rector for Research supervises and is responsible for Doctoral study programs and research work, including support to young researchers, research infrastructure, research funding, applied research, intellectual property protection, RTU scientific publications, and scientific

conferences**. The Vice-Rector for Academic Affairs** supervises and is responsible for the study process at the Bachelor, Master, first and second-level professional study programs, further education, including training programs, security, and quality assurance in studies, credit points, determination of academic staff positions, and workload, as well as the selection and admission of students. **The Vice-Rector for Strategic Development** is responsible for the development strategy and its successful implementation, supervises the implementation of projects important for the development of RTU, and represents the interests of RTU in interaction with public authorities, partners, and the public**. The Vice-Rector for Finance** is responsible for the financial management processes of RTU and for allocating and planning financial resources to ensure the functioning of RTU and implementation of the development strategy.

The accounting, study administration, science administration, and human resources administration at the university are centralized. Other administrative processes, such as procurement and project management, are centralized to the extent necessary to avoid institutional risks. At the same time, a decentralized management system has been provided at a high level at RTU, with a certain degree of autonomy for each academic unit. This means they have their own budget and self-governing structure, which allows defining and meeting the objectives of the organizational unit. This approach motivates the heads of departments to be proactive, to plan the development of the unit, and to apply for funding.

RTU governance structure information is published at Structure and administration | Riga Technical University (rtu.lv)

1.3. Description of the mechanism for the implementation of the quality policy and the procedures for the assurance of the quality of higher education, as well as the stakeholders involved in the development and improvement of the quality assurance system and their role in these processes.

RTU internal quality management system works in line with the “Excellence approach” (approved on 30 January 2017 at the meeting of the RTU Senate, Minutes No 606), as well as the “RTU Quality Policy” (approved by the Senate on 25 September 2017, Minutes No 612).

The Quality Policy is focused on the implementation of the RTU mission and the achievement of the strategic objectives. The Quality Policy lays out the framework and pathways for development and improvements of the RTU Strategy, research, study process, and organization. The University Quality Policy is aligned with the European Association for Quality Assurance in Higher Education 8 (ENQA) standards and guidelines. The RTU Excellence Approach and quality policy are mutually integrated documents that require RTU to use the quality model of the European Foundation for Quality Management (EFQM).

The EFQM quality model assumes cooperation with student representatives, partners, professional associations, student organizations, other higher education institutions, businesses, and organizations. RTU maintains an open dialogue to explore the needs of the parties involved and to respond appropriately by developing feedback for day-to-day and long-term cooperation.

By establishing links with the parties involved, the administration of RTU contributes to the development of excellence and ensures the clarity, unity, building of the work environment, and diversity management of the objectives to be achieved.

RTU staff participates in quality assurance by providing suggestions and feedback to improve the

RTU quality system. The heads of the RTU departments are responsible for carrying out internal quality assurance procedures and processes in their departments.

Based on the results of regular student and graduate surveys, improvements in the quality of the study process are being planned.

Cooperation with partners, suppliers, and other stakeholders takes place in accordance with the RTU Strategy, establishing appropriate cooperation networks and identifying appropriate policies, activities, and processes for effective cooperation aimed at ensuring the quality of the RTU and acquisition of feedback. To ensure the topicality and continuous development of existing study programs and before the introduction of new study programs, the interests of all stakeholders in modern and interdisciplinary technology education are considered.

External stakeholders (public authorities, cooperation partners, community representatives) evaluate the study process and its results in the evaluation of graduation papers, accreditation, make a contribution to improving the content and quality of study programmes. More on this point is set out in Sections 2.1. un 5.1.

Starting with December 2018, RTU has been a member of the European Foundation for Quality Management, having joined the global quality cooperation network.

RTU Excellence Approach has been elaborated in order to promote purposeful development of the university as an excellent organisation, and RTU Constitution, Strategy, and Quality Policy are integrated therein. It is based on the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) developed by the European Association for Quality Assurance in Higher Education and the basic principles of the EFQM Excellence Model.

The Structure of RTU Excellence Approach is designed in accordance with the criteria of the EFQM Excellence Model and forms the basis for the maintenance of performance at the university at a high level, a prerequisite for its continuous improvement, as well as for the achievement of sustainable results of RTU activities and excellence. Student results are a separate criterion, they are also in part transferred to the main activity results; thus, the quality of the study direction is closely related to RTU quality management.

RTU Excellence Approach is published at RTU Excellence Approach | Riga Technical University

RTU Quality Policy in Latvian is published at Kvalitātes politika | Rīgas Tehniskā universitāte (rtu.lv) (English translation is in the file of Appendix 03 of the list of Internal regulations).

In addition to the RTU's overall quality management activities, the study direction committee has been set up, the duties and activities of which are governed by the "Regulations of the Study Direction Committee". They supervise academic activities in the respective study direction and are responsible for the curriculum and quality of the study programmes within the study direction, including accreditation of the study direction. Expert assessment of the draft study programme is performed by the Study Direction Committee, then by the Faculty Council or the councils of several faculties involved. The expert assessment procedure is finalized by the Study Department: The Study Direction Committee evaluates the quality of the draft study programme and the compliance of its curriculum with the planned aims and tasks. The student council of the faculty and its members are involved in ensuring the quality of the study direction and study programmes implemented therein; they actively participate in the work of the decision-making bodies of the University: RTU Academic Assembly, RTU Senate, RTU Senate commissions, and faculty councils.

The RTU IESE (Institute of Energy Systems and Environment) environmental management module developed in 2007 and still actively maintained in compliance with the requirements of ISO 14001 helps to maintain the internal quality of processes of RTU IESE. Environmental management

modules are revised on an annual basis and reports are prepared on a regular basis. This is an effective tool for the prevention of shortcomings and non-conformities in the activities of RTU IESE. For more information on the RTU IESE Environmental Management System see section 2.1.

In addition, Riga Technical University participates in several international and national rankings and comparison systems. International rankings contribute to healthy competition among higher education institutions and they may be valuable for future students when they choose a place for their further studies. Rankings make it possible for RTU to evaluate its achievements in accordance with internationally set criteria and to compare itself to other higher education institutions in Latvia and in the world. Based on the evaluations in rankings, it is possible to make conclusions and set new objectives for sustainable growth and development of the study process, scientific activity, and the entire university.

RTU participates in the following international rankings: QS Stars University Ratings, QS University Rankings: EECA, U-Multirank, UI GreenMetric Ranking, 4International Colleges & Universities, Worldwide Professional University Rankings, Webometrics Ranking of World Universities, etc.

As of 1 May 2021, RTU is ranked in all international rankings on the following positions (RTU shows the best achievements among all Latvian universities almost in all rankings).

1. **The Times Higher Education World University Rankings (2021)**
   - RTU: 1000+ (2020: 1000+);
2. **The Times Higher Education University Impact Rankings (2021)**
   - RTU: Total evaluation: 201 – 300 (8SDG: = 61.3-68.3; 9SDG: 86.9; 13SDG: 63.2; 17SDG: 44.8-55.9, average: 71.0-77.4)
3. **The Times Higher Education Europe Teaching Rankings (2019)**
   - RTU: 201+ (since 2019 this ranking is no longer published)
4. **The Times Higher Education Emerging Economies Rankings (2020)**
   - RTU: 251-300 (2020: 251-300);
5. **The QS World University Rankings (2021)**
   - RTU: 701 - 750 (2020: 701-751);
6. **QS University Rankings: EECA 2020**
   - RTU 41 (2020: 54);
7. **QS Stars University Ratings**
   - RTU - 5 stars (Research -3; Teaching -5; Internationalization – 5; Specialist Criteria – 4; Employability -5; Facilities -5; Innovation -5; Inclusiveness -5). (2015.g.: Overall 3 stars)
8. **QS World University Rankings by Subject (2021**)
   - RTU: Subject: Engineering and Technology 401-450 (2020: 451-500)
9. **U-Multirank 2020**
   - RTU ranking “A” – in 11 criteria; ranking “B” – in 7 criteria
10. **UI GreenMetric World University Ranking 2020**
    - RTU – 56 (2019 – 128)

11. **European Ranking of Engineering Programs «EngiRank» 2019**

- Research Effectiveness – 7th place;
- Innovation – 16th place;
- RTU's Civil Engineering programmes – 6th place

12. **World's Universities with Real Impact (WURI) 2020**

- In the category – Entrepreneurial Spirit: RTU is on the 36th (The ranking was first published in 2020).

13. **Round University Rankings (RUR) 2020**

- RTU: World: 616 Country Rank: 1. (2019: RTU World: 702.; Country Rank: 1.)
- Teaching Ranking: RTU: 646 (2019: RTU: 643);
- Research Ranking: RTU: 525 (2019: RTU 739);
- International Diversity Ranking: RTU: 287 (2019: RTU 431);
- Financial Sustainability Ranking: RTU: 570 (2019: RTU: 607).

1.4. Fill in the table on the compliance of the internal quality assurance system of the higher education institution/ college with the provisions of Section 5, Paragraph 21 of the Law on Institutions of Higher Education by providing a justification for the given statement. In addition, it is also possible to refer to the respective chapter of the Self-Assessment Report, where the provided information serves as evidence for the full compliance, partial compliance or non-compliance.

1.	The higher education institution/ college has established a policy and procedures for assuring the quality of higher education.	Complies
		In line with the quality model introduced by RTU, process analysis and improvement are ongoing. Performance indicators and the results of the assessment of various surveys are analysed. The quality report data are compiled after the end of the academic year. Annual agreements on the target study process performance indicators are signed with the faculties; the quality is assessed by analysing the achievement of the defined objectives relative to the plan. For more details, see the 5th row of this table.

2.	A mechanism for the creation and internal approval of the study programmes of the higher education institution/ college, as well as the supervision of their performance and periodic inspection thereof has been developed.	Complies The development of study programs takes place in accordance with the “Procedure for the application, elaboration and amendment of the study programs” (approved at the Meeting of RTU Senate on 30 November 2015, Minutes No 610). The departments and institutes implementing the study process, Faculty Councils, the Office of Vice-Rector for Academic Affairs, the Student Parliament, and the Senate are involved in ensuring the internal study quality of RTU. These institutions carry out a comprehensive assessment of the new study directions and study programs, the changes to the study directions and programs, and the annual reports of the improvement of the study directions. At RTU, the operation of the internal quality assurance mechanism takes place at the level of the Rectorate, faculties, study directions, and study programs. At the level of the Rectorate, the internal study quality control of RTU is carried out by the Office of Vice-Rector for Academic Affairs. The Study Department performs: (1) the maintenance and control of the Study Program Register, which involves control of the conformity of the study curriculum to the aims, tasks, and learning outcomes of the study program, as well as the control of changes; (2) maintenance and control of the Study Course Register, which involves control of the conformity of study course descriptions with the learning outcomes, as well as quality control of study course descriptions; (3) periodical student polling at the University level.
3.	The criteria, conditions, and procedures for the evaluation of students’ results, which enable reassurance of the achievement of the intended learning outcomes, have been developed and made public.	Complies The evaluation of learning outcomes takes place in accordance with the “Regulation on the Assessment of Learning Outcomes” (approved at the Meeting of RTU Senate on 29 May 2017, Minutes No 610) and “Regulation on Final Examinations at RTU” (approved at the Meeting of RTU Senate on 26 April 2021, Minutes No 649).

4.	Internal procedures and mechanisms for assuring the qualifications of the academic staff and the work quality have been developed.	Complies
		In order to ensure the qualification and performance quality of academic staff, professional advancement needs are regularly assessed when evaluating the results. Professional advancement training modules are developed by collecting information from: (1) academic staff surveys on professional advancement needs once in two years; (2) analysis of student polling results; (3) cooperation with student self-governments; (4) world trends and good practices of other Latvian universities in the field of professional advancement of academic staff; (5) information provided by academic staff on professional advancement topics of interest; (6) proposals from the heads of academic units for the professional advancement of academic staff. The Centre for Academic Excellence (CAE), a teaching and learning centre, was set up at the end of 2018; its aim is to develop a strategy for the professional advancement of academic staff, including in line with Article 16 of Cabinet Regulations of Ministers No 569. Other tasks of CAE are detailed in Section 3.5. Academic units organize regular or one-time professional advancement activities having assessed the need for professional training of academic staff. The units assess whether it is more appropriate to participate in a particular event for certain representatives of academic staff, all members of the unit or to invite also members from other units.

5.	The higher education institution/ college ensures the collection and analysis of the information on the study achievements of the students, employment of the graduates, satisfaction of the students with the study programme, efficiency of the work of the academic staff, the study funds available, and the disbursements thereof, as well as the key performance indicators of the higher education institution/ college.	Complies Student expectations and satisfaction with the curriculum and study process are identified in sequential and planned surveys at all stages of study. Student surveys are organized in accordance with the Regulations on “Student Polling for Assessment of the Study Process” (approved at the Meeting of RTU Senate on 27 January 2014, Minutes No 577). The aim of polling is to clarify the adaptation of first-year students to the university system and the satisfaction of all students with the study process, lectures, and practical classes after each semester, the satisfaction of students with the services offered by the University, and the overall satisfaction of graduates with the study program. The results of the surveys are available to academic staff, heads of organizational units, and students in a summarized form. Annually, the State Revenue Service provides information on the employment of RTU graduates. The Total Quality Management System of RTU analyses the performance results of the study process, comparing the characteristics of the study programs, including the resulting performance indicators related to the study process in the overall EFQM quality model of RTU. At the beginning of September of each year, a faculty Activity Plan on study process indicators is drawn up: (1) number of students; (2) number of graduates; (3) number of graduates completing studies within the expected period of time; (4) number of students expelled from University; (5) number of foreign students in the total number of students; (6) average age of elected academic staff; (7) number of study programs implemented in English; (8) average indicator of the evaluation of faculty academic staff; (9) number of persons with a scientific degree elected to academic positions (%); (10) number of foreign guest lecturers. The established Faculty Study Activity Plans for the following year are drawn up by Faculty Deans, together with Deputy Deans for Academic Affairs and institute directors; they are approved by the Rector of RTU. RTU administration meets with representatives of faculties to evaluate the faculty activity plans on study process indicators, evaluating the progress in the previous academic year and defining the indicators to be achieved in the next two academic years. These indicators are used to monitor the study process performance of the faculty. These indicators and other aspects influence the amount of performance-based funding allocated to the faculty and contribute to the achievement of the objectives set forward in the RTU Strategy.

6.	The higher education institution/ college shall ensure continuous improvement, development, and efficient performance of the study direction whilst implementing their quality assurance systems.	Complies
		At the level of the faculty and study direction, internal quality is ensured by the Faculty Council, the Study Direction Committee and Directors of the study direction, Directors of the study programs, administration of the institutes, and chairs implementing study programs. Within the framework of the study program, internal quality is ensured by the program director and by the academic staff implementing the program. Internal quality control at the level of the study program is carried out by the administration of the relevant institute or chair. In order to ensure continuous development of the study programs, RTU Study Direction Committees monitor academic activities in the relevant study direction and are responsible for the curriculum and quality of the study programs within the study direction, including the accreditation of the study direction. The inclusion of employer representatives in the Study Direction Committee is a mandatory requirement. Study Direction Committee acts in accordance with the “Regulation of the Study Direction Committee” (approved by the Resolution of RTU Senate Meeting on 26 April 2021, Minutes No 649). The basic tasks of the Study Direction Committee are: (1) to analyse the situation in the labour market and make suggestions for the development of new study programs as well as for the closure of the outdated study programs; (2) to carry out expert assessment of the curriculum and quality of the study programs, assess their compliance with the defined objectives and compliance with the research area represented and labour market requirements; (3) to organize and monitor the accreditation of the study direction and the licensing of study programs; (4) to analyse the assessment and recommendations made by external experts and organize elimination of identified shortcomings; (5) to carry out an analysis of the study direction self-assessment report as well as the annual reports on study direction development activities; (6) in order to achieve strategic objectives of the University, to assess the proposed changes to study programs with a view to increasing the quality of all study programs included in the study directions; (7) to analyse the results of student, graduate and employee surveys and organize elimination of identified shortcomings, as well as organize additional surveys.

II - Description of the Study Direction (1. Management of the Study Direction)

1.1. Economic and/or social grounds for the creation of the study direction and the relevant study programmes, the assessment of the interrelation among the study programmes, as well as the analysis of the significance (singularity) of the study programmes in comparison with other similar study programmes in Latvia and abroad.

By decision No.132 of the Study Accreditation Commission of the Ministry of Education and Science of the Republic of Latvia of 23 May 2013, the study direction “Environmental protection” and all the study programmes included therein were accredited for six years (until 04.06.2019, with extension until 30.06.2024). The study programme is implemented at the RTU Faculty of Electrical and Environmental Engineering (hereinafter referred to as FEEE).

As at November 2020 the study direction “Environmental protection” includes six study programmes:

- Academic Bachelor’s study programmes: “Environmental Science” (accredited from 05.06.2013 to 30.06.2024) and “Environmental Engineering” (licenced on 27.04.2020)
- Academic Master’s study programmes: “Environmental Science” (accredited from 05.06.2013 to 30.06.2024) and “Environmental Engineering” (licenced on 27.04.2020)
- Doctoral study programmes: “Environmental Science” (accredited from 05.06.2013 to 30.06.2024) and “Environmental Engineering” (licenced on 27.04.2020)

Three of the six study programmes of the study direction “Environmental protection” are applied for accreditation – academic Bachelor’s study programme “Environmental engineering”, academic Master’s study programme “Environmental engineering”, doctoral study programme “Environmental engineering”. Since 2019, RTU has been implementing the project “SO 8.2.1 To reduce fragmentation of study programmes and to strengthen resource sharing at Riga Technical University”, which aims to reduce fragmentation of study programmes and strengthen resource sharing. Furthermore, its specific objective is to implement 17 new STEM study programmes specified in the RTU study programme development and consolidation plan coordinated with the Ministry of Education and Science (MoES) in EU languages, to develop one joint doctoral study programme, and to close existing 39 study programmes by 30 November 2023. The project provides for updating of the range of STEM study programmes offered by RTU by modernising interdisciplinary STEM study programmes and making them attractive for international students. Within the scope of the project, in the study direction “Environmental protection” there are plans to develop three new study programmes – academic Bachelor’s study programme “Environmental Engineering”, academic Master’s study programme “Environmental Engineering” and doctoral study programme “Environmental Engineering” – and close three existing study programmes – academic Bachelor’s study programme “Environmental Science”, academic Master’s study programme “Environmental Science” and doctoral study programme “Environmental Science”.

The existing study program "Environmental Science" will be closed after the accreditation of the study program "Environmental Engineering". Students will be automatically transferred to the appropriate level of the study program "Environmental Engineering".

The self-evaluation report primarily describes the study programmes to be accredited; however, in order to reflect the progress of the study process (e.g. statistical data on student dynamics, teaching staff capacity, capacity of the organisational unit implementing the study programme,

etc.), data on academic Bachelor's, academic Master's and Doctor's study programmes "Environmental science" are used as reference indicators.

The study programmes under the study direction "Environmental protection" are designed to ensure the integrity, the transversal approach and sustainability of environmental engineering study programmes of different levels throughout the whole direction. Study programmes submitted for accreditation in the study direction are **unique among the Baltic States** (see, in addition, the characteristics of each study programme). In the last implemented international assessment of scientific institutions (2013, implemented by "Technopolis") the implementer of the study programme, RTU Institute of Energy Systems and Environment, was recognised as the leading organisation in scientific research in the field of environmental protection in the Baltics.

Transversal approach to education through learning outcomes of study programmes of Environmental Engineering study programmes of different levels included in the accreditation of the study direction "Environmental protection" can be seen in Annex "Transversal approach to education".

Below is the economic and social justification for the establishment of study programmes to be accredited under study direction "Environmental protection" and their comparison with study programmes of other higher education institutions.

Academic Bachelor's study programme "Environmental Engineering"

The European Union has one of the highest environmental standards. The current environmental policy focuses on reducing the impact of the EU economy, protecting natural resources and preserving the health and well-being of EU citizens. In light of cross-sectoral activities in research, innovation, education and training, universities are key drivers for the transition to low-carbon technologies and approaches. It is therefore vital right now – during the transition period (the programming periods defined in the European Union Energy Strategy 2050) – to transform or create new study programmes and to introduce new learning approaches in order to prepare new specialists for a new era of change.

The developed study programme focuses on preventive systemic actions in environmental protection, as it aims to prepare high-profile and high-quality professionals with integrated academic education (level 6) and systemic thinking and understanding capable of following the development of environmental technologies and contributing successfully to the implementation of environmental and climate technologies.

Environmental engineering studies are also offered at the 11 internationally recognised and strong universities of European Union Member States and Switzerland, and this, in addition to environmental policy trends, confirm topicality of the study programme direction.

During the development of the study programme, a confirmation has been obtained that the study process is different in each European country, taking into account national laws, regulations and national priority axes.

For the evaluation of compliance of the study programme, the academic Bachelor's programme of RTU IESE was compared with Bachelor studies at the **Technical University of Denmark (DTU)** and **Tallinn University of Technology (TalTech)**. These two universities have been selected for a number of reasons:

- Scandinavian universities can be regarded as international leaders of environmental engineering education;

- these universities, together with the RTU, are universities of the *NORDTEK* network;

- in prestigious international university rankings the quality of the science and studies of study programmes of these universities has been ranked higher than RTU. For example, in the "QS World University Rankings by Subject 2019" DTU (Denmark) was recognised as the 112th best university in the world and TalTech (Estonia) is on the 601-650th place. RTU ranks 701-750th in this ranking;

- these engineering universities are popular among Latvian residents choosing to study abroad.

Tallinn University of Technology (TalTech) offers Bachelor's study programmes. The proposed programme focuses on materials, possibilities of use and development of bioresources, their potentials. Particular attention is paid to the sustainable use of resources as well as different processes (chemical, physical). In accordance with Estonian regulatory enactments, a Bachelor's study programme corresponds to three-year full-time studies (180 ECTS) and includes a research paper and mastering of study courses. Study courses consist of general study courses (21 ECTS in total), basic courses (72 ECTS), specialisation courses (75 ECTS) and optional courses (6 ECTS). The result of the TalTech Bachelor's study programme is an independently drafted Bachelor's thesis (6 ECTS).

Learning outcomes of the study programme:

- the student has extensive practical basic skills and knowledge in environmental processes (natural processes, regulatory framework and the monitoring framework) for work in the field of environmental protection, metrology and monitoring, development of processes and products;
- the student is able to use own knowledge of nature and engineering in practice;
- the student is able to describe clearly and convincingly the various processes – both physical and chemical – that take place both in the environment and in industrial processes;
- the student is able to use the acquired knowledge to improve or describe equipment and technology, to justify own choice;
- the student is able to independently collect and analyse information, make a reasoned and critical assessment of the new information, its feasibility, effectiveness and its potential impact.

The Bachelor's study programme of the Technical University of Denmark (DTU) is implemented by the DTU Environment Department, which offers also Master's and doctoral study programmes. The purpose of the programme is to teach the student to combine the obtained knowledge and skills in the creation of new technologies and innovation. The studies are organised in two languages – English and Danish. The program prepares students for further training either in the DTU Master's programme or at other universities. In accordance with Danish regulatory enactments, a Bachelor's study programme corresponds to three-year full-time studies (180 ECTS) and includes a research paper and mastering of study courses. Study courses consist of compulsory study courses and restricted elective study courses.

The outcome of the DTU Bachelor's study programme is an independently drafted research paper with significant theoretical relevance and potential for practical use.

Learning outcomes of the study programme:

- the student has knowledge of the principles of natural sciences and technology;
- the student has knowledge in IT, capacity and skills to use mathematical and physical methods in practice;
- the student is able to work graphically, verbally and in writing, acting with several partners in a team;
- the student is able to acquire new knowledge independently and analyse it critically;
- the student has knowledge of sustainable development, innovation and cooperation;

- the student is able to identify and contemplate on technical scientific matters and understand the interaction between the various environmental components;
- the student is able to use acquired knowledge and conduct research at international level, to develop ideas and address problems;
- the student is able to plan and perform research and development tasks;
- the student is able to combine the acquired knowledge to find appropriate technological solutions, taking into account ethical, economic, social and environmental aspects;
- under supervision, the student is able to start research and development projects, thereby creating new knowledge and skills that develop the relevant research area.

A Bachelor's degree is awarded when a student has passed theoretical courses, drafted and publicly defended a Bachelor's thesis.

If we compare the RTU study programme "Environmental Engineering" with the DTU study programme "Environmental Engineering" and the TalTech study programme "Environmental, Energy and Chemical Technology", it was stated that the proposed objective of the studies – to prepare systemically thinking highly skilled specialists focusing on preventive environmental prevention activities and the development and implementation of innovative zero-pollution technologies with integrated academic education – is broadly in line with the objectives of studies of compared universities. The learning outcomes and the planned competencies in all three compared study programmes are similar. All study programmes have a total of 180 ECTS. The programmes have a different design of study programmes: In TalTech, the Bachelor's thesis is 6 ECTS, in DTU – 15/17/20 ECTS, while in RTU – 22.5 ECTS. The breakdown between the volumes of compulsory and elective study courses is also different. It should be emphasised that the uniqueness of the RTU IESE study programme is that the student will be able to develop competences in one of the four areas of environmental protection, such as air, energy, resources or water, by selecting the relevant elective courses.

At Latvian level, the academic Bachelor's study programme "Environmental Engineering" is compared with the **study programme of the Latvia University of Life Sciences and Technologies (LLU) "Environmental Water Management"** and **the study programme of the University of Latvia (LU) "Environmental Science"**. This choice is related to the fact that the two study programmes are focused on environmental topics and, apart from the RTU's "Environmental protection" study programmes, are the largest by number of students.

The LLU's professional Bachelor's study programme "Environmental Water Management" is implemented by the Department of Environment and Water Management of the Faculty of Environment and Civil Engineering. The studies are in Latvian. Study courses consist of compulsory study coursess and restricted elective study courses. The form of implementation of the study programme is full-time and part-time studies. The full-time study programme lasts 4 years (8 semesters), while part-time study programme lasts 5 years (10 semesters). When mastering the study programme, students acquire knowledge that enables them to be well versed in environmental, water management, amelioration, wastewater treatment problems, as well as in waste management and sustainable use of natural resources. When completing the "Environment and Water Management" study programme, graduates acquire a **professional Bachelor's degree in environmental management and environmental engineering**, as well as the **qualification of an environmental engineer**. After the Bachelor level programme has been mastered, there is also the possibility of continuing studies in Master level programmes in LLU and other higher education institutions.

The Bachelor's study programme of LU "Environmental Science" is implemented by the Department of Applied Environmental Science of the Faculty of Geography and Earth Sciences. The objective of

the study programme is to provide students with basic academic and professional knowledge in environmental as interdisciplinary science, including mastering of the theoretical and methodological bases of environmental science and related sciences, while at the same time ensuring that students are constantly solving theoretical and practical problems in environmental science, ensuring that they are used in research and practice. The underlying objective of the study programme is to increase the general education and cultural level of students. The studies are organised in two languages – Latvian and English. The structure of the programme consists of the compulsory part (part A) study courses (84 credit points), compulsory elective part (part B) study courses (34 credit points) and elective part (part C) study courses in different fields of science (2 credit points). The total amount of credit points is 120 credit points or 180 ECTS. The study programme is implemented in the form of full-time intramural studies and lasts 3 years (6 semesters). In the course of studies, students also have the opportunity to master geographic information systems, resource evaluation and management and biodiversity protection management, as well as other knowledge and skills needed for environmental science professionals. Students acquire practical abilities and skills in laboratory and practical works, as well as in field courses in different places of Latvia. As part of studies, students carry out independent research in environmental science, developing a draft Bachelor's thesis and in the end – a Bachelor's thesis, which is an original study in one of the areas of environmental science. When completing **the "Environmental Science" study programme, graduates acquire the degree of a Bachelor of Natural Sciences in Environmental Science**. After the Bachelor level programme has been mastered, there is also the possibility of continuing studies in Master level programmes in LU and other higher education institutions.

When comparing the RTU's academic Bachelor's study programme "Environmental Engineering" with the LLU's professional Bachelor`s study programme "Environmental Water Management" and the LU's academic Bachelor's study programme "Environmental Science", it was stated that

- The LU's study programme "Environmental Science" and the RTU's study programme "Environmental Engineering" are similar in terms of the structure of the study programmes: the volume of both study programmes is 120 CP or 180 ECTS. When comparing the RTU's programme "Environmental Engineering" with the LLU's programme "Environmental Water Management", it is stated that the programme are quite different. LLU's "Environmental and Water Management" is more focused on the practical use of knowledge in the field.
- There are also known differences after graduation: LLU students after four years of studies obtain a professional Bachelor's degree in Environmental Management and a qualification of environmental engineer, while graduates of RTU obtain an academic degree of a Bachelor of Engineering in Engineering Sciences.
- The scope of graduation papers in the RTU's programme "Environmental Engineering" and the LLU's programme "Environmental Water Management" is also different: In case of LLU, there is a diploma paper of 12 CP and internship of 20 CP, but in case of RTU there is a Bachelor's thesis of 15 CP. The volume of the Bachelor's thesis and the number of credit points of RTU and LU study programmes are also different: In case of RTU, there is a Bachelor's thesis of 15 CP, but in case of LU, it is of 10 CP.
- Overall, it can be concluded that all three programmes in Latvia focus on different objectives and offer different curriculum – LU focuses more on educating and training the competent new environmental science specialists in the fields of geographic information systems, resource evaluation and management and biodiversity protection and management, LLU focuses more on transferring practical skills to students in the fields of water management and management of water resources, with extensive internship and practical study courses, but RTU focuses on developing broad-profile and high-quality specialists with integrated academic education with cross-disciplinary systemic thinking and understanding of

technological solutions for environmental protection (preventive technologies for environmental pollution and technologies for prevention of environmental pollution, zero-emission energy, resource recovery, etc.) and who are able to follow the development of environmental technologies and participate successfully in the deployment of environmental and climate technologies.

- The RTU study programme “Environmental Engineering” focuses on preparing environmental protection specialists with extensive competences in engineering matters for work in companies and public administrations in different fields. Mastering of the skills and knowledge within the study programme is secured by European level academic and scientific staff (EU experts in the fields of environmental engineering and energy, sustainable management of resources, environmental management), who are involved in the delivery of engineering solutions at national and European level on a daily basis.
- The **interdisciplinary** and **multisectoral approach** used in the implementation of the RTU study programme “Environmental Engineering” enables students to use the knowledge learned in the theoretical part of classes in practice for the analysis and resolution of current problems of specific companies/institutions making it possible for students to integrate in the real work environment. The implementation of the study programme focuses on the use of innovative pollution prevention technologies and their comprehensive evaluation for sustainable economic development.
- The interdisciplinary academic Bachelor’s study programme “Environmental Engineering” is the only one in Latvia and there are only a small number of similar Bachelor level programmes in the international education space, so the competitiveness of graduates is evaluated as very high. The curriculum of the study programme reflects development trends in the sector and ensures the preparedness of specialists.
- Mastering of the skills and knowledge within the RTU study programme “Environmental Engineering” is secured by European level academic and scientific staff (European Union experts in the fields of environmental engineering and energy, sustainable management of resources, environmental management), who are involved in the delivery of engineering solutions at national and European level on a daily basis. The curriculum and implementation of the study programme focuses on the creation of competences to adapt and respond to changes, following and even anticipating labour market demand. In order to achieve efficient functioning of such a model, in the curriculum and in the implementation of the study programme special attention is paid to the establishment of the cooperation platform “Companies – University”.
- Applied research also plays an important role in the RTU study programme “Environmental Engineering”. Students draft study papers on topical issues in the sector, studying and analysing scientific and professional literature in libraries and international databases. Students use the acquired knowledge and insights in practical research in Latvian or foreign companies, analysing issues related to environmental engineering and environmental protection, developing and implementing solutions for improving business activities. Students present the results of their research at the RTU’s annual scientific conference for students and the most prominent students in the Bachelor's study programme also present them at the international scientific conference CONECT.

It is important to start the implementation of an international Bachelor level environmental engineering programme in Latvia as soon as possible for the following reasons:

- Latvia has a high potential to become a European green technology superstate, which is based on both available bioresources and socio-economic factors. The implementation of the programme and the preparation of high-level experts will be a prerequisite for the development of the green economy at both national and regional levels;

- in the long term, it will be possible to develop new specialisations in the study programme, taking into account its structure, in response to changes in demand from different sectors;
- as it is recently started the implementation of the Bachelor, Master and doctoral level study programmes “Environmental Engineering” at RTU, the Bachelor’s study programme will be a cornerstone of succession and sustainability in higher education in the field of environmental engineering.

See Annex "Comparison of bachelor study programs" for a more detailed comparison of the study programme to study programmes of Latvian and foreign higher education institutions.

Academic Master’s study programme “Environmental Engineering”

The European Union has one of the highest environmental standards. The current environmental policy focuses on reducing the impact of the EU economy, protecting natural resources and preserving the health and well-being of EU citizens. In light of cross-sectoral activities in research, innovation, education and training, universities are key drivers for the transition to low-carbon technologies. It is therefore vital right now – during the transition period (the programming periods defined in the EU Energy Strategy 2050) – to transform or create new study programmes and to introduce new learning approaches in order to prepare new specialists for a new era of change.

Today, protecting the environment and tackling climate change are the most important global challenges. The need for contemporary environmental solutions and, therefore, specialists is growing steadily, and higher education institutions play a key role, both in research and in the preparation of new specialists for economic sectors. In view of the diversity of environmental and climate change themes and solutions, future environmental engineering study programmes should be directly oriented towards an interdisciplinary higher education model, combining engineering, natural and exact sciences, social sciences, political sciences, humanities, thereby providing the national economy with competitive cross-sectoral professionals ready to work locally globally and globally, building our common future. The interdisciplinary nature of environmental matters is also confirmed by the Latvian Smart Specialisation Strategy, defining a total of five specialisation areas: (1) knowledge-intensive bioeconomy; (2) biomedicine, medical technologies, biopharmacy and biotechnologies; (3) smart materials, technologies, and engineering systems; (4) smart energy; (5) information and communication technologies. For of them (knowledge-intensive bioeconomy; biomedicine, medical technologies, biopharmacy and biotechnologies; smart materials, technologies and engineering systems; smart energy) directly include the environmental protection (in particular, preventive environmental protection) approach.

The study programme provides knowledge and skills on the evaluation of the sustainability of existing technologies and systems (environmental, economic, social aspects); the development and optimisation of new environmental technologies and products (bio-resources, renewable energy sources, emissions prevention, etc.); the use of bio-resources for creation high added value developments and for long-term development of the economy through the bioeconomy prism; evaluation of existing environmental management models and development of new models at company and regional level; cross-disciplinary approach to resolution of environmental protection problems; conducting, evaluating, reporting and publishing original scientific studies.

The developed study programme focuses on the improvement of environmental quality, because its objective is to prepare systemically thinking highly skilled specialists focusing on preventive environmental prevention activities and the development and implementation of innovative zero-pollution technologies with integrated academic education (Master’s degree in engineering sciences) in two specialisations – “Environmental Engineering” and “Circular Bioeconomy”.

Environmental engineering, including bioeconomy specialisation, direction studies are also offered

at the 16 internationally recognised and strong universities of European Union Member States, Switzerland and Norway, and this, in addition to environmental policy trends, confirm topicality of the study programme direction.

During the development of the study programme, a confirmation has been obtained that the study process is different in each European country, taking into account national laws, regulations and national priority axes.

For the evaluation of compliance of the study programme, the academic Master's programme of RTU IESE was compared with Master studies at the Technical University of Denmark (DTU) and at the Royal Institute of Technology. These two universities have been selected for a number of reasons:

- Scandinavian universities can be regarded as international leaders of environmental engineering education;

- priorities of creation of study programmes in Scandinavian universities and at the Riga Technical University are similar;

- these universities, together with the RTU, are universities of the *NORDTEK* network;

- prestigious international university rankings appreciate high quality of the science and studies of study programmes of these universities. For example, in the "QS World University Rankings by Subject 2019" DTU (Denmark) was recognised as the 112th best university in the world and KTH Royal Institute of Technology (Estonia) as the 98th best university. RTU ranks 701st-750th in this ranking.

The DTU Master's study programme is implemented by the DTU Environment Department, which offers also Bachelor's and doctoral study programmes. The Department's main directions of research, studies and innovation are related to air, land and water resources studies, environmental impact and chemical exposure studies, waste engineering, and water technologies and urban water systems. In accordance with Danish regulatory enactments, a Master's study programme corresponds to two-year full-time studies (120 ECTS) and includes a research paper (Master's thesis) and mastering of study courses (total volume of study courses – 90 ECTS). Study courses consist of compulsory study courses and elective study courses.

The outcome of the DTU Master's study programme is an independently drafted Master's thesis with significant practical input.

Learning outcomes of the study programme:

- the student has knowledge of the principles of natural sciences and technology;
- has knowledge of sustainable development, innovation and cooperation;
- the student can and is able to identify and contemplate on technical scientific matters and understand the interaction between the various components;
- is able to use acquired knowledge, to develop ideas and address problems;
- is able to plan and perform research and development tasks;
- under supervision, is able to start research and development projects, within their scope creating new knowledge and new skills that develop the relevant research area.

Master studies of the KTH Royal Institute of Technology ensure that after graduation students have knowledge on energy systems and technologies, the graduate is bale to model different systems and analyse their environmental impact. Thanks to multilateral study courses, students have knowledge of both energy sources and ways and technologies to acquire them, on environmental impact and its mitigation opportunities, and on cities – their infrastructure, economy, planning and

sustainable development.

Full-time studies last 2 years of studies, during which the student masters 120 ECTS points (90 ECTS for mastering of study courses and 30 ECTS for Master's thesis). Study courses consist of compulsory study courses and restricted elective study courses.

The primary task of Master level education is to teach a student to create new knowledge using scientific methods and theories.

The goal of candidates for the Master's degree is to complete studies in two years of full-time studies, during which students learn Master study courses and to draft a Master's thesis that is defended publicly.

The outcome of the Master's study programme of KTH Royal Institute of Technology is an independently drafted Master's thesis with a potential for practical use.

As a result of mastering the study programme, the graduate obtains knowledge and understanding of:

- scientific methods and theories, allowing them to be used and developed independently;
- all aspects of the energy system, including technologies and systems, which are present at all stages from the energy source to final energy consumption;
- modelling, simulation and validation of processes using modern technologies;
- ethical issues and conflicts of sustainable development, allowing them to be evaluated;
- prevailing habits, thinking patterns, technical and economic systems, allowing them to be defended, developed and questioned in a reasoned way.

A Master's degree is awarded when a student has passed theoretical courses (90 ECTS), drafted and publicly defended a Master's thesis (30 ECTS).

If we compare the RTU study programme "Environmental Engineering" with the study programme of the Technical University of Denmark "Environmental Engineering" and the study programme of the KTH Royal Institute of Technology "Environmental, Energy and Chemical Technology", it was stated that the proposed objective of the studies – to prepare systemically thinking highly skilled specialists focusing on preventive environmental protection activities and the development and implementation of innovative zero-pollution technologies with integrated academic education – is in line with the objectives of studies of compared universities. The learning outcomes and the planned competencies in all three compared study programmes are similar. The programmes are also similar in the context of structure of study programmes: the volume of all study programmes is 120 ECTS. It should be emphasised that study programmes of RTU IESE is unique because of offering the "Circular Economy" specialisation, which is the only study programme f such type in Northern Europe and Central Europe.

At Latvian level, the academic Master's study programme "Environmental Engineering" is compared with the study programme of the **Latvia University of Life Sciences and Technologies (LLU) "Environmental, Water and Land Engineering Sciences"** and **the study programme of the University of Latvia (LU) "Environmental Science"**. This choice is related to the fact that the two study programmes are focused on environmental topics and, apart from the RTU's "Environmental protection" study programmes, are the largest by number of students.

The LLU's academic Master's study programme "Environmental, Water and Land Engineering Sciences" is implemented by the LLU Department of Environment and Water Management of the Faculty of Environment and Civil Engineering. The aim of the "Environmental, Water and Land Engineering" programme is to prepare high-skilled specialists for scientific, pedagogical and

professional and managerial work, who are well versed in scientific research and competent to solve scientific and practical problems related to the environment, water management and land management. Specialisation directions: environmental engineering science, hydraulic engineering and water management, land management, geodetics. The studies are in Latvian. Study courses consist of compulsory study courses and restricted elective study courses. The study programme is implemented as full-time studies. The full-time study programme lasts 2 years (4 semesters), i.e. 80 CP (120 ECTS). Master's studies prepare theoretically and practically educated specialists for work in higher education and science institutions, at different levels in public administrations, as well as in undertakings and institutions whose activities relate to solving environmental, water management and land management issues.

When completing the "Environmental, Water and Land Engineering" study programme, graduates obtain a **Master's degree in engineering**. After the Master level programme has been mastered, there is also the possibility of continuing studies in doctoral level programmes in LLU and other higher education institutions.

The LU academic Master's study programme "Environmental Science" is implemented by the Department of Applied Environmental Science of the Faculty of Geography and Earth Sciences. The objective of the Master's study programme is to provide modern theoretical and methodological knowledge in sub-sectors and directions of environmental science, at the same time providing an overview of the industry development in general and fostering of mastering of practical skills necessary in the labour market. The studies are organised in two languages – Latvian and English. The programme provides modern theoretical and methodological knowledge in sub-sectors and directions of environmental science – environmental protection, environmental management, environmental chemistry and ecotoxicology, environmental, at the same time providing an overview of the industry development in general and fostering of mastering of practical skills necessary in the labour market. The study programme is developed in line with development trends in environmental science, as well as recommendations from employers, students and alumni. The basic scheme of the course organisation is "lectures + laboratory/practical work + own studies". There is a field course in which students practically familiarise themselves with environmental problems and their solutions throughout Latvia. The structure of the programme consists of the compulsory part (part A) study courses (46 credit points), compulsory elective part (part B) study courses (34 credit points). The total amount of credit points is 80 credit points or 120 ECTS. The study programme is implemented in the form of full-time intramural studies and lasts 2 years (4 semesters). When completing the "Environmental Science" study programme, graduates acquire the degree of a Bachelor of Natural Sciences in Environmental Science. After Master's study programme graduates have the right to continue doctoral studies in Latvia and also foreign universities.

When comparing the RTU's academic Master's study programme "Environmental Engineering" with the LLU's academic Master's study programme "Environment, Water and Land Engineering Sciences" and the LU's academic Master's study programme "Environmental Science", it was stated that

- the study programme is focused on different areas of environmental protection – the LLU prepares highly qualified specialists in areas related to the environment, water management and land management, while LU prepares highly qualified specialists in sub-sectors of environmental science – environmental protection, environmental management, environmental chemistry and ecotoxicology, while the RTU prepares high-skilled specialists (Master's degree in engineering) in specialising "Environmental Engineering" and "Circular Bioeconomy" (which is the only study programme providing in-depth knowledge in circulation bioeconomy in Latvia and the Baltic), by integrating students in depth in the development

and evaluation of the environment and technology, as well as in resource management that do not have an impact on the environment and create high added value products and services for national economy. Accordingly, each study programme has its own specialisation and niche, representing different sub-directions of environmental protection.

- The RTU study programme "Environmental Engineering" focuses on preparing environmental protection specialists with profound knowledge in the field of bioeconomy and environmental engineering. The study programme can be well combined with engineering education previously acquired by students in other sectors, as it provides an integrated knowledge of the environmental impact assessment of different sectors and processes and the reduction of environmental pressure. Graduates of the "Environmental Engineering" study programme can work as leading specialists in the fields of environmental protection, bioeconomy, energy (thermal energy and smart energy), energy efficiency, environmental status modelling, resource management and related industries, are able to develop and implement innovative environmental and climate technologies in companies, re able to manage the development and implementation of environmental laws, as well as to manage environmental engineering development projects at local government level. Graduates of the programme are able to carry out research in the environmental engineering and energy sector, as well as to develop and implement environmental engineering projects.
- Mastering of the skills and knowledge within the RTU study programme "Environmental Engineering" is secured by European level academic and scientific staff (European Union experts in the fields of environmental engineering and energy, sustainable management of resources, environmental management), who are involved in the delivery of engineering solutions at national and European level on a daily basis. The curriculum and implementation of the study programme focuses on the creation of competences to adapt and respond to changes, following and even anticipating labour market demand. In order to achieve efficient functioning of such a model, in the curriculum and in the implementation development of the study programme special attention is paid to the establishment of the cooperation platform "Companies – University".
- The volume of all three Master's study programmes is the same – 80 CP. The duration of studies is the same, namely, 2 years or 4 semesters.
- As a proof, successful mastering of the study process is followed by the drafting of a Master's thesis of 20 CP in all three study programmes.

It can be concluded with certainty that the uniqueness of the RTU academic Master's study programme "Environmental Engineering" is also seen in Latvia, in comparison with LLU and LU study programmes, because, unlike LLU and LU academic study programmes, which focus on environmental science or water management and land management-related areas, RTU focuses on environmental engineering sciences, including circular bioeconomy. The Master's academic study programme "Environmental Engineering" will be the only one in Latvia and there are a small number of similar programmes in the international educational space. This fact, jointly with the rapid increase in the importance of environmental engineering sciences, creates favourable competitive conditions for graduates to be in demand in Latvia and beyond. The European Union has one of the highest environmental standards. The current environmental policy focuses on reducing the impact of the EU economy, protecting natural resources and preserving the health and well-being of EU citizens. In light of cross-sectoral activities in research, innovation, education and training, universities are key drivers for the transition to low-carbon technologies. It is therefore vital right now – during the transition period (the programming periods defined in the EU Energy Strategy 2050) – to transform or create new study programmes and to introduce new learning approaches in order to prepare new specialists for a new era of change. The study programme ensured topicality of curriculum of study courses and its compliance with the needs of the relevant

industry, labour market and with the trends in science. Each year, study programme is improved, taking into account the results of student questionnaires, as well as recommendations of the employers. Environmental specialists working in different sectors are involved in the study programme “Environmental Engineering”. The curriculum of study programmes is updated in compliance with the needs of the industry, labour market and science development trends. Each year, study programme is improved, taking into account the results of student questionnaires, as well as recommendations of the employers. Environmental engineering specialists working in different sectors are involved in the study programme. All changes reflect external trends and certify compliance of the study programme with the industry and labour market situation. Changes in the study programme are based on the need to ensure compliance with industry, labour market and science development trends, to maximally strengthen mastering of professional competences and preparedness.

Close link to scientific trends is ensured in the implementation and development of the study programme. Applied research also plays an important role. Students draft study papers on topical issues in the sector, studying and analysing scientific and professional literature in libraries and international databases. Students use the acquired knowledge and insights in practical research during internship in Latvian or foreign companies, analysing issues related to environmental engineering and environmental protection, developing and implementing solutions for improving business activities. Students present the results of their research at the RTU’s annual scientific conference for students and summarise in Bachelor’s theses, which are presented at the end of studies. The results of individual research are also summarised in scientific publications.

Annex "Comparison of master's study programs" provides a more detailed comparison of the study programme to study programmes of other higher education institutions.

Doctoral study programme “Environmental Engineering”

Nowadays, increasing attention is being paid to environmental protection issues and the public is interested in environmentally friendly solutions in different sectors of the economy. Higher education is one of the main indicators of global competitiveness and, in the light of globalisation and knowledge transfer, there is a need to develop interdisciplinary doctoral study programmes focusing on demand at regional and international level.

The “Environmental Engineering” study programme ensures the implementation of a doctoral study programme in the sub-sector of environmental engineering and makes it possible to prepare scientists in environmental engineering and energy. The study programme includes science courses and doctoral studies – scientific work to be carried out according to an individual plan, enabling the doctoral student to obtain a scientific doctoral degree and to prepare an internationally competitive higher-skilled environmental engineering specialist for academic and scientific work in universities, scientific research centres, and for organisational work in public and private institutions, who have developed environmental engineering related skills and working techniques, including matters to be solved in environmental engineering to the extent they are able to critically address environmental challenges, including in research and innovation, are able to provide new understanding and solutions for complex and dynamic systems. The study programme focuses on a comprehensive and systematic approach to analysing environmental systems, thereby allowing the doctoral student to understand, evaluate and solve the effects of human impact. Doctoral studies include organised post-graduate studies and systems for obtaining a doctoral degree and qualification in environmental engineering and energy, study courses and doctoral studies – doctoral student’s independent work performed on an individual basis and supervised by a scientific paper supervisor makes it possible to acquire in-depth knowledge in the fields of environmental engineering and energy. The preparation of specialists with a doctoral degree focuses on addressing of the complex

of environmental matters, paying principal attention to the analysis of interrelated systems, systemic thinking, enabling to obtain awareness of climate and environmental change, identification and assessment of human effects, including modelling complex and dynamic systems, including through evaluation of processes and technologies in the existing socio-economic environment, and analysing the place and role of the energy supply system not only in terms of environmental protection, but also in terms of economy and engineering.

If we compare the RTU study programme "Environmental Engineering" with the study programme of the Technical University of Denmark "Water and Environmental Engineering" and the study programme of the Chalmers University of Technology "Energy, Environment and Systems", it was stated that the proposed objective of the studies – obtaining of a doctoral degree in the field of environmental engineering and energy science and preparing internationally competitive specialists for academic and scientific work in universities, scientific research centres, and organisational work in public and private institutions – is in line with the objectives of studies of compared universities. The learning outcomes and skills in all three compared study programmes are similar. The most significant differences are in the total number of credit points determined by regulatory enactments of each country, and specialisation of each study programme, which is related to the specific and the specialization of the higher education institutions implementing the study programme.

The RTU IESE study programme is unique because the proposed study programme prepares broad profile specialists in environmental engineering in energy and, taking into account specialisation of the study courses and adaptability depending on the topic studied by the student, allows preparing specialists flexible to change with systemic thinking and ability to carry out an analysis of interrelated systems, modelling of complex and dynamic systems, evaluation of processes and technologies in the existing socio-economic environment and to analyse the place and role not only in terms of ecology, but also in terms of economy and engineering.

At Latvian level, the doctoral study programme "Environmental Engineering" is compared with the **study programme of the Latvia University of Life Sciences and Technologies (LLU) "Environmental Engineering"** and **the study programme of the University of Latvia (LU) "Environmental Science"**. This choice is related to the fact that the two study programmes are focused on environmental topics and, apart from the RTU's "Environmental protection" study programmes, are the largest by number of students.

The LLU's doctoral study programme "Environmental Engineering" is implemented by several organisational units of LLU, however, the Faculty of Environment and Civil Engineering is the main one. The aim of the "Environmental Engineering" programme is to prepare internationally relevant higher-skilled specialists for scientific research, organisational and academic work, while at the same time providing the necessary conditions for such a level of research work that would enable successful development of doctoral thesis and obtaining an internationally recognised doctoral degree in one of the sub-sectors of environmental engineering (environmental engineering or water management). The studies are in Latvian. Study courses consist of theoretical study courses of 24 CP and scientific paper of 96 CP. Studies in the "Environmental Engineering" sub-sector represent the following research directions: agrohydrology and air pollution in agriculture. Studies in the "Water Management" sub-sector represent the following research directions: integrated water management and engineering of water resources. The study programme is implemented as full-time studies. The full-time study programme lasts 3 years (6 semesters), i.e. 120 CP (180 ECTS). When completing the "Environmental Engineering" study programme, **graduates acquire the doctoral degree in engineering and energy.**

The LU doctoral study programme "Environmental Science" is implemented by the Faculty of Geography and Earth Sciences. The objective of the study programme is to prepare highly qualified

scientific staff and teaching staff, as well as highly qualified professionals for applied research or public governance work with internationally comparable competence and internationally equivalent scientific doctoral degree. The doctoral study programme in environmental science provides an opportunity to conduct quality research during studies and to obtain latest scientific insights in any of sub-sectors of environmental science. The study programme ensures publication of research results and preparation of the doctoral thesis. When studying in this programme, it is possible to deepen the theoretical knowledge, to obtain experience in scientific work and abilities to conduct independent research in any of sub-sectors of environmental science. The general skills required for work in the Latvian economy, higher education, science, environment and health protection institutions, as well as high qualification and opportunities to compete in the international academic circulation are acquired. The fulfilment of the requirements of the doctoral study programme and the defence of a doctoral thesis, according to the sub-sector, provide for the acquisition of a doctoral degree in environmental science in geography, chemistry, biology or economics (environmental management). The doctoral study programme in environmental sciences offers studies in the following sub-sectors of environmental science: environmental chemistry and ecotoxicology, environmental protection, environmental engineering, environmental management. The degree awarded, when graduating, depends on the subject of scientific paper. The possible names of the degree to be obtained in the study programme "Environmental Science": the scientific degree of the doctor of chemistry, doctor of geography, doctor of biology or doctor of economics in environmental science. Since 2020, **the degree of a doctor of science (PhD) in geography or biology, or chemistry, or economics in environmental science** has been awarded. The studies are implemented as full-time intramural studies of 3 years (6 semesters) or also part-time intramural studies and part-time extramural studies of 4 years (8 semesters).

If we compare the RTU's doctoral study programme "Environmental Engineering" to LLU's doctoral level study programme "Environmental Engineering" and LU's study programme "Environmental Science", the objective of studies in all three doctoral level programmes is preparation of qualified higher education specialists in different fields of research, however, specialising in different research directions. The LLU's doctoral level programme "Environmental Engineering" offers to get a doctoral degree in environmental engineering or water management, the topics offered by LU's "Environmental Science" are geography, chemistry, biology or economics (environmental management), while RTU's "Environmental Engineering" is offered in environmental engineering and energy. The volume and time of studies of the selected study programmes in Latvia differ. LLU offers doctoral studies during 3 years (120 CP or 180 ECTS), LU – 144 CP or 216 CP and RTU offers study of 4 years, i.e. 192 CP or 288 ECTS. The degrees awarded are also different (in case of LU): RTU – **doctor of science (PhD) in environmental engineering and power, LU – doctor of science (PhD) in geography or biology, or chemistry, or economic environment in science, LLU – doctor of science (PhD) in environmental engineering and energy.** In general, it can be concluded that all three doctoral level programmes offer different fields of research when preparing high-quality specialists in different areas of environmental protection and environmental science.

In the framework of the RTU doctoral study programme "Environmental Engineering", a scientific doctoral degree in the field of environmental engineering and energy science is obtained and broad profile internationally competitive high-skilled environmental engineering specialists with integrated education and systemic thinking, independent scientific and pedagogical skills, knowledge and abilities for work in economic institutions, who can work in research institutes, engineering companies, local governments, ministries, environmental quality monitoring bodies, as well as act as evaluators of scientific achievements, experts from international organisations, etc. The doctoral programme is implemented in the form of lectures, practical and laboratory activities, as well as in independent studies, learning the latest achievements in the field of environmental

engineering, using the achievements of fundamental and applied science, gaining in-depth theoretical knowledge in the methodology of environmental research. The study programme is designed to ensure a consecutive development of knowledge, skills and competences based on individual and group scientific work, continuous communication between doctoral students and their supervisors. When implementing the study programme, its objective “obtaining of a doctoral degree in the field of environmental engineering and energy science and preparing internationally competitive specialists for academic and scientific work in universities, scientific research centres, and organisational work in public and private institutions”, corresponds to the Level 8 of the European Qualifications Framework (EQF) and the Latvian Qualifications Framework (LQF), is achieved. The study programme complies with the RTU Regulations on doctoral studies. Graduates of the study programme acquire competences corresponding to the level of international achievements of the environmental engineering industry, corresponding to the upper limit of knowledge and enabling to solve critical environmental engineering challenges in research and innovation, enabling the launch of independent scientific or academic activities, expanding existing knowledge and providing a new understanding of environmental engineering and energy topics. The outcome of the study programme is a personally drafted doctoral thesis with significant theoretical relevance and potential for practical use, which includes original scientific research results obtained by independent evaluation and selection of appropriate modern research methods and provides new scientific insights in the field of environmental engineering and energy sciences. The interdisciplinary nature of the study programme and the diversity of the study courses offered enable students to develop the necessary competencies, thereby contributing to the preparation of highly qualified environmental engineering professionals who are suited to the demands of today’s labour market and knowledge-intensive economy, and enabling students to reach the upper limit of knowledge in the selected field of specialisation. All study courses in parts A, C and E contribute to the achievement of each of the learning outcomes of the study programme referred to in this document. The information contained in study courses is logically interlinked, ensuring the development of knowledge and skills of students. In the first year of studies, the general foundation for individual research in the selected field is laid, which is developed and strengthened in each subsequent year shaping early stage researchers, who are able to carry out independent, critical analysis, synthesis and evaluation, to solve important research or innovation tasks in environmental sciences and interdisciplinary fields. The interlinking (mapping) of the results to be achieved, the aims set and other indicators can be found in the Annex "Mapping of the study courses_doctors". During all study periods students are involved in the study process by doing pedagogical work (reading of lectures and supervision of graduation papers), thus ensuring transfer of knowledge, experience and research results at different levels of studies. Insights and knowledge from Bachelor and Master theses supervised by doctoral students, as well as, for example, the experimental stands created by them, are integrated in the development of their doctoral thesis and the improvement of study courses. The doctoral study programme has been created in such a way so as to cover all the main research directions of RTU IESE. By actively involving students and graduates of the doctoral study programme “Environmental Engineering” in research of RTU IESE, it is possible to increase the number of high quality and internationally recognised researchers. The **achievement of aims and results** of study courses and programme within the framework of the programme is implemented by organising on a regular basis seminars and discussions for the teaching staff on learning outcomes and basic quality assurance principles. Thorough implementation of learning outcomes is ensured in the study programme. The learning outcomes have been formulated at the level of the study programme and at the level of study courses. Students are informed about the learning outcomes to be achieved at the beginning of each study course, and they are also available in the ORTUS environment. As it was mentioned above, a link is ensured between the learning outcomes of the study programme and those of study courses. **The interlinking of study courses and consistency** in mastering of a study course are evaluated at

least once a year and in addition – when proposals are received from students. Independent studies of doctoral students play an important role. Their description is included in the study course description as a mandatory component. The ability of students to learn independently is purposefully developed in all study courses and within the scope of scientific work. Students obtain skills in research work by working with literature and internet resources, conducting scientific research, preparing publications, reports for conferences on a regular basis, etc.

See Annex "Comparison of doctoral study programs" for a more detailed comparison of the study programme to study programmes of Latvian and foreign higher education institutions.

1.2. Aims of the study direction and their compliance with the scope of activities of the higher education institution/ college, the strategic development directions, as well as the needs and the development trends of the society and the national economy.

The modern world's higher education system cannot be imagined without the existence of high-quality, interdisciplinary and pollution prevention oriented higher education study programmes in the field of environmental protection. In December 2018, the commission of the RTU study direction "Environmental protection" updated the strategy of the study direction for 2020-2025.

The current **goal** of the study direction is to provide students with sustainable, scientific research and cooperation with industry based, capable of adapting to changes, multi-disciplinary, multi-stage education in the field of environmental protection, developing at high level the labour market in the field of environmental protection, preparing internationally recognised, highly qualified environmental specialists and scientists with systemic thinking in the field of environmental protection and climate change.

The **sub-goals** of the study direction are:

- to ensure the succession of studies at three levels of studies;
- to integrate scientific research into all study programmes and all levels in order to multiply scientific evidence-based decision-making in the field of environmental protection at all levels of governance and decision-making, and to promote the interest of students in scientific research at an early stage
- to foster the internationalisation of the study direction by attracting foreign academic staff and students;
- to establish a close dialogue with industry through the implementation of the scientific research-based study process, in order to ensure timely mutual changes in the curriculum of study programmes and in the development of environmental protection related industries.

The tasks of the study direction relating to the outcomes are formulated as follows:

- to develop analytical critical thinking in students and to promote interest in the processes taking place in society analysing the economic situation in the country and development trends in specific industries, analysing and evaluating the situation in companies, national economy in general and in different management areas;
- to master knowledge and improve professional abilities and skills in the selected study programme by demonstrating appropriate academic performance and learning outcomes in each course and integrating them into research;
- to foster mastering of research work skills by drafting study papers within different courses and graduation papers at the end of studies;

- to develop skills in identifying problems, formulating objectives and their resolution, offering practical solutions to individual problems within the scope of study courses and in the graduation paper at the end of studies;
- as a result of the study process to develop intellect of students, promote their improvement, foster the use of intellectual skills in the study process and in their practical activities.

The goals of the study programmes within the study direction are subordinated to the goal of the study direction, forming an integrated system, while at the same time reflecting the specificities of each study programme. (in addition, see the description of each study programme in Section III of the report)

The goals set for the study direction and the study programmes therein stem from the strategic goals of RTU: excellence in science, sustainable valorisation, high-quality study process, and institutional excellence. The RTU Strategy 2021-2025 is based on the three main objectives of the University and is related to the five major priorities of the University: internationalization, interdisciplinarity, organizational, financial and infrastructure efficiency. These five horizontal priorities are used by RTU as a prism to monitor achievement of its objectives and to provide the Latvian national economy and society with internationally competitive high-quality scientific research, tertiary education, technology transfer, commercialization and innovation. The strategic direction of RTU development is to be an international and the leading Baltic university of technology. Accordingly, the goals of the study direction are part of the common university development strategy and are consistent with common social and economic trends. The implementation of study programmes of the study direction directly contributes to the implementation of interdisciplinary internationally recognised, scientific innovation-based study programmes and, therefore, the preparation of high-quality specialists in order to ensure the long-term development of the Latvian and European economies in an environmentally friendly and climate friendly way and capable of adapting to climate change.

The development strategy of the Riga Technical University (RTU) is implemented as part of the process of building the future of European engineering education. On 9 October 2015, RTU became a member of the Conference of European Schools for Advanced Engineering Education and Research or CESAER, and the university is now cooperating in engineering education, research and innovation policy making, which is on the agenda of the European Commission (EC). RTU is currently participating in three CESAER expert task forces: Human Resources, Innovation and Scientific Engineering Education – TFSEE. The last one has been created for CESAER experts to proactively influence European policies in tertiary education in general, including by expressing their opinions and ensuring representation of interests of science and technology universities in the European Higher Education Area and in the initiative “New Skills Agenda for Europe”, and in particular in STEAAM (Science, Technology, Engineering, Architecture, Arts and Mathematics) education. Expert task forces work in order to flexibly and quickly respond to the demand of European institutions and to offer support and solutions in different decision-making.

In order to foster the development of engineering sciences in Nordic countries, in June 2018 RTU joined the Nordtek network of universities, which united rectors and deans of the technical universities in the Nordic and Baltic countries. Nordtek defined three strategic goals to promote excellence of Nordic technical universities: (1) Engineering education – content and pedagogy; (2) Business and innovation; (3) Mobility. Thus, the goals set by Nordtek get successfully integrated in RTU’s strategic goals and focus on the improvement of the study process.

Tertiary education policies in Europe are created by collective decisions of countries and by international organisations. The European University Association (EUA) is one of the most important organisations shaping and influencing the European Higher Education Area. In 2017, RTU received

the EUA evaluation for the second time and was awarded the right to use the logo of the 24 Institutional Evaluation Programme (IEP) of the European University Association for 5 years.

Regardless of international organisations or intergovernmental decisions laying down European single tertiary education policy directions, these policies are in any way implemented by universities themselves. Therefore, study programmes of the direction also include transfer of qualitative and innovative study curriculum or results and clearly formulated learning outcomes to be achieved in each study programme. This process includes:

- determination and analysis of the requirements of target groups of the study direction;
- selection of solutions, curriculum analysis for them to correspond to interests of target and involved groups, and the analysis of their transfer opportunities;
- integration or recognition of results at European, national, regional, local and/or sectoral level, for example, certificates of employers or international partner universities for graduates.

Pursuant to the RTU strategy, the strategy of the RTU **Faculty of Electrical and Environmental Engineering** (**FEEE)** for 2014-2020 was developed and its **strategic goal was formulated**: by 2020 to become Latvia's leading internationally recognised study, science and innovation institution in the fields of energy, electrical engineering and environmental science, ensuring a high quality study process, internationally recognised scientific research and sustainable innovation, commercialisation and knowledge transfer in the economy (in 2020, work on the development of the new FEEE strategy was started under the leadership of the FEEE dean, in line with the keynote of the RTU strategy for 2021-2025). The new FEEE currently is beeing finalized, thefroe, faculty continues its work by FEEE strategy 2014-2020.

The vertical **sub-goals** defined in the FEEE strategy include:

- *High quality study process.* Internationally recognised high-quality study programmes prepare competitive graduates in the fields of energy, electrical engineering and environmental science, who ensure the development of the Latvian economy, are able to think analytically and creatively, as well as to learn all their lives.
- *Internationally recognised scientific research.* High-quality scientific research in the fields of energy, electrical engineering and environmental science that meets the needs of the Latvian economy, as well as the themes of international research programmes.
- *Sustainable innovation, commercialisation and knowledge transfer in the economy.* An effective knowledge transfer process and an innovation development environment in cooperation with national and foreign companies.

At the same time, the horizontal goals are directly subordinate the RTU's strategic goals:

- Internationally competitive faculty activities in the fields of study, science and innovation.
- Promoting linkages with other academic sectors and specialisations in order to improve the content of studies and to promote the flow of innovation in the economy.
- *Organisational efficiency.* Efficient faculty management, ensuring development and the implementation of a modern study and research process.
- *Financial efficiency.* Financial independence of the faculty and a transparent internal financial system that promotes the development of the faculty.
- *Infrastructure efficiency.* A modern study, research and innovation environment with modern technical equipment.

RTU IESE develops the **development strategy** of the institute for a five-year period on a regular basis, which is based on strategic goals of the state and RTU that provide for internationally competitive high-quality scientific research, tertiary education, technology transfer,

commercialisation and innovation. The IESE strategy also include the priority research directions defined by international institutions.

The RTU IESE strategy for 2016-2020 has been created with participation of a broad group of IESE employees. **Four strategic RTU IESE action lines** were defined in the process of development of the strategy: training and study process; scientific activity; working with businesses and a block of technical experiments; external communications, communication with society. Then, having divided into four groups, employees of RTU IESE worked on the layout of the goal, tasks and cooperation strategy for each action line. Student representatives of each level of the study direction “Environmental protection” and representatives of employers participated in the discussion of the developed strategy.

The **vision** of RTU IESE is to be the leader in studies and science in the field of environmental protection and energy in the Baltics and at international level, where interested, hard-working knowing students study and professionals, teachers interested in latest developments work, as well as which offers scientific services for the private sector.

See the directions of RTU IESE strategic action lines, tasks and activities included in the appendix "RTU IESE strategic action lines".

The study programme “Environmental Engineering” fully complies with the goal of the strategy of the RTU Faculty of Energy and Electrical Engineering(currently the Faculty of Electrical and Environmental Engineering) for 2014-2020 – by 2020 to become Latvia’s leading internationally recognised study, science and innovation institution in the fields of energy, electrical engineering and environmental science, ensuring a high quality study process, internationally recognised scientific research and sustainable innovation, commercialisation and knowledge transfer in the economy.

Monitoring of the implementation of the RTU IESE strategy takes place every year and progress in the implementation of the strategy is described at the annual IESE meeting. Progress int he implementation of strategic goals is determined using achievement indicators. The overview of strategic goals and tasks is based on the iterative approach, thus ensuring that the RTU IESE strategy focuses on current development of RTU IESE and changes along with ongoing external changes and needs. The Environmental Management Module, which has been functioning since 2007, is a component of the RTU IESE strategy and is an effective tools for prevention of faults and non-conformities in activities of IESE (for more information on the RTU IESE Environmental Management System see section 2.1).

When evaluating the performance of the study direction "Environmental protection” in accordance with the RTU Development Strategy and the indicators set in the FEEE strategy, a conclusion can be made that performance in several indicators exceeds the goals set by the faculty for 2014-2020 (see below).

Indicator	Goal of the FEEE strategy in 2020	Indicators of the study direction "Environmental Protection"*
High quality study process		
Employment of graduates one years after graduation	98%	Employment in total – 98%* Employment in the sector – 86%*
Number of international students in the total number of students	10%	22%*
Number of enrolled Master students / students who obtained Bachelor's degree	65%	2.7
Number of visiting lecturers in the total number of academic staff	10%	10%**
Number of academic staff with a doctoral degree in the total number	≥70%	91%**
Number of the study programmes taught in English	3	6**
Internationally recognised scientific research		
Doctoral degrees awarded per 100 awarded Bachelor's degrees	6	8**

The indicator corresponds to the research period from 2017 to 2019. ** Indicator as at November 2020. * Indicator as at January 2020 for 2020.*

In the survey conducted by the Employer's Confederation (LDDK), RTU was recognised as an education institution that is most recommended and acknowledged by employers and it is on the honourable 1st place in this rating every year. This is an evaluation of Latvian higher education institutions created by the Latvian portal Prakse.lv and LDDK. It evaluated which professions were necessary on the labour market at that moment and which higher education institution was able to prepare the best specialists for competitive companies. Such an evaluation has been prepared for the purposes of helping graduates of basic schools and secondary schools to make a correct choice of their profession and higher education institution. It was recognised that RTU was an example of ensuring a real link between studies and the real labour market. This survey of most demanded professions listed engineering professions.

In order to evaluate compliance of study programmes of the study direction with labour market requirements and employment opportunities of graduates of the study programme, a survey of employers or focus group interviews was conducted in all study programmes. Respondents of the survey are CEOs of internship companies, who often also are graduates of study programmes and cooperation partners. They are urged to objectively evaluate the specific study programme, knowledge and skills of graduates of the study programme and their compliance with labour market requirements, as well as to forecast employment opportunities of graduates. The results of these surveys can be obtained from heads of study programmes.

1.3. SWOT analysis of the study direction with regard to the set aims by providing explanations on how the higher education institution/ college expects to eliminate/ improve weaknesses, prevent threats, and avail themselves of the given opportunities, etc. The assessment of the plan for the development of the study direction for the next six years and the procedure of the elaboration thereof. In case there is no development plan elaborated or the aims/ objectives are set for a shorter period of time, information on the elaboration of the plan for the development of the study direction for the next assessment

period shall be provided.

In order to ensure the high quality of the study direction, a report on enhancing the academic quality is designed annually and is further evaluated by an expert appointed by the Vice-Rector for Academic Affairs. The report is approved by the RTU Senate. An integral part of the report is SWOT analysis, which allows to focus on what has been achieved and to highlight the challenges to be solved. It is an essential tool for achieving the goals formulated for the study direction.

With involvement of directors of all programmes of the study direction, representatives of employers and representatives of the FEEM Student Self-government, the SWOT analysis and the development (see appendix "Study direction development plan") plan of the study direction was considerably revised in spring 2019 based on the proposed aims, sub-aims and objectives of the study direction. By promoting planning and improvement of the study direction, the SWOT analysis was discussed with members of the FEEM Convent of Councillors and the development plan was approved at the Convent meeting. The development plan of the study field is successfully implemented: the study process promotes the achievement of the goals set in the plan - to provide students with sustainable, research-based and industry-based, adaptable, interdisciplinary multidisciplinary education in the field of environmental protection; training internationally recognized, highly qualified environmentalists and scientists with systematic thinking in the fields of environmental protection and climate change. The development tasks of the study field are achieved. The development plan of the study direction allows to strategically plan and improve the study process.

Study direction SWOT analysis:

Strengths:

- Awareness and quality mark of RTU IESE – as a well-known brand – in Latvia and the Baltics, which shows the results of high-level studies and research.
- Interdisciplinary, practical, and science-integrated higher education level program (bachelor's studies, master's studies, doctoral studies).
- High-developed infrastructure, modern, fully equipped audiences, laboratories, excellent digital infrastructure (ORTUS, *Use Science*, Publication Databases, etc.) and portal.
- Multi-scale and continuous improvement through participation in research projects in faculty and access to the infrastructure base for industrial enterprises (energy, environmental and industrial sectors) for research and research activities.
- Compliance of thematic areas in the field of studies with the Smart specialization Strategy (RIS3) contributes to the faster development of the sector and the additional funding needed for it.
- The quality of studies and science is provided by internationally recognized in scientific activity and loyal academic staff with rich, professional experience, who continually develop their competencies and provide the study process in English as well.
- A successful process of updating academic staff is due to the growing number of doctoral graduates in recent years (the average age of elected academic staff is 39 years).
- Democratic relations between administration, academic staff and students, students participating in decision-making and in the development and improvement of the study process, a policy of academic honesty has been strengthened. FEEE is the most active student self-government, with leading students in the direction of “Environmental Protection” students in recent years.
- An integrated research and study process, extensive opportunities to participate in

international scientific conferences, including the annual international scientific conference "CONECT" (conference materials published in high-level journals – Journal of Environmental Management, Energy Procedia, Journal of Environmental and Climate Technologies, etc.) and seminars (both for students and staff); and the development of applications for scientific projects and the implementation of projects. A vast, modern, and accessible RTU library (works 24/7), the study process uses the latest textbooks and "Case study" materials.

- Management of the field of studies, including development of new research courses and feedback with students and graduates on the progress of the study process, shall ensure continuous development and quality control of the study process. The quality system in the RTU is designed as an excellence approach of the RTU, providing quality of studies and research as well as continuous development.
- improving the quality of the final works, involving students in the development of scientific projects, and updating the final work on topics in cooperation with industry.
- A broad international partnership and cooperation with foreign universities in the field of study and scientific research.
- Increases a demand for environmental protection specialists with integrated knowledge in engineering in the labor market in Latvia and the world.
- Strong RTU Alumni Association, which builds a reputation and sustainable collaboration with former students.

Weaknesses:

- Different levels of student initial preparedness (particularly among local and foreign students), different awareness of the cultural and educational process and student motivation.
- Unreasonably exploited mobility opportunities for students and academic staff.
- Lack of competition on the announced places of academic staff.
- Expressed student employment in parallel with the full-time study process, which exacerbates achievement rates.
- Underloaded academic staff, thus insufficient capacity to reinforce the implementation of a student-centred education approach.
- In the long term, a lack of stable (rather than individual project-oriented) funding that prevents the flexible and effective involvement of foreign training force and industry professionals in the study process and research.
- Insufficiently developed RTU international brand to compete successfully with foreign student recruitment at an equivalent level.

Opportunities:

- Development of existing study programs and development of new study programs, assessing developments in the fields related to the direction of study and in line with trends in the labor market and the directions of scientific research.
- Opportunities for study abroad in the framework of exchange programs, participation in academic staff mobility programs, international experience in projects, etc.
- Developing additional funding and extending international cooperation through participation in national and European programs and projects (National Research Programs, LCS funded projects, Horizon 2020, Horizon Europe, etc.), as well as in the development of applied research and in cooperation with companies in the implementation of market-oriented research.
- Use of infrastructure for research centers of national interest for study and research.
- Expanding cooperation with foreign universities and international institutions and organizations within the field of their studies.

- Ensuring the process of remote learning through the benefits of digital infrastructure, such as part-time students or region-based students, and successfully attracting foreign training force, including through the implementation of extended MOOC (Massive Open Online Courses).
- Informed new and emerging academic staff and integration during the study process and in raising qualifications.
- Integration of problem-prone learning methods (in partnership with companies) into the study process.
- Exploiting the potential of joint study courses, double-diploma, joint study program.
- Stimulating students to engage more actively in activities outside the classroom industry.
- Introducing new, integrated study methods in the study process.
- Raising public interest and awareness of the environmental sector, thereby stimulating further training in the country.

Threats:

- Lack of a sustainable strategy in Latvia's higher education policy.
- Insufficient public funding and distribution of financial resources between the fields of study, reduction of public funded budgets.
- When combining full-time studies with work, students cannot be fully involved in the study process, this causes problems in achieving the results of their studies, reducing their achievement, as well as the threat of not completing their studies.
- Reduction in the number of students (Bachelor, Masters) for a variety of reasons (demography, insolvency, increased university competition, including foreign university).
- The insufficient amount of individual scholarships to make full use of mobility programs for students can reduce student mobility because the costs of staying in many European countries are very high.
- The impact of travel restrictions caused by COVID-19 on the mobility of foreign students, trainers, and students.
- Enlarged availability of the MOOC (Massive Open Online Courses) and their recognition in the workplace, contributes to changing student choice and switching from face-to-face studies to distance or virtual studies, which can have a significant impact on future investments in higher education infrastructure.
- There is no clear prospect for a long-term period of demand in sectors of the economy in which young specialists will be employed during their studies.

To the extent possible, RTU IESE works to prevent or reduce weaknesses and to prevent or reduce threats. For example, students can attend seminars and trainings organized by RTU IESE, which allows students with different levels of preparation to acquire additional knowledge. Students and teachers are encouraged to take advantage of mobility opportunities. When a job vacancy is open at RTU IESE, it is primarily offered to students of the “Environmental Protection” study field, thus promoting the employment of students in the field related to the study field. In parallel, work is being done to strengthen strengths and seize opportunities.

1.4. The structure of the management of the study direction and the relevant study programmes, and the analysis and assessment of the efficiency thereof, including the assessment of the role of the director of the study direction and the heads of the study programmes, their responsibilities, and the cooperation with other heads of the study programmes, as well as the assessment of the support by the administrative and technical staff of the higher education institution/ college provided within the study direction.

At the level of faculty and study direction, internal quality is ensured by the Faculty Council, the Study Direction Committee and the director of the study direction, directors of study programmes, administrations of the institutes or departments implementing the study programme.

In order to ensure continuous development of the study programme, RTU Study Direction Committees supervise academic activities in the respective study direction and are responsible for curriculum of the study programmes within the study direction, including accreditation of the study direction. The inclusion of representatives of employers in the Study Direction Committee is a mandatory prerequisite. The Study Direction Committee works in accordance with the "Regulations of the Study Direction Committee" (approved by the RTU Senate on 26 April 2021, minutes No. 649). Main tasks of the Study Direction Committee are:

- to analyse the situation in the labour market and to make proposals for the development of new study programmes as well as for the closure of the study programmes which have lost their topicality;
- to carry out an expert examination of the content and quality of study programmes, to evaluate their compliance with the defined objectives, their compliance with the scientific sector represented and the labour market requirements;
- to organise and monitor the accreditation of the study direction and the licensing of study programmes;
- to analyse the reviews and recommendations provided by external experts and to organise the correction of the identified shortcomings;
- to carry out an analysis of self-evaluation report of the study direction, as well as the annual report on the measures for improvement of the study direction;
- to evaluate the proposed changes to study programmes with a view to increasing the quality of all study programmes included in the study direction to achieve the strategic goals of the university;
- to analyse the results of student, graduate and employer surveys and to organise the rectification of identified shortcomings;
- to organise additional surveys.

Overall the study direction "Environmental protection" currently has **6 study programmes** (**3** new study programmes are forwarded **for accreditation of the study direction** – academic Bachelor's study programme "Environmental Engineering", academic Master's study programme "Environmental Engineering", doctoral study programme "Environmental Engineering") and are led by **1 programme director** – professor, Dr.hab.sc.ing. Dagnija Blumberga.

The committee of the study direction "Environmental protection" consists of 9 participants, of which **5 represent academic staff of the study programmes**, **3 – representatives of employers** and **1 student representative** as an observer without voting rights (see the Annex "Composition of the Study Direction Committee").

The study direction "Environmental protection" at Riga Technical University **is provided by the RTU Institute of Energy Systems and Environment** (RTU IESE). The institute and the department included into it ensure teaching and methodological work: create and update study course programmes, ensure appropriate teaching of study courses, supervision and defence of graduation papers and perform other activities related to teaching, methodological and scientific work. Support in science in ensuring integrated study processes is provided by **RTU IESE Scientific laboratories** – the Environmental Monitoring Laboratory, the Biosystem Laboratory, the Combustion Research Laboratory, Solar Energy Systems Laboratory or the Building Energy

Efficiency Laboratory, as well as the RTU Design Factory and laboratories.

Other organisational units of RTU – faculties and institutes – for example, the RTU; Faculty of E-Learning Technologies and Humanities; Institute of Humanities and Department of Languages for Special Purposes; Faculty of Civil Engineering, Department of Water Engineering and Technology; Faculty of Material Science and Applied Chemistry, Institute of Technical Physics and Department of Chemistry; Faculty of Engineering Economics and Management, Department of Innovation and Business Management and Department of Occupational Safety and Civil Defence; Faculty of Computer Science and Information Technology, Department of Engineering Mathematics, etc. – are involved in the implementation of study programmes of the study direction.

In order to ensure the quality of the study programmes included in the study direction and provide necessary support to teaching staff and students, the study direction has a professional team, as well as study programmes self-evaluation working group (see the Annex "Study programmes self-evaluation working groups"). Administrative staff, teaching staff of the institute, students, employers are involved in governance of the study direction.

- The involvement of **teaching staff** in the development of the study direction, as well as in the development of new study programme takes place directly: making proposals for the improvement of study programmes (in terms of content and organisation) and their implementation, analysing existing similar study programmes in the field of environmental engineering, summarising opinions of professional and scientific organisations (from seminars and conferences) for future development of the field of environmental engineering, analysing student survey results of each semester, discussing at the RTU IESE Council meeting necessary goals, tasks, outcomes of the Study programme and courses to be included, participating in events organised by employers and Career Days.
- Cooperation with **employers** in the context of governance of the study direction and new study programmes takes place at several levels. First, the regular participation of employers in the definition of strategic goals in the **consultative and professional councils** of the study process (council of professors, study direction council, study programme council) allows timely responses to the necessary changes in the content of study programmes (changing course) or the need for the development of new study programmes. Second, the **involvement of employers in the implementation of the study process** as visiting lecturers and in the counselling in graduation papers. Third, **cooperation during the development of scientific projects and scientific contract work** allows for discussion of changes in the content and implementation of study programmes. From year to year, cooperation is expanding, priorities are changing and mutual interest and feedback is increasing. Cooperation with employers is also co-ordinated by the RTU Career Centre, which establishes and maintains contacts with potential employers, advises students on the development of professional careers, in the selection of topics for diploma papers, in the review of diploma papers, at meetings of the Study Direction Committee and other events. Within the study direction, the dialogue with industry takes place at least once a year (mainly in May-June, at the end of the year of studies). This type of cooperation provides mutual benefits in providing high-quality up-to-date information.
- The involvement of **students** in governance of the study direction and development of new study programmes starts during the existing study programme "Environmental Science", when **student survey** result point to the need, for example, to specialise the Bachelor level study programme more specifically in fields of environmental protection, but at Master level – to offer study programme specialisation opportunities. Student surveys in the study process will be carried out on a regular basis – in each academic year students are invited to express their opinions on the performance of academic staff in each study course. When concluding

studies in the programme, they are welcome to express their opinion on the study programme in general – to evaluate its organisation and implementation. The survey results will be analysed during the audit of the Study programme and used in the development of the process of organisation and implementation the study programme in the next academic year, reviewing their results at the meetings of the Study Programme Council, as well as at the meetings of responsible departments of the higher education institution. In addition, the participation of students in the study process **advisory council** (Study Direction Council) plays a significant role in improving study programmes and developing new programmes, where students came up with proposals on the study courses to be included and the ways to implement them, the shortcomings identified in the existing "Environmental Science" study programme.

- Administrative staff performs study support processes – study work organisation, ensuring of public and international relations, record-keeping on students, technical support in study programmes of the study direction and other works related to the implementation of the study programme. Key positions of administrative and technical staff include a public relations specialist, specialists for planning and coordinating the study process, technical support specialists and the head of laboratories. The team of academic staff consists of:
    - **study process planning specialist-bookkeeper** (2 persons), whose main duties and competence include supervision of administrative (office) work and management in general. Their duties include also organisation of business correspondence, circulation of information, service of students and resolution of standard situations or referring to responsible specialists, incl. sending of complaints or applications for review to the respective structural unit. Their duties include organisation and maintenance of record-keeping of an organisational unit, support in the process of enrolment of students, preparation of schedules of classes, informing of students on changes in the study process, as well as serving of visitors and students and resolution of problems. These specialists summarise necessary data, analyse them, as well as prepare necessary reports, they may also perform other duties at the assignment of the head of the organisational unit. It should be mentioned that these specialists provide support in the organisation of bookkeeping of the Council of Professors, the Doctoral Council.
    - **public relations specialists** (2 persons), whose duties include the creation and maintenance of the RTU IESE public image, communication with media, development and posting of publicly available information, organisation of events, including organisation of lifelong learning courses and attraction of participants, cooperation with foreign partners, etc.
    - **financial specialist** (1 person), whose competence is planning and supervision of financial flows of organisational units, support in the study process and development of scientific project proposals and reports. The financial specialist also participates in the personnel selection process providing proper administrative support.
    - **head of scientific laboratories** (1 person) and **technical support specialist** (1 person).
    - **administrator of computer systems and computer networks** (1 person), whose main duties and competence include maintenance, installation, configuration of computer equipment and office equipment, performance of system diagnostics tests and resolution of complex problems in the system.

In addition, the Dean's Office of the Faculty employs **2 study process planning and coordination specialists**, who are responsible for planning of classes and premises for the study programmes and coordination and supervision of changes, as well as communication and

bookkeeping for students.

The study programmes implemented within the study direction fully correspond to the main goals of higher education – development of personality, democratic society and science and satisfaction of labour market requirements. In order to ensure this compliance, create and implement an effective strategy for management and development of the direction, it is based on the following principles:

- cooperation – all parties get involved in resolution of direction development matters: staff, students, employers, local governments and state institutions, public organisations, etc.;
- consistency – ensuring access to cooperation and partnership in resolving direction development matters within RTU, in cooperation with other institutions;
- succession – continuity of studies and personality development goals in the implementation, ensuring logical succession in study programmes and lifelong learning;
- sustainability – justification of educational decisions and balanced development;
- availability – all students have equal opportunities to obtain respective education within the study direction;
- coordination – an integrated approach to planning and implementation of changes is implemented ensuring equal management and coordination of changes among different organisational units and levels and types of study programmes.

Internal quality control at the faculty and at the level of the study direction is ensured by the Vice Dean for Academic Affairs. The quality of the study programme is ensured by the Head of the study programme and the academic staff involved in the implementation of the program, whereas the whole process is controlled by the administration of the responsible institute or department. Once in an academic year the abstracts and curriculum of the study program, the methodological materials, as well as recent study literature and methodological guidelines for study papers (reports, study papers, internship reports and graduation papers) are reviewed. The academic staff and the administration of the study programme participate in various experience exchange activities, cooperating with the higher education establishments in other countries, participating in the meetings with representatives of relevant institutions and entrepreneurs, as well as discuss the current developments in the field, analysing the results of the students' research papers and projects.

The responsibilities and duties of the Head of the study program are provided in the job description. The most important of them include: management of study programme development, improvement of the curriculum in compliance with the requirements of the scientific fields or the sectors of the national economy, implementation of quality assurance, supervision of study plan development, promotion of internationalization, cooperation with RTU Study Department providing the input of data in the Information system, as well as the cooperation with other departments of RTU that are involved in the implementation of the study programme. The administration of the Faculty constantly monitors the compliance of the premises and technical equipment with the modern quality requirements, and appropriate classrooms have been created with the necessary multimedia equipment. Support functions for the development and implementation of study programmes are provided by RTU Study Department. RTU Programmes Management and Curriculum Design Unit plays an important role supporting the improvement of the study programme.

A working group has been created for the successful implementation of “SO 8.2.1 “To reduce fragmentation of study programmes and to strengthen resource sharing at Riga Technical University” within the study direction “Environmental protection” (for details of the project see section 1.1), development, licencing and accreditation of new study programmes, which include the

director of the study direction, the director of the study programme, teaching staff, heads of scientific laboratories, RTU IESE bookkeeping specialists and a student representative.

RTU has established a rigid system for the management and development of study programmes. Proposals to introduce any changes in the curriculum are made by the Study Direction Committee based on the recommendations of the academic staff, references from employers, suggestions from student self-government, as well as observing the latest trends in the national economy and the labour market. The Study Direction Committee requests the Faculty Council to review and approve them. Based on the decision of the Faculty Council, the RTU Senate approves changes in the study direction. Amendments in the structure of study programmes are approved by the order of RTU Vice Rector for Academic Affairs. Technical support of the study direction is provided by the study programme record keeping as well as IT service. Such cooperation in the implementation of the study programmes within the study direction is to be evaluated as efficient and stimulating the development of the study direction.

The general governance system of RTU IESE, in accordance with the Environmental Management System, which was introduced in 2007 and is maintained, includes the organisational structure, planning, distribution of responsibility, internship, procedures, processes and resources for the development, implementation, review and maintenance of the education policy. The systemic approach ensures that a scientifically justified activity improvement programme is implemented. It prevents the implementation of mutually uncoordinated, fragmentary activities, which often lead to irrational consumption of financial and human resources. A systematic approach to governance is ensured by the scheme implemented by IESE (PDPR model) – for more information on the RTU IESE Environmental Management System see section 2.1. The management structure of the study field is given in the Annex "RTU Study Direction Management Structure".

1.5. Description and assessment of the requirements and the system for the admission of students by specifying, inter alia, the regulatory framework of the admission procedures and requirements. The assessment of the study period, professional experience, and the options for the students to have their previously acquired formal and non-formal education recognised within the study direction by providing specific examples of the application of these procedures.

The admission process and procedure of students matriculation is stipulated in the RTU Admission Regulations, which are elaborated based on the Law on Higher Education Institutions and Regulations of the Cabinet of Ministers No 846 issued 10 Oct 2006 ''Regulations on Requirements, Criteria and Procedures for Enrolment in Study Programmes'', as well as the specific requirements of study programs and the industry. The RTU Admission Regulations are approved by the RTU Senate and published on November 1 each year (see the files of Appendix 29-34 of the list of Internal regulations).

Admission requirements are logical, understandable, and linked to the goals defined in the RTU Strategy. Admission system is state-of-the-art, easily accessible, logically structured, and is evolving in line with today's digitalization trends, providing the potential students with the convenient and easy to use application to university registration tool.

Applicants are admitted to full-time and part-time undergraduate programmes based on the results of the **Centralized Examinations** (CE) in Mathematics, the Latvian language and the Foreign Language, and the final grades in individual subjects obtained in the Secondary Education, and the

entry test results. If, in addition to these CEs, the applicant has a CE in Physics or Chemistry, the results of these CEs are taken into account in the ranking calculation.

In order to participate in the competition for the state budget funded seats, the rating in Mathematics CE is calculated as the average value of all Mathematics CE rating sections and must be at least 12 percent. The applicant having CE lower than 12% in mathematics, can apply only for paid studies.

To determine the candidate's rank in the competition, each CE rating, calculated as an average of all CE evaluation sections, and each entry test (if any applies) is multiplied by the appropriate weighting factor and the resulting multiplications are added together.

Persons, who have received secondary education prior to 2009 (including), as well as persons, who have received secondary education abroad, or persons, who were exempted from passing the secondary education state examinations in accordance with the procedure set by regulatory enactments, may be admitted to the study programs based on their year grades in the secondary education document in the subjects mentioned in the RTU Admission Regulations, which must be successfully passed. Up to 2019, the admission based on the secondary education year grades was attributed to persons who completed secondary education prior to 2004. In general, the RTU Admission Regulations follow Regulations of the Cabinet of Ministers No 846.

Persons who have completed secondary education and have not passed any of the CEs mentioned in the RTU Admission Regulations or have failed the year grade, shall pass the CE in accordance with the Cabinet of Ministers Regulations No 335 "Rules on the content and procedure for centralized examinations".

Persons who have not passed CE in Latvian and who do not meet the requirements of RTU Admission Regulations, shall pass the entrance examination in Latvian as prescribed by RTU. The result is evaluated in percentage.

In compliance with Cabinet Regulation No 543 adopted on 29 September 2015 “Regulations on Replacement of the Foreign Language Centralized Examination in the General Secondary Education Program by Foreign Language Examinations Conducted by International Testing Institutions”, CE in the foreign language can be replaced with a foreign language examination conducted by an international testing institution the certificate of which must be presented to the RTU Admission Committee. The applicants who have acquired a Bachelor Degree in a field relevant to the study programme are enrolled to the graduate study programmes. The applicants take part in the competition with a weighted average grade from the Bachelor or professional study programme records. The weighted average grade is calculated as the sum of all the grades received in each study course multiplied by the credit points acquired in the study programme and is divided by the total number of credit points within the study programme. If credit points are not verified, the number is calculated as the multiplication of the grades and contact hours obtained in each study course divided by the total number of contact hours.

Before applying for the doctoral studies, the candidate and the Head of the Doctoral Study Programme must agree upon the possible scientific advisor / consultant and receive his/her written consent. The Doctoral Thesis scientific advisor may be from another scientific establishment; however, the applicant must also choose the scientific advisor / consultant from RTU. Documents necessary for the competition are compiled by RTU Doctoral Studies Department. After the collection of documents, the Doctoral Studies Department submits them to the Scientific Committee of the respective Faculty, which draws the Ranking table of the applicants according to the evaluation criteria set by the Faculty Scientific Committee and approved by the order of RTU Vice Rector for Research.

Taking into account the spread of Covid-19 and to simplify the process of admission of applicants for studies at RTU, starting from summer 2020 the process of enrolment to undergraduate studies and higher level study programme in the e-environment has been improved.

There are two ways to apply for the state budget funded seats in undergraduate study programs:

- Electronically in the Joint Enrolment Undergraduate Study Programme information system, using the e-service portal (https://www.latvija.lv). Taking into account the spread of Covid-19, starting from the summer admission of 2020, in the year of studies 2019/2020 graduates of secondary education may approve their electronic application remotely, without coming in person. If secondary education was obtained abroad or before the year of studies 2019/2020, the applicant must confirm their electronic application by personally arriving at the designated locations within the deadlines and presenting the originals of the required documents;
- Arriving at the RTU Admission Committee in person, presenting the originals of the required documents.

The application for the competition for state budget funds in higher level study programmes graduates of RTU Bachelor's study programmes submit an application remotely on the RTU portal ORTUS within the set application deadlines. Taking into account the spread of Covid-19, starting from the summer admission of 2020, graduates of Bachelor's study programmes of other higher education institutions accredited in Latvia may also submit applications on the RTU websites or may arrive in person to the RTU Admission Committee. The applicants for PhD programmes, can submit application for full-time studies by arriving at the Admission Committee, bringing the required documents, within the admission deadlines.

Applicants who do not qualify for the state budget funded seats and applicants who have received their education outside Latvia, as well as in other specific cases, must appear in person at the RTU Admission Committee within the admission deadline, with the required documents.

Taking into account the spread of Covid-19 and to improve the RTU's process of admission and to simplify the application of applicants for studies at RTU, starting from summer 2021 there are intentions to introduce electronic application for studies for paid undergraduate studies and higher level study programmes.

When enrolling to Master's and doctoral study programmes "Environmental Engineering" of RTU study direction "Environmental protection", in addition to the above-mentioned conditions, those students, who obtained previous education (at Bachelor or Master level) in a field not related to environmental protection or engineering and technologies, to ensure their understanding of environmental engineering and energy topics required for studies in the Master's or doctoral study programme "Environmental engineering", in addition to the curriculum of the study programme "Environmental Engineering" should master courses related to environmental engineering and power, which are defined in the study direction "Environmental protection" lēmums Nr. 19.06.2020-M2 un 19.06.2020-D2 (see Annex "Regulations for Admission to Master's Studies with Amendments", "Regulations for Admission to Doctoral Studies with Amendments").

Recognition of previously acquired formal and non-formal education at RTU is carried out in accordance with the "Regulation on the Recognition of the "Courses Completed at Other Universities and RTU Study Programmes" (Resolution of RTU Vice-Rector for Academic Affairs No 02000-1.1/29 as of 4 April 2016) and the "Procedure for Recognition of Competencies Developed Outside Formal Education or From Professional Experience and Learning Outcomes Achieved in Previous Education at Riga Technical University" (approved at the Meeting of RTU Senate on 23 September 2019, Minutes No 632).

RTU Admission Regulations are published at https://www.rtu.lv/lv/studijas/uznemsana/uznemsanas-noteikumi (for local students) and at https://international.rtu.lv/ (for foreign and exchange students).

The procedure of recognition of a study period, professional experience, previously acquired formal and non-formal education within the study direction is convenient and relatively simple for students. When a student submits an application with necessary documents attached on mastering of similar study courses and/or professional experience, they are evaluated. In order to reference professional experience, students should prepare and submit a description of their professional activity, which is evaluated by the commission, which decides on compliance of the professional activity with the requirements of the study programme. An additional interview is possible, if it is necessary to clarify unclear matters.

There is a regular (every semester) exchange of professional experience Within the study direction “Environmental protection” (in particular during the last 2 years, which is explained by the wide availability of the study process outside education institutions in the industry, associations, non-governmental organisations, etc.). For example, in 2017, five students of the RTU Bachelor’s study programme “Environmental Science” mastered basics of innovative business of 4 CP in the training cycle organised by the Latvia Technology Park. This knowledge is equivalent to the study course “Economics” (3 CP) of the Bachelor’s study programme “Environmental Science”.

In the Master’s study programme “Environmental Science” and “Environmental Engineering”, documents of several students were evaluated and previous education and/or experience in the professional area was recognised.

Recognition of study courses mastered in formal education in all study programmes of the direction takes place almost every semester upon request of students.

Students of the Bachelor’s and Master’s study programmes, enrolled at later staged of studies have the study courses mastered at the previous level of studies or first level professional higher education study programme (college) recognised, if the study courses and their amount correspond to RTU study programmes.

The development and licencing of new study programmes (Bachelor’s academic study programme “Environmental Engineering”, Master’s academic study programme “Environmental Engineering” and doctoral study programme “Environmental Engineering”) are subordinated to the year of accreditation of the study direction “Environmental protection”. The beginning of implementation of new study programmes in the year of studies 2020/2021 started to have students in the new study programme for the accreditation of the study direction “Environmental protection”. When submitting a self-evaluation report of the study direction, it does not include existing Bachelor’s, Master’s and doctoral study programmes “Environmental Science” of the study direction, which are specified as programmes to be closed in the RTU study programme development and consolidation plan. The students of the study programmes to be closed (for example, those in academic leave), who will not complete studies in the study programmes "Environmental Science” before closure of the study programme, in accordance with the Study Agreement will be offered to continue their studies in the new study programmes “Environmental Engineering” or in other education institution (higher education institution). The students of the study programmes “Environmental Science” to be closed, who will wish to continue studies in the new study programme, will be subject to the procedure of the RTU Vice-Rector for Academic Affairs of 4 April 2016 “On the Recognition of the Courses Completed at Other Universities and RTU Study Programmes” (see the file 10 of Appendix of the list of Internal regulations), applying the list of recognition of study courses prepared specifically for the new study programme and the study programme to be closed within the study direction “Environmental protection” (see Annex "List of recognition of bachelor courses", "List of

recognition of master's courses", "List of recognition of doctoral courses").

1.6. Assessment of the methods and procedures for the evaluation of students' achievements, as well as the principles of their selection and the analysis of the compliance of the evaluation methods and procedures with the aims of the study programmes and the needs of the students.

Summative assessment system is used in appraisal of student achievements, it implies that the final grade is composed of numerous components. Assessment of student learning outcomes is carried out in accordance with the "Regulation on the Assessment of Learning Outcomes" (approved at the Meeting of RTU Senate on 27 May 2017, Minutes No 610), which is available on Studies Regulations page of RTU web page (https://www.rtu.lv/writable/public_files/RTU_1_studiju_rezultatu_vertesanas_nolikums.pdfhttps://www.rtu.lv/writable/public_files/RTU_par_nolikuma_par_studiju_nosleguma_parbaudijumiem_rtu_apstiprinasanu_jauna_redakcija.pdf) (Latvian only)) (see the file of Appendix 04 of the list of Internal regulations). The main advantage of the summative assessment system is that the final grade is made up of several components. Therefore, the students may contribute to their final grade working during semester. Criteria for assessment of the study courses and individual/home tasks are published in ORTUS portal beforehand. During semester, the assessment for each home task, test, report, presentation and any other task is ascribed certain weight in the final grade. Exam grade may not exceed 50% of the final grade. Academic staff may take into consideration and also assess student attendance. Assessment structure for the study course is determined by the academic staff themselves, abiding the resolution of RTU Senate that the exam grade may not contribute more than 50% to the final grade. Selecting assessment criteria and methods for evaluation of student achievements, specifics of each study program and learning outcomes are taken into consideration.

Assessment of learning outcomes is carried out in accordance with the Regulation on the Assessment of Learning Outcomes (see the file of Appendix 04 of the list of Internal regulations) and the Regulation on Final Examinations at Riga Technical University (see the file of Appendix 08 of the list of Internal regulations).

Pedagogical methods used in the implementation of study courses, as well as assessment forms and methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs.

Based on the Regulation, teaching staff of each study course develops criteria for getting assessment and acquaints students with them. Acquaintance of students of the study programme with the assessment criteria of study course tests and conditions for receiving an assessment is ensured:

- on-site during the implementation of the study course. Upon commencing the implementation of each study course, during the first class the responsible teaching staff makes a presentation regarding the course, its objectives and tasks, the content of the course, learning outcomes, the set requirements, the type of test for mastered course (test or examination), the time, the duration and conditions of the test (including the number of questions), the requirements for obtaining a positive assessment and assessment criteria.
- prior to the test (in the case of a test – during the last class before the test, in the case of an examination – during a tutorial), teaching staff informs about the set requirements, the type

of test for mastered subject (test or examination), the time, the duration and conditions of the test (including the number of questions), the requirements for obtaining a positive assessment and assessment criteria.

- immediately before the test (test or examination) – before the commencement of the test, the teaching staff informs about the set requirements, the type of test for mastered course (test or examination), the time, the duration and conditions of the test (including the number of questions), the requirements for obtaining a positive assessment and assessment criteria.

Acquaintance of students of the study direction "Environmental protection" **with study courses** within the study programme is ensured at two levels:

- through the university's internal system ORTUS, in accordance with the order of the Vice-Rector for Academic Affairs on the use of the RTU e-studies system in study courses. The ORTUS portal is available to any students and an e-studies environment has been created within the ORTUS system, which is intended for mutual communication between students and lecturers and includes also descriptions of all study courses of the study programme, including, course code, name, status level and type, thematic area, organisational unit and teaching staff, which ensures the implementation of courses, abstract of the course, as well as objectives, tasks of the course, competencies and skills set, learning outcomes and their assessment. Descriptions of study courses are summarised in the Catalogue of Study Subjects and are publicly available to any user without registration (see – https://www.rtu.lv/lv/studijas/bakalaura-limena-studijas/studiju-kursi (Latvian only)). The information on the course available to students in the e-studies environment includes the description of the study course and its plan, the information published by teaching staff on the requirements, assessment, assessment of tests and study aids.
- on-site during the implementation of the study course. Upon commencing the implementation of each study course, during the first class the responsible teaching staff introduces to the course, its objectives and tasks, the content of the subject, learning outcomes, the set requirements, the type of test for mastered course (test or examination), the time, the duration and conditions of the test (including the number of questions), the requirements for obtaining a positive assessment and assessment criteria.

RTU does not set specific study **attendance requirements**, except for students of the 1st year, whose attendance of classes is mandatory in accordance with the rector's order On Procedure of Studies for 1st year Students. During other years, organisational units and teaching staff have the right to set their own requirements for attendance of classes informing students thereof at the beginning of the year. At the RTU IESE meeting of 30 August 2012 as decision on attendance of lectures by students was approved (extract from minutes of the meeting No. 30/08/212). The decision provides that the teaching staff is entitled to keep records of the student's attendance of lectures, when implementing a study course. When commencing the implementation of a course, the responsible teaching staff must inform students of the classes that must be attended: (1) by informing students orally about the objective, content, progress, classes that must be attended, course assessment criteria and testing conditions. (2) by handing out in printed form or/and by attaching in the ORTUS e-studies environment a course plan specifying topics included in the course, the distribution of lessons (theoretical lecture, practical class or laboratory work), the lesson that must be attended. Attendance of students is recorded on attendance sheets. The attendance sheets include a course plan (topic, date) and the place for the teaching staff's signature. In order to ensure record-keeping for each student during the first class, attendance sheets are distributed (or if the first class is not attended, the teaching staff issued the attendance sheet at the request of the student), where the responsible teaching staff sign about each class attended by the student. The results of course attendance are taken into account at the end of the course:

- in case of full attendance of the course, the responsible teaching staff decides on easements in the final examination of the course (for example, cancellation of one questions in the examination). The teaching staff acquaints students with specific conditions how student's participation in lectures is taken into account in course assessment by handing our attendance sheets, as well as acquainting students with the course description and mastering conditions.
- in case of partial attendance of the course, the responsible teaching staff decides on additional questions in the final examination of the course, but no more than one additional question per class that was not attended. The teaching staff acquaints students with specific conditions how student's participation in lectures is taken into account in course assessment by handing our attendance sheets as well as acquainting students with the course description and mastering conditions.

To ensure feedback between the student and the lecturer in a specific study course, knowledge of students is assessed and independent study work is controlled constantly during a semester using seminars, discussions, in-between test works.

The assessment of **graduation papers** (Bachelor's and Master's theses) is based on RTU's rules for assessment of graduation papers (incl. on the procedure of submission and examination of an appeal regarding final and state examinations), as well as the guidelines developed by IESE for the assessment of graduation papers (Bachelor's and Master's theses).

The final mark for the Bachelor's and Master's thesis (graduation paper) consists of:

- the arithmetic average of individual reviews of members of the committee for assessment of Bachelor's and Master's theses for the paper and presentation of the paper, incl. the assessment of the paper supervisor as a member of the committee for assessment of Bachelor's and Master's theses.
- the assessment of the reviewer of the Bachelor's and Master's thesis.
- Performance of students in drafting of Bachelor's and Master's theses during semesters.

The implementation of the **doctoral study** programme takes place in close cooperation with the supervisor of the doctoral thesis. In addition, every semester doctoral students report at the RTU IESE meeting (for students of the first year at least twice per semester, for students of other years – at least once per semester). Such a mechanism of implementation of the study programme allows ensuring the achievement of learning outcomes. The system for monitoring of progress of doctoral students is as follows: twice per semester in accordance with the prepared schedule, doctoral students report on their progress in drafting a doctoral thesis by presenting their results to the committee (the committee includes at least four IESE doctors). Progress of students is assessed based on the following criteria: mastering of the mandatory study plan; progress in drafting the doctoral thesis (methods, results); progress in drafting scientific publications; progress in participation in conferences; pedagogical activity.

The system for assessment of progress in the work of doctoral students is: 0 – The doctoral student presents the same as in the previous report without any new contribution; 1 – The doctoral student presents change of topic or minimum increase in the work compared to the previous time; 2 – The doctoral student prevents new ideas and/or results which will make a contribution to drafting of the doctoral thesis; 3 – The doctoral student presents significant results compared to the previous report. If the doctoral student's assessment is "0" or "1", he/she should present his/her progress again in two weeks.

The assessment of doctoral theses is based on the rules of the RTU Doctoral Council for the assessment of doctoral theses.

1.7. Description and assessment of the academic integrity principles, the mechanisms for the compliance with these principles, and the way in which the stakeholders are informed. Specify the plagiarism detection tools used by providing examples of the use of these tools and mechanisms.

Since 2010 all students that gradate from any RTU study programme should upload electronic versions of their graduation papers in ORTUS portal in order to improve the quality of graduation papers, create a bibliographic database of the graduation papers and introduce an automated control system for detecting plagiarism. RTU uses three major plagiarism control tools in the study process:

1. **Level 1** is implemented within the study programme. Since 2012, test papers (course papers) and graduation papers (Bachelor's, Master's and doctoral theses) of study programmes of the RTU IESE study direction "Environmental protection" have been checked in the iThenticate plagiarism prevention tool. After the submission of the electronic version of course papers and at graduation paper control visits (at least once a month in the semester, when graduation papers should be submitted and at least twice a semester in the semesters, when graduation papers should be drafted), the responsible teaching staff checks authorship of the paper using the iThenticate tool.
2. **Level 2** is ensured at RTU level. Since 2015 graduation papers of study programmes of the study direction have been checked in the joint computerised plagiarism control system (JCPCS), which unites numerous Latvian universities and colleges. RTU uses the system in cooperation with the University of Latvia. This system is used to check graduation papers after their uploading to the ORTUS environment. JCPCS complements and extends plagiarism identification opportunities.
3. **Level 3** is ensured at RTU level. Starting from 20 December 2017, RTU has been having TurnitIn®, the world's leading tool for the correction of written papers and combating plagiarism that is used daily by millions of students and academics around the world. TurnitIn® tool is integrated with RTU ORTUS estudy system and provides full service of submitting, correcting, verifying the originality (plagiarism) and return of the submitted papers. TurnitIn® offers two main platforms: a platform that automatically checks for the percentage of non-genuine content (plagiarism) and a platform that allows to electronically correct the submitted papers. This tool is used to check all the electronic versions of graduation papers submitted for defence and further control measures are operatively implemented for potential plagiarism detection.

Graduation papers are checked in all systems in parallel, thus using the advantages of all systems. The developed Doctoral Theses are in a similar way controlled with extreme scrutiny. Since 1997, the Researcher Code of Ethics has been effective at RTU (see the file of Appendix 19 of the list of Internal regulations). Academic Integrity Code approved at the RTU Senate meeting of 29 February 2016. The aim of the Academic Integrity Code is to strengthen academic culture and integrity in the academic environment of RTU, to explain the concept of academic integrity and related actions, to define main procedures in examination of academic fairness violations. (see https://www.rtu.lv/writable/public_files/RTU_rtu_studiju_reglaments_7.1.1.4..pdf (Latvian only)).

Procedures have been defined how a report on violation of academic integrity by a student is prepared, its examination and registration, possibilities of appealing. Informing and education of students on aspects of academic integrity takes place during study courses and at special

seminars.

Both students and RTU academic staff have access to the book “Academic integrity glossary. General guidelines for academic integrity” issued by the RTU Press (see https://ebooks.rtu.lv/product/akademiska-godiguma-terminu-vardnica-akademiska-godiguma-vispar ejas-vadlinijas/ (Latvian only)).

In addition, RTU participates in different initiatives that bring forward and solve academic integrity related issues. RTU is a member and one of the founders of the European Network for Academic Integrity (ENAI), where it is involved in active work sharing experience, keeping updated about academic integrity related issues, and organizing conferences. The Dictionary of Academic Integrity Terms and Guidelines is one of the newest aids that has been developed and will soon be published by RTU Press. In the framework of Specific Support Objective (SSO) 8.2.3 of the project “Development of Efficient Management of Riga Technical University”, RTU, in cooperation with the University of Latvia (UL) and Riga Stradins University, develops educational aids, as well as participates in the establishment of the Latvian national academic integrity organization and development of plagiarism control tools.

The organisational units implementing the study programme have developed a control mechanism, i.e. the initial check is performed in the process of interim assessment, which is performed by the work of the Advisory Examination Commission. When the student comes to these examinations, he or she should submit the electronic version of the performed work and the paper is checked in free plagiarism control tools in presence of the student. When students draft their graduation papers, they are instructed about plagiarism and its consequences several times. Methodological materials contain detailed instructions on correct presentation of references. This process allows to reduce plagiarism and highlights faults in the student’s paper, which needs to be rectified. The generally accepted “good practices” show that more attention should be paid to the papers showing 20 percent or more matches. A message is received from the system, when the match level is higher than 20%. The papers are examined, reasons of matches in the text are evaluated and a decision is made whether the student should be allowed to defend his or her Master’s thesis.

Some examples from study programmes of the study direction “Environmental protection”:

- The percent of matches of information does not exceed 22% in Bachelor’s and Master’s theses in the reporting period. The generally accepted “good practices” show that more attention should be paid to the papers showing 20 percent or more matches. These 6 papers with matches over 20 % were subjected to an additional expertise. The organisational unit evaluates, what the matches consist of. When evaluating the papers, a conclusion was made that the match percentage consisted of the content of regulatory enactments and information published on websites of enterprises or institutions, which students had copied in their paper including a reference, or have mentioned its source in the text.
- In the year of studies 2019/2020, 42-55% of matches of information were found in part 1 (it includes the analysis of literature and reflects the first interim assessment for three semesters of drafting of the Master’s thesis) of graduation papers of four foreign students in the Master level study programme “Environmental Science” as a result of the check performed by RTU IESE using the iThenticate computer software. These students failed this interim assessment, their talks on RTU fairness principles were held with administration of the study programme and they were provided with an opportunity to redraft their papers.
- In the year of studies 2018/2019, 33% of text matches in the methodology part were found in the graduation paper in English drafted by one student of the Master’s study programme “Environmental Science”. Having carried out a profound analysis of the paper and the sources used to write it, it was stated that the matches came from the author’s references to

own scientific publication published before the Master's thesis. As a result of talks with the paper supervisor, as decision was made to refer to the published scientific article in the methodology part of the Master's thesis thus proving authorship.

Overall, it can be concluded that the educational work with students was very successful, because in the majority of cases no cases of plagiarism were stated, as well as the number of matches in the text was small. This is related to the practices implemented by RTU IESE by educating students on principles of academic integrity and plagiarism:

- at Bachelor level these matters are integrated in the study course: Introduction to Study Field" (2 CP), "Introduction to Environmental Research Methods and Theory" (4 CP), at Master level – "Intersectoral and Interdisciplinary Research Methods" (4 CP); at doctoral level – "Garage of Doctoral Studies: Analysis and Publication of Scientific Research Results" (6 CP).
- regular checks for plagiarism within course papers.
- regular progress reviews within study courses "Bachelor's Thesis", "Master's Thesis".

1.8. Specify the websites (e.g. the homepage) on which the information on the study direction and the relevant study programmes is published (in all languages in which the study programmes are implemented) by indicating the persons responsible for the compliance of the information available on the website with the information published in the official registers.

Detailed information on the study direction and the study programmes pertaining to it with the indication of the languages of instruction is available at RTU web page:

1. RTU web page in the section on education opportunities in the Latvian language (https://www.rtu.lv/lv/studijas) (responsible person – I. Bušovska, Head of the Admission Department);
2. RTU web page in the section containing comprehensive information on education opportunities in the English language (https://www.rtu.lv/en/studies) (responsible person – I. Tipāns, Director of the International Cooperation and Foreign Students Department);
3. Interactive web pages dedicated to RTU study directions, study programmes therein, as well as the detailed description of the offered study courses in the Latvian and English languages (https://stud.rtu.lv/rtu/vaaApp/sprpub and https://stud.rtu.lv/rtu/discpub/list) (responsible person – G. Alksnis, Head of the Program Management and Curriculum Design Unit);
4. Web page designed for the foreign student target audience on RTU study programmes implemented in English and student mobility opportunities (https://international.rtu.lv, https://apply.rtu.lv) (responsible person – I. Tipāns, Director of the International Cooperation and Foreign Students Department);
5. FEEE website section on programmes in Latvian https://www.rtu.lv/lv/evif/toposajiem-studentiem-evif/studiju-programmas-3 (responsible – Z. Urtāne)
6. FEEE website section in English https://www.rtu.lv/en/university/structure-and-administration/faculties/electrical-and-environmental-engineering (responsible – Z. Urtāne)
7. Information on study programmes within the study direction in Latvian https://videszinatne.rtu.lv/studijas/nac-studet/ (responsible – A. Ozarska, L. Čerdancova)
8. Information on study programmes within the study direction in English

https://videszinatne.rtu.lv/en/studies/ (responsible – A. Ozarska, L. Čerdancova)

9. Information on study programmes within the study direction in English

https://fsd.rtu.lv/riga-technical-university-rtu/bachelors-studies/environmental-science-bachelors/

https://fsd.rtu.lv/masters-studies/environmental-science-masters/

https://fsd.rtu.lv/riga-technical-university-rtu/doctoral-studies/environmental-science-doctors/

10. Informative e-mail info@videszinatne.lv (responsible – A. Ozarska, L. Čerdancova), which is actively used by potential students to learn additional information on admission and apply for pre-study visits to RTU IESE.

In addition, RTU IESE actively uses social networks to provide the necessary information to potential and existing students, as well as participants of the lifelong learning study process.

- FACEBOOK website – Institute of Energy Systems and Environment, @RTUVASSI, we regularly share news of the institute on progress of the study process admission, scientific achievements and events organised by us, including visits of pupils, lifelong learning courses, etc.
- Instagram website – @rtu_vassi, we share news and different interesting facts.
- RTU IESE podcast channel "Sustainable worlds" – Anchor.fm https://anchor.fm/ilgtspejigas-pasaules, Spotify https://open.spotify.com/show/5sj3MqoQZbhDU5FV1PD7P0 and other podcast websites. Thematic discussions with RTU IESE and cooperation partners on environmental protection processes, scientific discoveries, etc. are organised.

In March 2020, under the influence of COVID-19 restrictions, as well as being aware of the need to provide high-quality, diversified and continuous information, RTU IESE developed a communication strategy of the institute. The overarching goal of the communication strategy is to multiply the awareness of the image of RTU IESE in Latvia and internationally, thus fostering the awareness and interest of potential students, cooperation partners (industry, public authorities, universities and scientific research organisations) in news in the field of environmental protection. The communication of RTU IESE includes for sub-goals and one of them is directly focused on the study process, i.e. to increase the prestige of environmental engineering professions. Tasks have been defined to achieve this – for example, to increase the share of youths enrolled in Bachelor studies, to improve cooperation with schools, etc. The implementation of the communication strategy is managed (by regular meetings) by a created working group led by the RTU IESE communication specialist A. Ozarska and with participation of RTU IESE management and academic staff.

II - Description of the Study Direction (2. Efficiency of the Internal Quality Assurance System)

2.1. Assessment of the efficiency of the internal quality assurance system within the study direction by specifying the measures undertaken to achieve the aims and outcomes of the study programmes and to ensure continuous improvement, development, and efficient performance of the study direction and the relevant study programmes.

RTU operates pursuant to "Constitution of Riga Technical University" (approved by the Law "On the

Constitution of Riga Technical University", the law was adopted in the Saeima on 23 October 2014 (see the file of Appendix 01 of the list of Internal regulations.).

"RTU Strategy and Development Programme for 2021–2025" (approved at the meeting of RTU Senate on 21st of December 2020,) lays out the key principles of RTU development in the period until 2025 (see https://www.rtu.lv/en/university/strategy). Three aims of the University are defined in the Strategy: (1) excellence in sicence; (2) high-quality study process; (3) sustainable valorisation and (4) institutional excellence, as well as definite tasks and qualitative indicators pertaining to these aims, for example, to promote cooperation between faculties and structural units of the study program and study course to avoid fragmentation and overlap. In order to efficiently control implementation of RTU Strategy, RTU Strategy Management System has been established, which provides that strategic aims, activities and tasks are cascaded to the level of definite organizational units and their staff.

RTU has an internal quality management system in place in accordance with the RTU Quality Policy updated and approved at the meeting of RTU Senate on 25 September 2017, Minutes No 612 (see: RTU kvalitātes politika (Latvian only)) and the RTU Excellence approach approved at the meeting of RTU Senate on 30 January 2017, Minutes No 606 (see: RTU_excellence_approach.pdf). Since the study direction "Environmental Protection" is one out of 12 study directions implemented by RTU, and its internal quality system is closely related to RTU Quality Management System.

RTU Quality Policy is aimed at implementation of RTU mission and achievement of strategic aims – scientific research, academic, infrastructure and organizational excellence, and recognizability. The Quality Policy provides the framework for implementation of RTU Strategy, and the paths for development and improvement of research, study process and organization. RTU Quality Policy is reconciled with the ENQA standards and guidelines. RTU Excellence Approach and Quality Policy are reciprocally integrated documents, which determine that RTU employs the EFQM quality model.

Starting with December 2018, RTU has been a member of the European Foundation for Quality Management, having joined the global quality cooperation network.

RTU Excellence Approach (see the figure in file "RTU Excellence Approach") has been elaborated in order to promote purposeful development of the University as an excellent organization, and RTU Constitution, Strategy and Quality Policy are integrated therein; it is based on the Standards and Guidelines for Quality Assurance in European Higher Education Area (ESG) developed by the European Association for Quality Assurance in Higher Education and the basic principles of the EFQM Excellence Model.

The structure of RTU Excellence Approach (see the figure in file "Structure of RTU Excellence Approach") is designed in accordance with the criteria of the EFQM Excellence Model and forms the basis for the maintenance of performance at a high level, a prerequisite for its continuous improvement, as well as for achievement of sustainable results of RTU activities and excellence. Student results are a separate criterion, they are also in part transferred to the main activity results; thus, the quality of the study direction is closely related to RTU quality management.

To promote introduction of the model of the EFQM total quality management system, as well as to assist in the compilation of a self-assessment report, a working group was established at RTU on 29 September 2017 (Rector's order No 01000-1.1/225), which comprised representatives of RTU administration, faculties and Student Parliament (18 in total). Several of them are administrative and academic staff representatives and doctoral students related to this study direction:

- Head of the working group
    - Artūrs Zeps, , RTU Vice-Rector for Development;
- Coordinator of the working group

    - Juris Iljins, Director of the Quality Management and Document Management Department.
- Members of the working group
    - Elīna Gaile–Sarkane – Chair of RTU Senate;
    - Ugis Bratuškins – Dean of the Faculty of Architecture;
    - Laine Kučinska – Director of the Department of Public Affairs;
    - Zane Rostoka – Head of Personnel Department;
    - Elīna Ločmele – Head of the Department for Research Coordination and Information;
    - Laila Eliņa – Head of the Scientific Activity Coordination and Information Centre;
    - Uģis Citskovskis – Deputy Director of the Study Department;
    - Dace Paule – Director of the Project Management and Development Department;
    - Inese Kundžena-Kundženova – Head of the Planning and Economic Analysis Unit;
    - Laura Zaķe – Head of the Department of Financial Management of Projects;
    - Inga Lapiņa – FEEM Vice-Dean for Academic Affairs;
    - Aldis Balodis – Vice Dean for Academic Affairs of the Faculty of Mechanical Engineering, Transport and Aeronautics;
    - Aldis Balodis – Vice Dean for Research of the Faculty of Electrical and Environmental Engineering;
    - Deniss Ščeulovs – Director of the Institute of Business Engineering and Management
    - Māris Turks – Dean of the Faculty of Material Science and Applied Chemistry;
    - Representative of the Student Parliament.

Potential problems were identified and suggestions for improvement of RTU Quality Policy, including improvement of academic quality, were made at the meetings of the working group. In the period of one year, the working group considered compliance to nine criteria of the EFQM model and analysed 101 sub-criteria, having identified 133 problems in total and having made 146 suggestions. The priority problems were included in RTU Development Plan as tasks set for a definite term to be solved by the respective organizational units. Quality model review report is drawn up with regard to the Quality System, which identifies the areas that should be improved. Performance indicators and results of student polling are integrated in RTU Quality System.

Application of RTU Excellence Approach is based on process-oriented activities and includes clear process flow and their interaction. Striving for excellence, RTU actively works on process planning, definition of its aims and interaction analysis. RTU has developed criteria and methods for ensuring efficient process operation and management. RTU conducts the process analysis and provides recommendations and suggestions on process improvement, which are discussed with process managers and persons responsible for process procedures; later they are approved as performable tasks with a definite completion term. Task creation and control tools inbuilt in the Document System, reports on task performance at the organizational unit level provide the necessary support for achievement of performance indicators of the annual aims and tasks set in RTU Strategy. For example, development of the uniform study programme application structure and assessment criteria is one of the tasks for the process “Provision and Organization of Studies” approved in the system with the completion term set until academic year 2019/2020; they were developed and approbated on the study programmes developed within SSO 8.2.1 project.

The departments and institutes, faculty councils, the service of the vice-rector for academic affairs, the service of the vice-rector for development, the student parliament and the RTU Senate are involved in ensuring internal quality of studies at RTU. These institutions comprehensively evaluate the study directions and programmes to be newly created, as well as changes to study directions and programmes, evaluate annual self-assessment reports of study directions. The internal quality assurance mechanism of studies at RTU is functioning at the level of administration, faculties, study

directions and study programmes of the university.

Study Direction Committees at RTU supervise academic activities in the respective study direction and are responsible for curriculum of the study programmes within the study direction, including accreditation of the study direction. Members of student self-government are involved in ensuring the quality of the study direction and study programmes implemented therein; they actively participate in the work of the decision-making bodies of the University: RTU Constitutional Assembly, RTU Senate, RTU Senate commissions and faculty councils.

At the level of faculty and study direction, internal quality is ensured by the FEEE Council, the Study Direction Committee and the director of the study direction, director of the study programme, administration of the institute or department implementing the study programme, as well as the FEEE student self-government. Control of internal quality at the level of faculty and study direction is ensured by the vice-dean of the faculty for studies or the person or committee delegated by them.

The main quality indicators used for monitoring and evaluation of development goals of the RTU study direction “Environmental protection” are:

- scientific and practical significance of the results of study courses, diploma papers, projects, scientific articles (based on internal and external evaluations);
- competence and qualifications of academic staff (based on internal (student survey) and external evaluation);
- results of evaluations by international students, external evaluators, cooperation partners, industry non-governmental organisations, associations, etc.;
- quality, added value, use of implemented projects, studies and scientific papers;
- development of new courses and modules, as well as new scientific directions.

Supervision and inspection of the implementation of the study process of study programmes “Environmental Science”/”Environmental Engineering” implemented by RTU IESE take place at several levels:

- control attendance of course classes. In order to determine the quality of the study courses implemented by teaching staff, control attendance of course classes is ensured during the implementation of course classes (at least one attendance during the course) by a committee of 2 persons (teaching staff of the institute). The committee participates in the class and provides a written opinion on the implementation of the course, incl. course content, professionalism of teaching staff, teaching methods, etc.
- opinions of students after the specific class, incl. notebook system (for more information see section 2.2).
- end of the course. Student survey, the procedure of which is determined by the Regulation approved by the RTU Senate “On Student Surveys for the Evaluation of the Study Process”, is performed after each study course. Survey results of each course are summarised at the institute meeting and changes to the content of the study course and course implementation conditions, if needed.
- at the end of the year of studies. Every year, in June or July, the institute organises a meeting with employers, including to discuss industry trends. Taking into account recommendations of employers, changes to the content of the course and to the content of study programmes are made.

The study programme and scientific activities implemented by RTU IESE fully comply with and are based on observation of ethical principles in study and research processes. Ethical principles are defined in the RTU IESE strategy, as well as in the guidelines for drafting course papers, diploma

papers, presentations.

The compliance of internal quality of the study direction “Environmental protection” with the requirements of higher education is ensured based on Standards and guidelines for quality assurance in the European Higher Education Area, the RTU Development Strategy, the FEEE and IESE development strategy.

In order to ensure high quality of studies, RTU IESE is working in several directions:

- compliance of all the study direction and individual courses with the growing requirements for the quality of study, defined by the current level of development of technology and solutions, as well as science. Information on the quality of the study direction and individual courses is obtained from student surveys in the ORTUS system, surveys of graduates, surveys of employers, and from meetings between lecturers and student groups or individual students.
- inspection and ensuring the quality of lecturers. In order to determine the quality of the study courses implemented by teaching staff, control attendance of course classes is ensured during the implementation of course classes. The committee participates in the class and provides a written opinion on the implementation of the course, incl. course content, professionalism of teaching staff, teaching methods, etc. Information on the quality of lecturer’s work is obtained also from the ORTUS system.

For RTU IESE to be able to manage and improve performance in the field of environment, as well as to demonstrate the importance of environmental management in governance of higher education institutions to students and academic staff, an RTU IESE Environmental Management System was created in 2007 and is still maintained. It is part of the RTU IESE strategy. The environmental management system has been developed in accordance with the basic principles of the environmental management system in accordance with the conditions of LVS EN ISO 14001:2017. The Environment Management System of the Institute has been documented, is implemented and maintained in accordance with the requirements of the standard, reviewed annually, reports are created and it is updated as needed. The environmental management system is updated with participation of students (Master level students), as well as the academic and service staff of RTU IESE. This is an effective tool for prevention of shortcomings and non-conformities in the activities of IESE. An “Environmental Management System Manual” has been developed for the improvement of administration of studies. The “Do” phase of the PDPR model provides that the discussion of the new and completed tasks of the study programme takes place collegially – at meetings of the institute. Each task has a responsible lecturer or employee of the institute is appointed. The “Check” phase of the PDPR model provides that the responsible lecturer or employee, who regularly reports on the progress of the corresponding task at the institute’s meetings. Students from respective study programmes also participate in such meetings of the institute. However, the main task of this phase is to check the impact of the measures planned and implemented on improving the quality of studies compared the requirements and goals, using feedback from students, graduates and employers, as well as criteria such as achievements, number and quality of publications, and so on. The ORTUS portal plays a very important role in gathering information. The “Act” phase means that IESE reviews, evaluates, improves the implementation of the introduced measure and goals to be achieved. It is therefore envisaged that the IESE Strategy for 2015-2020 strategy was revised annually, ensuring continuous development and changes of IESE in line with ongoing external changes and needs. The implementation of the strategy is regularly discussed at the meetings of IESE.

In order to improve the study process, the observation of lectures of lecturers employed in the programme (attending and watching classes) continues. According to RTU rector’s order No

01000-1./2/27 of 19 March 2015, observation of classes should be ensured in undergraduate and higher-level study programmes. A minimum of two classes in the courses of the study programme carried out by the organisational unit and two classes organised by another organisational unit should be included in the observation of classes each semester. It is recommended to base the choice of classes on the results of student survey. The results of observation of classes are summarised and analysed in the department meetings, where recommendations for lecturers to improve the quality of lectures and seminars are formulated. In general, the results of observation show that lecturers use modern training methods as well as technology capabilities. Lecturers are knowledgeable in their field. The main function of observation is not control, but rather exchange of experience. Following the observation of a class, recommendations are provided to the teaching staff for improving the content of the study course or methodological work, taking into account the opinions of both the observer and student surveys. During the visit, the observer watches and analyses how the content of the studies is being realised. Observation of another colleague's academic activities also contributes to improving the critical thinking and analysis skills of the observer. Observations are organised in such a way as not to create unnecessary tension for lecturers, and this activity takes place in a collegial manner. 16 observations of lecturers are organised in each year of studies in the study programmes of the study direction "Environmental protection".

2.2. Analysis and assessment of the system and the procedures for the development and review of the study programmes by providing specific examples of the procedures for the development of new study programmes within the study direction (including the approval of study programmes), the review of the study programmes, the aims, and regularity, as well as the stakeholders and their responsibilities. Description of the mechanism for obtaining and providing a feedback, including with regard to the work with the students, graduates, and employers.

Study programme development and revision processes are regulated according to the "Procedure for Application, Elaboration and Amendment of the Study Programmes" (published on https://www.rtu.lv/writable/public_files/RTU_studiju_reglaments_4.6._programmu_izstradasanas_kartiba_29.04.2019.pdf (Latvian only)); see the file of Appendix 06 of the list of Internal regulations), which in detail specify activity sequence and parties involved, starting with drawing up an application for new study programme elaboration and finishing with study programme closure. Procedures are reconciled with the effective national regulatory enactments pertaining to study programme licensing and amendment.

Revision of the study programme curriculum is the responsibility of the Study Direction Committee. The responsibilities and activities of the committees are regulated by the "Regulation on the Study Direction Committee" (approved at the RTU Senate on 26 April 2021, Minutes No 649; published on https://www.rtu.lv/writable/public_files/RTU_studiju_reglaments_4.7._studiju_virziena_komisijas_noliktums_29.04.2019.pdf (Latvian only) see the file of Appendix 07 of the list of Internal regulations).

Expert assessment of the study programme is performed by the Study Direction Committee, then – by the Faculty Council or the councils of several faculties involved. The expert assessment procedure is finalized by the Study Department. The Study Direction Committee evaluates the quality of the draft study programme and the compliance of its curriculum to the planned aims and tasks.

In order to analyse study directions and to receive feedback, RTU has developed a polling cycle:

- When starting studies at RTU, a student survey is conducted about expectations from studies, availability of information, admission process. The survey takes place electronically on the ORTUS portal;
- Each semester, the polling of the students at a study programme is conducted to find out student opinion about instructor's work quality and obtain evaluation of the study programme. Polling is conducted electronically in ORTUS portal, the results are received by each instructor personally and the head of the organizational unit;
- After each graduation round, polling of the graduates of Bachelor and Master programmes is conducted. The results are taken into consideration in the improvement of the study programmes within a study direction and discussed at methodological seminars.
- Annual polling of Doctoral students and Doctoral alumni has been introduced, it is also planned to conduct surveys of Doctoral entrants. The polling on the admission procedure and study process has been launched.
- It is also planned to run regular centralised polling of RTU employers. Polling of employers presently takes place at the end of internship of each student, as well as within the scope of development of study programmes.

Starting from spring semester of the academic year 2020/2021 it is planned to introduce a mid-semester survey.

The following mechanisms are used to obtain feedback from employers. **RTU Council Convention**, composed of representatives of different sectors, advises RTU Senate and Rector on the RTU Development Strategy. It has the right to propose an issue to the Senate and the Constitutional Assembly. The RTU Strategy and its development program are presented in the RTU Council Convention, the decision-making bodies, as well as to cooperation partners, industry associations and leading companies, with feedback and suggestions being incorporated into the RTU documents. The involvement of stakeholders and the realization of major projects is the responsibility of the Vice-Rector for Strategic Development. He clarifies existing needs, coordinates key priorities and activities, implements recommendations and promotes the sustainable development of the RTU. Employers, as providers of the internship of RTU students, after completing the practice, prepare online feedback on the knowledge and skills of the student, thereby also assessing the relevance of the knowledge provided by the study program to the needs of the industry. Employers' feedback is obtained also from the Council Convention, composed of representatives of different sectors and industry associations, as well as from the assessments provided by employers on the portal prakse.lv (RTU is the most recommended university at https://www.prakse.lv/top (Latvian only) for several consecutive years).

Employers also actively participate in the implementation of the study direction by participating in Study Direction Committees, Councils of Professors, as well as graduation paper committees and reviewing process. The Study Direction Committee analyses recommendations from employers and external experts, which are used as the basis for improvement of the study programmes. For more information on the involvement of employers in decision-making see section 5.1.

Feedback within study programmes is received through **every semester student polling**, regulated by the "Regulation on Student Polling for Assessment of the Study Process" (approved at the RTU Senate on 27 January 2014, Minutes No 577; published on https://www.rtu.lv/writable/public_files/RTU_anketesanas_nolikums.pdf (Latvian only)), see the file of Appendix 20 of the list of Internal regulations).

As part of the study direction, one of the types of feedback is the **notebook system**. It works in the following way: a notebook is issued to each Master student at the beginning of the year of

studies, where each students signs specifying his/her name, surname and year. The notebooks are handed out to students at the beginning of each class, so that students can express their opinions, suggestions, possible improvements and complaints about the specific class. In order to encourage students to fill their notebooks, the teaching staff reminds about the possibility of giving feedback and recommendations for improvement the quality of the study process. In the Bachelor level study programme, complaints and suggestions regarding the progress of the study process are summarised by study course leaders and passed on to the representatives of the RTU Self-Government, who discuss them with the administration of the study programmes during a meeting.

As regards doctoral study programmes, RTU has a Doctoral School established in May 2010 with a view to establishing a support structure for young researchers within the framework of the Department of Doctoral Studies. The main tasks of the Doctoral School are to promote the professional improvement of doctoral students, the improvement of the quality of research work, the establishment of interdisciplinary and inter-institutional cooperation among young researchers, as well as the involvement of students in science and continuation of studies by enrolment for doctoral studies. For the implementation of these tasks, the Doctoral School organises a variety of activities (seminars, summer schools, discussions, etc.), advises and informs doctoral students on different support opportunities, evaluates the existing research environment and makes recommendations to improve it, and cooperates with different foreign partners (e.g. CERN (European Organization for Nuclear Reserach)). At the beginning of doctoral studies in the study direction of “Environmental protection”, **future doctoral students** complete a survey, overall attitudes and expectations at the beginning of their studies are learned. There is another survey at the end of studies to assess the overall satisfaction of the graduate with the study process, the quality of studies and confidence in the knowledge and skills acquired during the study process. Feedback to doctoral students within the study direction “Environmental protection” is also provided through semesterly reports (first year students at least twice per semester, students of other year at least once per semester), which take place every Monday according to a previously prepared schedule and with participation of doctoral students and teaching staff with a doctoral agree. The aim of such a activity is to provide comprehensive recommendations for drafting of a successful doctoral thesis for doctoral students, as well as to promote progress in drafting a doctoral thesis. Displays of progress of doctoral students have proved their effectiveness – the study programme “Environmental Science” (currently – “Environmental Engineering”) has the highest number of defended doctoral theses in RTU.

The **role of students** in the improvement of the study process is particularly important. On 9 June 2020, the RTU FEEE Council approved the Rules of Procedures of the Student Self-Government (SG) of the Faculty of Electrical and Environmental Engineering. All members and activists of the RTU FEEE SG are bound by these rules. The rules set goals of RTU FEEE SG, including in maintenance of the quality of studies, structure, mechanisms of convention of general meetings and decision-making, election procedure and inclusions of members, rights and duties of SG positions, the goals of RTU FEEE SG are: (*) Representation of the interests of FEEE students in highest decision-making bodies, faculty and university organisational units. (*) Improvement of the quality of studies. (*) Promotion of scientific activities of students. (*) Improvement of the social environment. (*) Development of cultural life. (*) Promotion of sporting activities. (*) Integration of foreign students of the faculty. (*) Promoting the sustainability of Student Self-Government.

Courses and seminars on latest teaching methods are organised for academic staff, as well as attendance of courses to improve qualification is promoted. Academic staff and heads of study programmes participate in different experience exchange activities cooperating with universities of other countries, meeting representatives of respective institutions and businessmen, as well as discussing among themselves latest developments in the sector, research papers and projects of

students by analysing their results.

Study programme course abstracts and course programmes, methodological materials, newest educational literature and methodological instructions for study papers (reports, study papers, internship reports and graduation papers) are reviewed once an academic year.

In order to receive feedback from RTU graduates, RTU Alumni Association has been established. It actively operates at the University (http://alumni.rtu.lv/ **(Latvian only)**, https://www.facebook.com/RTUAlumni/ **(Latvian only)** and runs an online community platform (https://rtuconnect.net/ **(Latvian only)**), which aims at developing alumni traditions. The Association organizes various events, which bring graduates back to the University, allow for networking, cooperation among the graduates and with the University, and integration in University activities. RTU Grand Graduation Ceremony is a major event introduced by the Association; it gathers the respective year graduates from all nine RTU faculties, academic and general staff, as well as guests.

Feedback with graduates of the study direction "Environmental protection" is ensured as follows:

- **cooperation with graduates in academic and scientific research areas of RTU IESE**. Former graduates (in particular graduates of Master and doctoral study programmes) of the study direction "Environmental protection" integrate successfully in the labour market of the sector and currently get involved as leading experts of the industry in academic and scientific research work of RTU IESE (visiting lectures, definition of problem situations for topical of graduation papers, etc.), as well as actively attend the upskilling courses and informative thematic seminars organised by RTU IESE.
- **reunion of graduates**. In 2015, RTU IESE started a tradition to organise reunions of graduates of the study direction "Environmental protection" every 5-7 years. The first such event was held in November 2015 gathering graduates from study programmes "Environmental Science" from 2003 to 2015. Existing and former teaching staff of RTU IESE also participated in the reunion. The organisation of the reunion in 2015 was symbolic – this was the first year, when RTU FEEE moved from the old building of the faculty (Kronvalda Boulevard 1) to the newly built FEEE building at Azenes Street 12/1. The graduates appreciated the achieved progress in the improvement of study infrastructure and scientific research laboratories.
- **Communication of IESE employees (former graduates of IESE) with course mates**. RTU IESE uses communication through IESE employees (former graduates of IESE) as a successful feedback with former graduates of the study direction. Almost every year graduates of study programmes of the study direction "Environmental protection" (Bachelor, Master and doctoral) continued with doctoral studies and later continued working at RTU IESE. Graduates meet every years and during such meetings they obtain information, for example, on current employment, education obtained in addition, etc., which is later successfully used for the preparation of reports.

The above-mentioned techniques were used in the development of the study program "Environmental Engineering". Taking into account that RTU VASSI has considerable experience in managing study programs "Environmental Science", the accumulated experience from the management of existing study programs was used in the development of new study programs.

"Procedure of Application, Development and Amendment of the Study Programme" https://www.rtu.lv/writable/public_files/RTU_studiju_reglaments_4.6._programmu_izstradasanas_kartiba_29.04.2019.pdf (Latvian only)

"Regulations of the Study Direction Committee"

https://www.rtu.lv/writable/public_files/RTU_studiju_reglaments_4.7._studiju_virziena_komisijas_nolikums_29.04.2019.pdf (Latvian only)

The document “On Student Surveys for the Evaluation of the Study Process” approved by RTU Senate can be seen in the file of Annex 20 of the list of Internal regulations.

2.3. Description of the procedures and/or systems according to which the students are expected to submit complaints and proposals (except for the surveys to be conducted among the students). Specify whether and how the students have access to the information on the possibilities to submit complaints and proposals and how the outcomes of the examination of the complaints and proposals and the improvements of the study direction and the relevant study programmes are communicated by providing the respective examples.

Student complaints and proposals are considered in compliance with "Procedure for Submission and Examination of RTU Students' Proposals and Complaints" (published at https://www.rtu.lv/en/university/proposals-and-complaints and attached in the file).

The Procedures stipulate how RTU students may submit suggestions and complaints concerning the study process and other issues and determine the terms for consideration and reply (if the applicant has provided contact details) of applications and summary of application statistics.

A student may submit the Application electronically or in person to the RTU Career Support and Services Division. Having receive a written Application, an employee of the RTU Career Support and Services Division determined the provider of a reply by topic, registers the Application, scans and electronically sends it to the responsible organisation unit for the provision of a reply.

Electronically, the Application may be submitted on the RTU ORTUS portal (https://ortus.rtu.lv) or on RTU website (https://www.rtu.lv/) by filling out an electronic form. Replies to proposals and complaints of students are provided within ten working days of receiving the application. The period of examination of an Application is extended, if there is an objective need, but not longer than for one month of receiving the Application. The head of the RTU Career Support and Services Division controls that the time limit for examination of any Application is observed and once a year, after the end of the year of studies summarises the Application statistics and submits it to RTU administration and the Quality Management Division. The Quality Management Division analyses the Application statistics and evaluates the process of examination of Applications based on the assessment of the process provided by submitters of the Applications.

RTU a total of 137 complaints/proposals have been received between 12 August 2019 and November 2020, 11 of which have been submitted anonymously. Of the submissions 30 were complaints, 80 were problems and 27 were suggestions across eight topics (subject: the number of complaints or problems / the number of proposals received):

- Study process: 53 / 10
- Sports: 4 / 2
- IT issues: 10 / 5
- Maintenance of infrastructure issues: 7 / 3
- Accommodation related: 7 / 1
- Scholarships: 3 / 1
- Foreign students' questions: 11 / 3

- Library 1 / 0
- Other: 16 / 2

The evaluation of the complaints submitted about the study process showed that 10 of them were related to the planning of timetables of studies, failure to post them on time in the ORTUS e-studies environment, while nine are related to communication between the teaching staff and the student. Complaints were also received about the planning of online and on-site lectures – students are unable to get from their home to the faculty and vice versa during pauses between lectures. Proposals for the creation of new study programmes, introduction of additional classes, organisation for training for teaching staff related to the use of *MS Teams* and *Zoom* were received. It is proposed to consider purchasing a subscription to *Grammarly premium* for students.

In household matters, complaints were received about cleanliness of common use toilets and quality of water in drinking water points. In dormitories – regarding the need for tumble driers.

IT matters are mainly related to the load on the system, due to which students are unable to log in to the ORTUS portal. A recommendation has been received on security of the ORTUS portal link, which raise concerns in students regarding sending of their data.

Complaints on sports matters are related to the amount of money received for sporting opportunities by Bachelor (100 euro) and Master (10 euro) students.

IT issues and suggestions were related to improving ORTUS or inserting incorrect schedules.

Other contains a complaint on potential infringement of person's rights and two proposals for infrastructure improvement opportunities – creation of bike racks with a roof, lack of them around faculties and student dormitories, as well as applications for study payment matters.

In household matters, complaints were received about cleanliness of common use toilets.

Any types of complaints or recommendations can be submitted through the student self-government. For example, a student has a complaint/recommendation. The student sends it to the self-government, the self-government sends it to the study division or responsible persons, who might solve the problem or examine a recommendation.

Students may transfer any complaints or recommendations to the study administration and teaching staff through the study course leader. It is a person elected by students, who undertakes responsibility for communication with teaching staff and informing of course mates on any types of changes, which teaching staff or the study division wants to make known to students. The course leader is each study course is often visible and accessible to the student in person.

To create even more student oriented study environment for RTU students and RTU teaching staff have the opportunity to write letters to the RTU rector Leonīds Ribickis. Written letters can both anonymous and signed. In this way, anyone can ascertain that the recommendation/complaint reaches the highest section of the RTU management structure. Students and teaching staff have such an opportunity in the RTU study portal ORTUS.

In addition, within the scope of the project "SO 8.2.3 Development of Efficient Management of Riga Technical University", which aimed to improve the quality of content of study programmes and, using the available resources effectively, to ensure better governance at RTU and improvement of competences and skills of management personnel, it is planned to create an e-solution for acceptance and processing of students' applications, complaints and proposals within the RTU *Moodle* system and to implement it. As a result of this action, it is planned to introduce a system where student complaints and proposals could be submitted electronically and in one place and processed in this system. On the basis of submitted complaints and proposals, an analysis will be

carried out and on the basis of the conclusions there will be an opportunity to improve the progress of the various processes at RTU. This system will also ensure a more efficient circulation of information and the possibility to keep track of how quickly the organisational units respond to submitted complaints and proposals. It is also planned to introduce a functionality for submitting various applications in this system in order to make the work of the Student Service Centre more efficient and make access of students to different processes more flexible.

Within the study direction, Bachelor and Master students have meetings with the administration of the study direction at the beginning of the year of studies, so that 1st year students are acquainted with the teaching staff and the study programme. Students of the 2nd and 3rd year provide feedback on their last year of studies from student's point of view, as well as during the meeting, students have the opportunity to make recommendations for the development of the study process.

Every year, there is a meeting of the study direction, where the study process to date is reviewed and the recommendations received for the development of the study process are discussed.

Several of the submitted complaints/proposals and proposals are related to the faculty implementing the study direction.

The administration of RTU IESE constantly monitors the study process and always listens to suggestions and complaints of students and sees that all the issues are resolved. Following the initiative of RTU FEEE Student Self-Government, meetings with the administration of the RTU study direction "Environmental protection" and FEEE Student Self-Government representatives (often with participation of course group leaders) are organised every semester to discuss improvements to the study process and listen to proposals on matters of interest for students.

As mentioned above, in section 2.2, one of the most effective prevention mechanisms in monitoring the study process in the Master's degree study programmes implemented by RTU IESE is the system of student "evaluation notebooks". The written opinions of students on the quality of the class after each class and acquainting of the responsible teaching staff and administration of the study programme with these opinions on a regular basis enable them to follow the quality of teaching, student complaints and suggestions on the content of classes, the form of implementation of the classes, etc. In a summarised way, the opinions are regularly viewed at RTU IESE meetings and solutions are sought. In the Bachelor level study programme, complaints and suggestions regarding the progress of the study process are summarised by study course leaders and passed on to the representatives of the RTU Self-Government, who discuss them with the administration of the study programmes during a meeting.

A few complaints were received in writing within the study direction during the reporting period (since academic year 2013/2020), all of them were examined in accordance with the established procedure. For instance:

- In 2013, there was a complaint about the assessment of the reviewer of a Bachelor's thesis from a Bachelor level student of the study programme "Environmental Science". The student submitted an appeal regarding the assessment provided by the reviewer regarding his Bachelor's thesis. A committee for evaluation of the process of drafting graduation papers was created. In relation to the complaint, the commission studied the situation, listened to the opinions of the parties involved and evaluated all the received document – the student's application, a written explanation of the situation, an explanation of the head of the department and the director of the study programme. In accordance with the guidelines for drafting of graduation papers, a new independent reviewer was assigned. The assessment of the new reviewer matched the assessment of the previous reviewer. Following the evaluation of the situation the Committee decided to leave the reviewer's assessment in force.

- In 2015, there was a complaint about the examination assessment (unsuccessful result) within a study course of the Master level study programme “Environmental Science”. An appeal committee was created, which was led by the Dean of FEEE, professor Dr.sc.ing. Oskars Krievs, with participation of the responsible teaching staff of the study course, an independent teaching staff and a student representative. In relation to the complaint, the commission studied the situation, listened to the opinions of the parties involved and evaluated all the received document – the student’s application, a written explanation of the situation, an explanation of the head of the department and the director of the study programme. In accordance with the established procedure the conflict resolution procedure included passing of a new examination. Since the assessment of the repassed examination was identical, the appeal committee decided to leave the existing assessment in force.
- In 2019, there was a complaint about the lecturer of the study course “Civil Defence”. A complaint was received from a student of the Master’s study programme “Environmental Science” on unacceptable pedagogical approach not respecting gender equality principles, which is not acceptable in the study process. The Student Parliament, the administration of the organisational unit responsible for the implementation of the study course and the administration of the study programme “Environmental Science” were involved in the resolution of the problem. As a result of that, the teaching staff apologised in writing to the entire year for unacceptable use of language in the implementation of the study course and this satisfied all the parties involved.

Within the scope of the study direction, complaints of students, for example, on low quality of individual study courses in the e-environment implemented during COVID-19 in spring 2019/2020 are often resolved preventively: students report on existing problems in the specific course and the administration of the department or study programme solves this with responsible teaching staff in the form of discussions.

2.4. Provide information on the mechanism for collecting the statistical data, as developed by the higher education institution/ college. Specify the type of the data to be collected, the collection frequency, and the way the information is used to improve the study direction.

RTU Quality Policy provides the framework for implementation of the Strategy, the paths for development and improvement of research, study and organization processes. RTU Quality Policy and implementation thereof employ a fact-based approach - decisions are based on the acquired objective data, information analysis and monitoring.

RTU draws up quality reviews based on the analysis of processes and their results. Quality reviews are drawn up once a year, summarizing the data on performance indicators of RTU administration, core activities and support processes.

28 performance indicators characterizing process quality are set for one of the core RTU activity processes "Organization and Management of the Study Process". The data are summarized once a year for the previous academic year by study level and study programme.

Performance indicators characterize the quality of entrant enrolment process, study process planning and the quality of implementation of studies - implementation of the initial admission plan, number of matriculated entrants vs. number of entry applications, number of entry applications with RTU as the first priority vs. all matriculated students, number of graduates vs. total number of

students, number of exmatriculated students (except for graduates) vs. total number of students, number of students with academic arrears vs. total number of students, number of students exmatriculated due to academic failure vs. total number of exmatriculated students, number of timely signed learning agreements vs. all signed learning agreements, etc.

Observing the current study programme performance, reachable qualitative or quantitative aims are set for the indicators when possible, e.g., 45-56% of RTU Bachelor programme graduates continue studies at Master programmes (data on 2014-2018) and 42-50% of graduates of the Master programme continue studies at the doctoral study programme (data on 2017-2019).

The data in the quality review that is submitted to RTU administration are analysed by study level, by faculty and study direction. Indicators of numerous study programmes are compared with the general average RTU level.

The Study Department organizes further review and data forwarding to the faculties and directors of the study programmes, whereas process managers introduce the necessary improvements. Changes to the approved processes occur in cooperation with quality management specialists.

In addition to performance indicators characterizing study process quality, which are summarized in the review, a study programme quality visualization tool has been created in Power BI environment, which will be used to reflect Bachelor and Master study programme performance in an academic year with the help of radar chart. In the chart, study programme results at each study level will be presented comparatively - in relation to the best performance at the respective level. The tool is envisioned for the directors of the study programmes and faculty administration to facilitate collection of transparent information on each study programme performance considering numerous indicators simultaneously, as well as to rank the programme in relation to the best performance. It will be also possible to compare the programme performance in several academic years. The tool is currently at the development and test phase. Performance indicators of 11 study programmes are planned to summarize in the radar chart: academic staff vs. number of students, academic staff with scientific degree, ratio of graduates to the number of matriculated students, number of students who continue studies (not exmatriculated), proportion of foreign students, number of outbound mobility students, Bachelor programme graduates who continue studies at RTU, number of matriculated students from the respective Bachelor study programmes, average assessment of the study programmes in student polls, number of study materials published in ORTUS learning environment and applicability thereof, as well as financial revenue generated by study programmes per student. Comparative reviews of the study programmes results will be available to directors of all RTU study programmes. It is planned to develop and improve the tool for collection of statistical data necessary for evaluation of the study programme performance and data visualization within the framework of the project “SO 8.2.3 Development of Efficient Management of Riga Technical University”. The objective of the project is to improve the quality of content of study programmes and, using the resources available in an efficient way, to ensure better governance of RTU and improvement of competencies and skills of management staff. One of project activities directly focuses on the improvement of the statistical data collection mechanism at RTU, namely the **study analytics solution**. To introduce information management tools which analyse different data in data warehouses of universities. To follow the indicators set by university administration and to obtain data in real time and upon request. The newly created system would analyse different data, for example, attendance of classes by students, student count, number of state budget funded study places, etc.

In addition, RTU Study Department summarizes and annually submits until 15 October to the Central Statistical Bureau and the Ministry of Education and Science a statistical review "Review of the University, College at the Beginning of Academic Year 20_/20_" (Cabinet Regulations No 812 of

20 December 2016, Appendix 5 (https://likumi.lv/doc.php?id=287576 (Latvian only)). The Review contains the following information (sources of information and/or RTU employees responsible for data collection are indicated in parentheses).

- Distribution of students by study programme (Study Management System| Reports | University Review at the Beginning of the Academic Year).
- Enrolment results (University Review at the Beginning of the Academic Year).
- Students having obtained a degree or qualification in the academic year (University Review at the Beginning of the Academic Year).
- Distribution of enrolled students by age (University Review at the Beginning of the Academic Year).
- Distribution of students by age (University Review at the Beginning of the Academic Year).
- Distribution of students having obtained a degree or qualification by age (University Review at the Beginning of the Academic Year).
- University staff in the reporting year as of 1 October (Administrative Office).
- Premise floor area (the Unit of Legal Provision in Real Estate Issues).
- University revenues in the previous year (Planning and Economic Analysis Unit).
- Budget expenditure of the University in the previous year (Planning and Economic Analysis Unit).
- Number of students, who reside in student hostels (Study Organization Unit).
- Number of students by the language of instruction. Distribution of enrolled students by place of residence (University Review at the Beginning of the Academic Year).
- Number of mobility students in the total number of students (University Review at the Beginning of the Academic Year; International Cooperation and Foreign Students Department).
- Number of mobility students in the total number of students who have obtained a degree or qualification (University Review at the Beginning of the Academic Year; International Cooperation and Foreign Students Department).
- Own revenue from allocation of the mobility student tuition fees by country in the previous year (International Cooperation and Foreign Students Department).
- Revenue from allocation of foreign financial study grants by country in the previous year (Project Financial Management Unit).
- Revenue from allocation of foreign financial study grants for research by country in the previous year (Project Financial Management Unit).

Summarized statistics on the number of students/graduates is used for the following purposes:

- Improvement of the study direction. For example, if at some study programme the annual number of student dropouts is much higher than the number of graduates who obtained degree/qualification, the causes of such a situation are sought for with scrutiny.
- If at some study programme the number of enrolled students decreases annually, the cause should be identified, and potential programme closure should be considered.
- Allocation of financing (for state budget funded seats).
- Compilation of RTU information materials, press, etc.

2.5. Description and assessment of the integration of the standards set forth in Part 1 of the ESG. Specify which of the standards are considered a challenge and which require special attention.

In the context of the study quality assurance policy, one of the challenges to be emphasized is the organization of the RTU working environment so as to motivate the staff and students to realize the mission, vision and goals of the university and to ensure the excellent quality of the University activities. In the context of study programme development and validation, one of the challenges is to reach agreement on the common structure and curriculum of separate sections for the study programmes submitted for licensing. It is promoted by the Study Department, which deals with developing the study programme description template and completing the sections applicable to the RTU in general. In the context of student-centred learning, teaching and assessment, perceiving the development of curriculum and study forms as one of the most significant challenges of today's higher education, RTU has established the Centre of Academic Excellence, which acts as a bridge between teaching and learning cultures. The challenge lies in a relatively low activity of local students in using exchange programmes for studies abroad. To compensate for it RTU promotes international opportunities by inviting guest lecturers and conducting study courses with foreign students. In the context of information management, it is considered how the data on employment of graduates from the State Revenue Service could be linked to specific study programmes. In addition, in this context, the question of choosing the most appropriate method for mapping study programmes is evaluated taking into account the great variety of RTU study programmes. Active professional development of the academic staff is also taking place within SSO 8.2.2 project "Strengthening the academic staff of Riga Technical University in the areas of strategic specialization".

Compliance of the study programmes in the study direction with ESG Part 1 standard:

Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG) Part 1	**Compliance with ESG will be ensured within the scope of study programmes**
1.1. Policy for quality assurance	Compliance with ESG will be ensured based on: 1) RTU Quality Policy (https://www.rtu.lv/lv/universitate/dokumenti/kvalitates-politika (Latvian only)); 2) Approved indicators of the RTU Development Strategy for 2021-2025 (https://www.rtu.lv/en/university/strategy); 3) Internal regulations on the procedure of development of process descriptions.

1.2. Design and approval of programmes	Compliance with ESG will be ensured based on RTU Studies Regulations(https://www.rtu.lv/lv/studijas/bakalaura-limena-studijas/studiju-reglaments (Latvian only)) and what they describe: 1) Regulations on the Register of Study Courses; 2) Procedure of Application, Development and Amendment of Study Programmes; 3) Regulations of the Study Direction Committee; 4) Survey on students' expectations from the study process when starting studies in the first year; 5) RTU's uniform requirements for study programmes.
1.3. Student-centred learning, teaching and assessment	Compliance with ESG standards and guidelines takes place in accordance with: 1) Individual study plans for students with excellent achievements; 2) Procedures for recognition of previously acquired education; 3) Study course evaluation questionnaires where students can express their opinion regarding teaching staff; 4) Plan for strengthening academic staff (SO 8.2.3 project "Development of Efficient Management of Riga Technical University"); 5) Activities carried out by the Centre for Academic Excellence; 6) Regulations for Assessment of Learning Outcomes.

1.4. Student admission, progression, recognition and certification	Compliance with ESG standards and guidelines takes place in accordance with: 1) Enrolment Rules; 2) RTU Senate meeting decision of 25.03.2019 “On lists of study programmes for enrolment, tuition fee, applicant registration fee and academic failure passing fee”; 3) RTU’s uniform requirements for study programmes; 4) Enrolment plans; 5) Tuition fee payment procedure; 6) Study process description; 7) Study management system; 8) Study programmes comparison tool.
1.5. Teaching Staff	Compliance with ESG standards and guidelines takes place in accordance with: 1) RTU Rules of Procedure; 2) Order on determining the RTU coefficient; 3) Order on the RTU’s wage payment procedure; 4) Order on the procedure of regulation of employment relationships; 5) Order on the procedure of determining premiums; 6) Senate decision on determining teacher’s workload; 7) Instruction on the procedure of conclusion of contractor agreements and author agreements with natural persons at RTU; 8) RTU regulations on the procedure of election of professors and associate professors; 9) RTU regulations on the procedure of election of assistant professors, lecturers and assistants; 10) Order on the composition of the Scientific Council; 11) RTU’s uniform requirements for study programmes; 12) Order on observation of classes; 13) Order on professional improvement courses at RTU; 14) Order on the procedure of organisation of paid courses at RTU.

1.6. Learning resources and student support	Compliance with ESG standards and guidelines takes place in accordance with: 1) IT infrastructure development plans; 2) Regular supplementing of library resources; 3) Order on the establishment of the Erasmus+ Scholarship Committee. 4) Career and psychological support provided to students by RTU Career Support and Services Division.
1.7. Information management	Compliance with ESG standards and guidelines takes place in accordance with: 1) Study process description; 2) Study management system; 3) Study programmes comparison tool; 5) Register of Study Courses; 6) Register of Study Programmes.
1.8. Public information	Compliance with ESG standards and guidelines takes place in accordance with: 1) Extensive RTU website; 2) Targeted public relations.
1.9. On-going monitoring and periodic review of programme	Compliance with ESG standards and guidelines takes place in accordance with: 1) Regulations of the Study Direction Committee; 2) Annual study direction improvement reports; 3) Employer involvement activities, incl. implementation of elective study courses.

1.10. Cyclical external quality assurance	Compliance with ESG standards and guidelines takes place in accordance with: 1)In addition to the cyclic external evaluation and accreditation, evaluation procedures are carried out on the level of individual RTU organizational units (faculties, institutes, chairs). 2) Recommendations made by experts are analyzed and the appropriateness of their implementation is evaluated. 3) RTU participates in several international and national ratings and comparison systems. Ratings can be seen in RTU webpage (https://www.rtu.lv/en/university/rankings). Ratings enable RTU to assess progress against internationally recognized criteria and to compare itself with other higher educational institutions in Latvia and worldwide.

II - Description of the Study Direction (3. Resources and Provision of the Study Direction)

3.1. Provide information on the system developed by the higher education institution/ college for determining the financial resources required for the implementation of the study direction and the relevant study programmes. Provide data on the available funding for the relevant study programmes, as well as the sources of the funding for the scientific research and/or artistic creation activities and their use for the development of the study direction. Provide information on the costs per one student (for each relevant study programme of the study direction) by specifying the headings indicated in the calculation of costs and the percentage of the funding among the indicated headings.

According to the Conceptual Report "Introduction of a New Higher Education Financing Model in Latvia" approved by the Cabinet of Ministers on June 29, 2015 (http://likumi.lv/ta/id/274944-par-jauna-augstakas-izglitibas-finansesanas-modela-ieviesanu-latvija (Latvian only)) Latvia has introduced structural reforms in the sector to ensure the development of an efficient and sustainable higher educational system. A three-pillar funding model has been introduced to reconcile the supply offered by higher education with the needs of Latvia's economic development and labour market, high-quality research-based higher education content and performance management in higher education institutions. The base funding for provision of the study process is the 1st pillar, performance funding is the 2nd pillar, and development funding is the 3rd pillar.

The first pillar, or base (base funding), is implemented through state budget funded study places. Determination of the number of state budget funded study places is regulated by Sections 51 and 52 of the Law on Higher Education Institutions (http://likumi.lv/ta/id/37967-augstskolu-likums#p-50515 (Latvian only))

RTU funding from the basic state budget is made up of the study base financing corresponding to

the list of study programmes and the number of students; it is used to cover such expenses as utilities, taxes, infrastructure maintenance (including data for the Student and Graduate Register), purchase of equipment and supplies, staff remuneration, and funding for research activities.

The number of study places is allocated after discussions with the Ministry of Education and Science. Funding from the state budget is allocated for full-time studies.

The amount of study base funding is determined on the basis of the number of study places determined by the state at RTU, as well as the state-defined study place basic expenses and study cost coefficients in the thematic areas of education.

Study cost coefficients for thematic areas of education are indicators that determine the amount of study place costs in the respective thematic area of education in relation to the basic costs of the study place.

The cost coefficients for the study programmes in the thematic areas of education for Bachelor and professional study programmes are set by Cabinet Regulations of December 12, 2006 "Procedures for Financing Institutions of Higher Education and Colleges from the Funds of the State Budget" (https://likumi.lv/doc.php?id=149900 (Latvian only)) (the "Regulations") in Annex 1.

Values of study cost coefficients are 1.5 times higher for Master study programmes and three times higher for Doctoral programmes than the study cost coefficients specified in Annex 1 to the Regulations for the respective thematic area of education.

The amount of the study funding granted to the institution of higher education or college from the state budget for the implementation of Bachelor, professional and Master study programmes is calculated using the following formula:

Fs = Tb x [S(ki x ni) + 1,5 x S(ki x mi)] + Sb x S(ni + mi), where

Fs - amount of study financing;

Tb - basic costs of the study place;

ki - coefficient of the study costs in the relevant field of education (Annex 1 to the Regulations)

ni - the number of study places for a higher education institution or college at undergraduate and professional study programs in the relevant thematic area of education;

mi - the number of study places at the Master study programs in the relevant thematic area of education;

Sb - study place social security expenses at undergraduate, professional and Master study programs (Annex 2 to the Regulations).

The basic costs of a study place and the social security expenses of a study place are determined in accordance with Appendix 2 to the Regulations.

In study direction "Environmental Engineering" and "Environmental science" Bachelors study program the cost per student is 4860,74 EUR, Masters study program - 7291,10 EUR and Doctor's study program - 14852,21 EUR.

Each year, the Ministry of Education and Science calculates the basic costs of a study place for the following budget year and, by November 1 of the current year, coordinates the calculations with the Ministry of Finance and those Ministries which have higher educational institutions and colleges subordinated to them. RTU funding from the state basic budget for the provision of study places in the respective academic year is distributed in accordance with the decision of RTU Senate "Methodology for Allocation and Application of Basic Budget, Performance-Based Funding and

Tuition Fees to RTU Units" (see the file of Appendix 16 of the list of Internal regulations; hereinafter - the Methodology). The Methodology is reviewed and revised every year and is subjected to any necessary changes.

The study direction “Environmental protection” is implemented by RTU FEEE Institute of Energy Systems and Environment, therefore the matter of financial provision of the study direction and respective study programme is viewed in the context of the institute.

RTU has a decentralized budget, and each organizational unit is allocated a separate budget. In a general sense, a budget is a plan of revenues and expenditures for a specific period of time, work, event or function. The revenues and expenditures of RTU shall be administered in accordance with 54 principles approved by the Senate or as stipulated by the Vice-Rector for Finance.

Revenues can be divided into those allocated to the organizational unit for carrying out certain tasks for which it is responsible, such as consultancy, organization of training; and those allocated to the organizational unit as a result of calculations based on the envisaged workload (e.g., funding for the implementation of the study course "Innovative Product Development and Entrepreneurship" at different study programmes or funding for the administration and development of the study programme) and/or indicators achieved in previous periods (e.g., research support).

According to the Budget Allocation Methodology, the financing is allocated to the organizational units either according to the financial or budget year or immediately after receiving the financing. The financial or budget year of RTU organizational units is from October to September of the following year, and for this period the financing is calculated and distributed:

- Subsidy or basic budget funding (training of state budget funded students) is divided into monthly limit - 1/12 of the estimated annual funding per month is allocated to the organizational unit;
- Tuition fee funding (training of tuition fee-paying students, including funding paid by students for settling academic arrears) is allocated twice a year (in October and April) as a monthly limit - 1/6 of the estimated funding per semester is allocated to the unit monthly;
- Performance funding (research support funding) is allocated as a monthly limit - 1/12 of the estimated annual funding is allocated to the unit per month;
- Research base funding (research support funding) is allocated as a monthly limit - 1/12 of the estimated annual funding is allocated to the unit per month;
- Foreign student tuition fee funding is allocated several times a year, taking into account that most of the funding for the envisaged workload is allocated to the organizational unit at the beginning of the semester - it is planned in the forthcoming periods, by adjusting the allocation process with the allocation of tuition fee funding to facilitate the unit's operation during the budget planning process.

Each head of RTU organizational unit is provided with remote access to operational financial information on the unit's budget, including the envisaged workload and correspondingly allocated funding for the implementation of study programmes and study courses in subsequent periods. Based on this information, the head of the organizational unit plans the work of the unit at the beginning of each financial or budget year, including remuneration issues for academic staff members who are subordinate to the head of the unit, and develops a procurement plan for the following year in compliance with the implementation and development of the study programme or study course, etc.

According to the World Bank research on higher education governance in Latvia, which was conducted in 2017 and 2018, the World Bank concluded that RTU used the opportunities offered by

the system-level funding model reform to gradually adjust the internal distribution of decisionmaking powers by strengthening the position of deans. Prior to the introduction of the second pillar of the state funding model, RTU funding was provided to units below the level of faculties. To address the issue of weak positions of deans, more than half of the new 2nd pillar performance income is used to provide funds to faculties where the dean is the budget holder. First, it opens up new opportunities for faculty-level strategic development. Second, deans now have greater opportunities to ensure the development of faculties, which is their responsibility. Third, since acad. year 2019/2020 deans of faculties have additional funding from tuition fees of international students.

In academic year 2019/2020, RTU has made changes in the Methodology to ensure that the basic state budget funding for the provision of study seats is distributed by study programmes and thematic areas of study courses, ensuring precise distribution of funding according to the indicators by which RTU receives the state budget funding. In addition to the seats financed by the state basic budget, the study programme financing also consists of tuition fee revenue from the resources of natural or legal persons, which can be divided into two subgroups:

1. revenue from local fee-paying students;
2. revenue from foreign fee-paying students.

Funding from local fee-paying students is allocated in compliance with the Methodology where, in order to provide greater opportunities for the development of fee-based study programmes, for several academic years, a significant amount of the funding received has been channelled to the Head of study programme, who may appropriately use this funding to renew facilities and attract higher level specialists for the implementation of the study process, etc.

Funding from foreign fee-paying students in a respective academic year is allocated in accordance with the Resolution of RTU Senate On Approval of the "Methodology for Allocation of Funds for Study Process Provision at the International Cooperation and Foreign Students Department" in the Respective Academic Year (see the file of Appendix 41 of the list of Internal regulations; hereinafter - Methodology2). Methodology2 is revised and approved every year taking into account necessary changes.

In academic year 2019/2020, RTU made significant changes to Methodology2 with an aim to bring it closer to the Methodology governing budget allocation, thus facilitating the work process of the persons responsible for the implementation of the study programmes - both by aligning funding allocation periods and principles. The new Methodology2 provides funding for the responsible structural unit of the study program development, similarly to the Methodology. Two new coefficients are introduced in the calculation of study course funding - the correction factor for the number of students and the sustainability coefficient of the study program, as well it is taken into accont whether foreign students acquire the study course together with local students. The financial surplus, which is formed from the application of both coefficients and the acquisition of joint study courses, is directed to the structural unit responsible for the study program.

Analysing the financing procedure of the study programmes and the study directions at RTU as a whole, it can be seen that the state basic budget and local fee-paying student funding in the long run are determined taking into account the basic principles established by the state. In the process of determining the amount of funding, the study cost coefficients of the thematic areas of studies and the values of the study cost coefficients according to the level of the study programme, as well as the number of students at the study programme and the study courses implemented therein are taken into account. As mentioned above, by using study cost coefficients of the thematic areas of studies, it is possible to determine the amount of financing required for the implementation of a particular study programme and study course. In the Methodology for academic year 2018/2019,

RTU Senate approved that in the future the study cost coefficients of the thematic areas of studies would be applied individually to each study course of the study programme, thus ensuring even more appropriate amount of financing for the implementation of study courses included in the study programmes. In order to implement this system, the Expert Committee was established by order of the Vice-Rector for Academic Affairs, who determined thematic areas of studies for each study course. RTU has the following thematic areas of studies and the applicable coefficients, which are eligible for study direction programmes:

Thematic area of study courses of RTU	**RTU coefficient**
Architecture and urban planning	3,5
Civil engineering and real estate management	1,71
Civil and occupational safety	2,9
Economics	1,4
Power and electrical engineering	2,9
Physics	3,2
Geodetics and cartography, geomatics	2,9
Innovation	2,9
Chemistry and chemical technology	3,2
Mathematics and statistics	2,42
Material sciences	3,2
Heat engineering, heat, gas and water technology	2,9
Environmental engineering and management	**3,2**

In academic year 2019/2020, it is envisaged to incorporate similar principles in Methodology2 and apply them to study programmes, where the total number of foreign students in all academic years is greater than or equal to 90. The study programmes with less than 90 foreign students have a support mechanism, which envisages financing from the total funding of the foreign students, in order to ensure an adequate amount of funding for the implementation of the study courses of the study programmes.

In order to ensure the functioning and sustainable development of study programmes, RTU has been improving the Methodology and Methodology2 for each academic year in accordance with changes in the external and internal environment, thus also eliminating possible risks in the implementation process of the study programme or its study courses. The transition process involves all stakeholders, thus ensuring transparency, as well as a transparent decision-making process. The required changes are at first initiated by RTU Vice-Rector for Finance, and additional changes can be initiated by any RTU employee by submitting a request to RTU Vice-Rector for Finance or to the Finance and Budget Committee of RTU Senate. The Finance and Budget

Committee of RTU Senate consists of 21 senators (deans, heads of organizational units of faculties, professors, as well as student representatives) who have voting rights, as well as nine RTU Senate advisors, who are mainly representatives of various administrative units, such as vice-rectors, heads of departments etc. Once the Finance and Budget Committee of RTU Senate has considered and evaluated the proposals, it shall propose amendments to the Methodology or Methodology2 or develop a new version of the document(s) for the next academic year for approval by the RTU Senate (50 senators). It should be noted that historically changes in the Methodology or Methodology2 have been proposed after performing a thorough analysis, including mitigation of their possible negative impact on the implementation of study programme courses.

Research base funding (base funding provided by the state) is allocated among faculties according to the performance-based output indicators, i.e., number of publications (weighted by impact and citation), money attracted by research projects and industry contracts, and defended Doctoral Theses (considering also the time it takes to complete Doctoral studies). The calculation is made based on the transparent methodology, which was approved by the Scientific Council (the document: "Methodology for Allocation of Research Base Funding to RTU Organizational Units") on 20 November 2018. A decision regarding allocation of the budget among faculty institutes is made within faculties (by the Faculty Councils).

RTU also makes 3 project calls a year with internal funding. The 1st project call aims at supporting publication activities of young scientists. The 2nd call supports projects where RTU cooperates with industry partners, and this call is aimed at promoting inter-faculty and inter-disciplinary research within six research platforms of RTU. The goal of the 3rd call is to involve graduates in the research process. The regulation documents are usually approved by the Scientific Council of RTU. However, the decisions regarding selection of particular researchers or projects are made by expert groups organized by the Office of Vice-Rector for Research, on the faculty level or the research platform level (Council of Coordinators of Research Platforms; decision of RTU Senate No. 600 "On Approval of the Regulation of Coordinators' Board of the Research Platform at Riga Technical University" as of 23 May 2016. Projects are administered by the Office of Vice-Rector for Research. The Office also coordinates administration of the externally funded research projects, e.g., within Horizon 2020 programme and other. Research projects funded by the EU Structural Funds are administered by the Office of Vice-Rector for Strategic Development.

The Internal Research Excellence Grant for young scientists is a new initiative, with an aim to attract talented young researchers to RTU and provide with funding, which allows establishing new research groups in a prospective research field. Funding for a 3-year period is based on international competition under conditions similar to EC ERC grant, and international call and evaluation performed by external, i.e., foreign well-recognized researchers. The final decision for awarding the grant is made by the Scientific Council of RTU.

RTU Research Support Fund (decision of RTU Senate No. 585 "RTU Regulation of Research Support Fund" as of 15 December 2014) aims at providing financial support for various research related activities, such as support for maintenance of research equipment, protection and licensing of intellectual property, covering of expenses related to the Doctoral study process, publishing of scientific journals, participation and organization of scientific conferences, support to researchers in establishing new laboratories in a prospective research field. The Research Support Fund is an instrument to support research activities, which foster the development of the strategically important research fields. 10 % of the research base funding (state budget funding) is allocated to the Research Support Fund every year. Establishment of five new laboratories or centres has already been supported by the Fund by June 2019, e.g., RTU High Energy Particle Physics and Accelerator Technology Center (for cooperation with CERN), Biochip Laboratory, Scientific Laboratory of Experimental Mechanics of Materials, Scientific Laboratory of Electromechatronics,

Research Center of Communication System Technologies, Ergonomic Electrical Technology Research Laboratory. The RTU Scientific Council decided to support at least one perspective area of research through a competition every year (decision of the RTU Scientific Council No. 04000-3/09, adopted on 21.09.2020).

In academic year 2019/2020, 54 RTU doctoral students received a doctoral research grant. The amount of support per doctoral grant was planned of 10,000 EUR. The recipients of the grant were elected to the position of a scientific assistant or researcher. The purpose of RTU doctoral grants is to support research related to doctoral theses and to contribute to the defence of the doctoral thesis in the 4th year after starting doctoral studies.

Funding of the study direction "Environmental protection" has been stable in recent years, even with a tendency to increase. As it is characteristic for engineering study programmes in Latvia in general, the main flow of study programme funding in the study direction "Environmental protection" is provided from state budget grants for study programmes: It was 97% in 2013, and 93% in the year of studies 2019/2020. In recent years, as the number of international students increases, funding from fees of international students has been growing as well – amounted to 6.5% in 2019/2020 (in addition, for the description of each study programme see part III of the report).

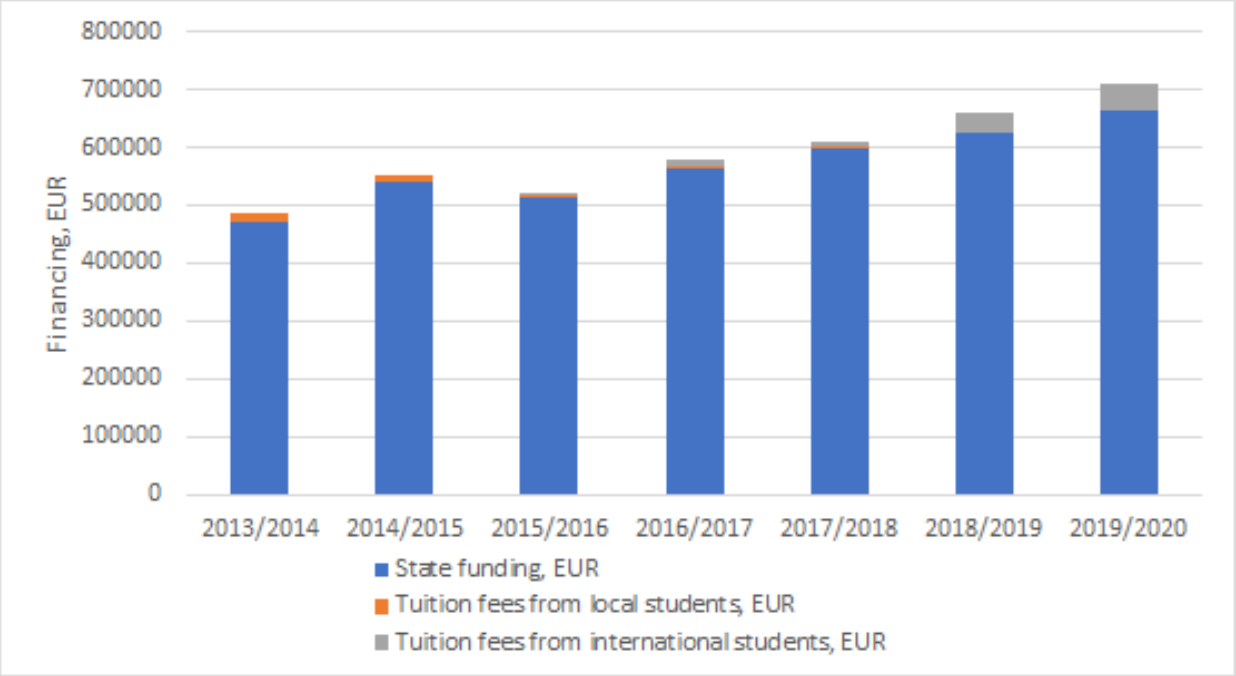

Figure: *Total revenues of the study direction "Environmental protection" from academic year 2013/2014 to academic year 2019/2020.*

Since the beginning of financial year 2018/2019, in addition to information on the budget of each subordinate unit, the heads of RTU organizational units are provided with a regularly updated overview of the overall financial results of the faculty study process, thus the objective information on performance is made available not only to the Dean but also to the Heads of institutes, departments and other organizational units. The provision of such a report ensures not only transparency of information, but also an opportunity for the Dean of the Faculty and Council to react promptly in situations where it is necessary, for example, to review individual expenditure items within the framework of joint financing.

Overall, the funding of RTU, IESE, the organisational units implementing the study direction "Environmental protection", also the funding for the implementation of study programmes and activities related to the improvement of the study process (for example, scientific research base) for maintenance of included study programmes consists of the following sources of funding:

- Grant from the state budget for the implementation of the study programme;
- Funding from companies and private persons covering the tuition fee, including fees of international students;
- Funding from other sources (projects, contract works, etc.): these funds are indirectly attributed to the implementation of academic study programmes – purchased infrastructure for laboratories (equipment tools, etc.) and practical classes (e.g. modelling software) and lectures (e.g. scientific literature, databases of scientific articles);
- Indirect funding – (1) funding programmes of the European Union and different countries for upskilling of academic staff and (2) funding programmes of the European Union and different countries for exchange trips of academic staff and students. Since these funds are not directly accounted for in RTU financial systems, because these are often individual payments to teaching staff and students, no financial summaries on them are available and they are not reflected in the report.

3.2. Provide information on the infrastructure and the material and technical provision required for the implementation of the study direction and the relevant study programmes. Specify whether the required provision is available to the higher education institution/ college, availability to the students, and the teaching staff (the specific equipment required for the relevant study programme shall be indicated in Part III, Chapter 3 below the respective study programme).

The construction of RTU Ķīpsala campus began in 1965 with the aim to create a unified study and research centre. The construction process is underway and it is envisaged to host the majority of university students in Ķīpsala by 2021. After completion of the construction, RTU Ķīpsala campus will become the most modern engineering study centre in the Baltic States.

The issue of sustainable development is taken into account in the construction process of the campus. Recognizing its concern for sustainable development and demonstrating its willingness to engage in the promotion of sustainable development, RTU has joined the Sustainable Development 61 Solutions Network, which seeks to achieve the 17 UN Sustainable Development Goals (SDGs) by 2030. RTU is currently the only organization in the Baltic States that has been admitted to the network.

Through its networking activities, RTU, as a higher education and research institution, has prioritized the achievement of seven UN SDGs that coincide with RTU research platforms. RTU considers the provision of quality education and the promotion of lifelong learning to be its primary goal. RTU also intends to contribute to research and innovation in sustainable and modern water technologies, power systems, infrastructure and urban environment. The University is also committed to promoting the creation and distribution of sustainable products.

RTU buildings are equipped with state-of-the-art climate control equipment, technical solutions that are remotely controlled and provide the opportunity to track energy consumption to make buildings more comfortable for students, academic staff, researchers and guests. . One of the results achieved in the development of RTU infrastructure is the participation in the GreenMetric Ranking (http://greenmetric.ui.ac.id/overall-rankings-2020/), which recognizes RTU Ķīpsala campus as the 40th greenest campus in the world and RTU – as the 95th greenest university in the world (https://www.rtu.lv/en/university/for-mass-media/news/open/rtu-one-of-the-top-100-greenest-universities-in-the-world). In the Baltic region, RTU is a leader in terms of green thinking infrastructure.

Furthermore, for the third year in a row, RTU has been included in the top or platinum category in the Sustainability Index. In accordance with the methodology of the Sustainability Index, the companies in the platinum category has fully integrated corporate responsibility in their operations and have responsible persons at the level of management and performers. The companies are systematically collecting data and assess impact, as well as report their activities with high-level transparency and engagement of impact audiences, and their published data have been approved by an external auditor. 19 companies were included in the platinum category this year, and RTU is the only higher education institution among them. This is a high assessment of the RTU's attempts to embody green lifestyle and make a scientific contribution to the development of environmentally friendly technologies. By reducing human impact on the environment and climate change, RTU has committed to introduce the "Green Ķīpsala" concept in the RTU student campus by 2023. In order to do this, RTU is purposefully working to improve infrastructure in accordance with sustainability principles, changing habits of students and employees, as well as using the innovative green products and technologies created by RTU scientists in the infrastructure of Ķīpsala student campus. The infrastructure of Ķīpsala campus provides students, staff and guests with all the necessary services and utilities, e.g., it is possible to park a bicycle and a car, quench one's thirst at water drinking points. Developing the infrastructure, care is taken of all groups of people, including people with disabilities: each building has parking lots, easy access to classrooms, laboratories and other facilities, the use of Braille to provide essential information, as well as all sanitary facilities are designed according to the requirements. The association of people with disabilities and their friends APEIRONS (https://www.apeirons.lv/ (Latvian only)) commends RTU for its achievements in infrastructure related issues for people with disabilities.

In RTU Ķīpsala campus, there are currently 54 classrooms, 187 laboratories, 19 special training rooms, 10 computer classrooms, 12 workshops and several research centres of national importance. The campus also houses a hostel with 950 beds and a special area for people with disabilities.

Foreign students, visiting lecturers and university guests can use the renovated RTU dormitory (Āzenes 22a, Riga).

Owing to a high level of digitalization, the available infrastructure and material and technical facilities for the implementation of the study direction and corresponding study programs provide an opportunity to increase the University's competitiveness, improve operational quality and efficiency, as well as to make information available by integrating IT solutions into administrative, academic and research processes of the University and providing administrative and academic staff with modern, reliable, secure and unified IT infrastructure and quality IT services.

The IT Department of the Administrative Service works in three areas:

1. Creation, development and maintenance of an integrated information system of RTU providing support for administrative, academic and research work of RTU;
2. Provision of high-quality and uninterrupted voice and data communication services throughout the territory under the control of RTU, as well as maintenance of RTU data centres and key network resources;
3. IT service support, incl. providing information on new IT solutions, giving necessary consultation and organizing IT training.

To ensure easy and efficient identification of IT users, an IT user identity management system has been introduced; as a result, each IT user has a unique electronic identity that is valid in all information systems. In addition to the aforementioned, a user session management system is ensured in IT systems, which means that there is no need for IT users to re-authenticate when logging in to RTU information systems. It gives the experience of using a unified integrated

information system without having to memorize different identification data and re-enter them, implementing different IT application scenarios.

All IT users are provided access to the centralized *intranet* portal ORTUS (https://ortus.rtu.lv – screenshots of the interface are attached in "Screenshots of RTU IT systems") , which functions as a single digital gateway, combining information from all RTU information system components and providing users with an easy-to-use way of accessing the directory of all IT services in one place.

The Centralized Study Management System is used for efficient administration of the study process, which ensures digital provision of the study life cycle, incl. Electronic Register of Study Programmes (its public part is available at https://stud.rtu.lv/rtu/vaaApp/sprpub – screenshots of the interface are attached in "Screenshots of RTU IT systems"), drawing up learning agreements and enrolment of students in study programs, Register of Study Courses (its public part is available at https://stud.rtu.lv/rtu/discpub/list – screenshots of the interface are attached in "Screenshots of RTU IT systems"), designing student's individual study plans, drawing up orders, implementing study courses and study process, registering grades, recognizing study courses, awarding qualifications, administering payments, hostel information, gathering information to issue diploma supplements, etc. This system is one of the main cornerstones in the administration of RTU study process.

To ensure effective implementation of the study process, Moodle e-learning environment is used, where all relevant information is compiled in an automated way (study courses, users, groups, access rights, etc.). This system ensures student-instructor communication. The academic staff members place various electronic materials, assessment tests, homework assignments, information on a particular study course, etc. in the system. Students can also view their financial information on the ORTUS portal, as well as make request for documents (references, transcripts of records, copies of a learning agreement, etc.). RTU teaching staff has *Zoom* and *Microsoft Teams* video conferencing platforms for distance online classes.

Since 2007, more than 130,000 unique study course sites have been generated in the e-learning environment of RTU. Students can access electronic learning resources anytime and anywhere.

Digitization of classrooms and schedules has been carried out to ensure efficient premises management and study planning (https://nodarbibas.rtu.lv/index.php?id=0&lang=en) – screenshots of the interface are attached in "Screenshots of RTU IT systems"). Each RTU student and academic staff member can access their schedule, which provides information on the venue, time, instructor, room, title and type of lecture. In addition, for user's convenience purposes, the system greatly facilitates lecture planning and scheduling, as well as optimizes the use and efficiency of premises.

Electronic Staff Management and Record-keeping Systems, which cover the circulation of recordkeeping and personnel documents at RTU (https://docs.rtu.lv/ (Latvian only)) – screenshots of the interface are attached in "Screenshots of RTU IT systems"), are also used to ensure the efficient administrative work. Electronic document coordination and document e-signing functionality have been introduced, thus reducing print-based document circulation and significantly increasing document circulation speed. Since autumn semester 2019, students have been provided with electronically signed learning agreements. Since 2016, RTU graduates have been receiving electronically signed transcripts of records.

In terms of quality assurance, a digital student survey system is used, with the help of which the quality control of study courses and study programs is implemented each semester. Based on the results of quality control, regular measures are taken to improve study programs and the study process, in general.

For additional convenience of RTU students, academic and general staff members, RTU leases

Microsoft Windows and Microsoft Office software, which provides all IT users with access to the latest Microsoft software. RTU students can use the licensed Windows operating system and the 64 Microsoft Office productivity suite provided by RTU for study needs. All IT users have access to Microsoft Office 365 cloud computing platform with one terabyte of storage space available to each user and access to a variety of additional collaboration and productivity tools (Microsoft Teams, SharePoint Online, Forms, OneNote, OneDrive, Outlook, etc.). RTU students, academic and general staff have access to the University's email system

To support research activities, RTU has developed the Centralized Research Support System, which records all information on publications, patents, commercialization applications, Doctoral Theses, RTU scientific journals, research staff, etc. The system provides access to information according to OpenAccess principle https://science.rtu.lv. RTU students and academic staff also have centralized access to research software.

RTU has the high-speed fibre optic Internet and extensive wireless network infrastructure with over 400 access points, including the international *Eduroam* service. In addition, desk phones and mobile communications are provided for fast and easy communication.

To ensure a stable and secure operation of the information technology infrastructure, continuous monitoring of the IT infrastructure and systems is performed, resulting in proactive incident control. Data backup is also ensured.

The Information Systems Security Policy has been developed and implemented with the primary goal of ensuring the secure use of RTU information systems by establishing and maintaining a sufficient set of measures to reduce or prevent potential or resulting harm. Implementation of the Information Systems Security Policy envisages security checks, data transmission network monitoring, as well as preventive measures. Regular IT security and personal data protection training is organized for IT users. Automated security incident management and risk management have been implemented. Statistics demonstrate that the number of IT security incidents dropped significantly over the last five years.

The IT User Support Center provides IT user support, by applying a one-stop approach to process applications based on ITIL guidelines. Since 2007, the IT User Support Center has processed and resolved more than 160,000 IT user applications.

RTU infrastructure elements: there is a toilet on each floor, a specialised drinking water tank is available, an elevator, an open type student study rooms/reading room, several lounges, classrooms and instructors' offices, meeting rooms, a cafeteria, as well as vending machines selling different drinks and snacks have been installed in the premises.

Educational building at Āzenes Street 12 b.1		
Type of use of the room	Number of rooms	Useful area m^2
Discussion rooms/presentation room	5	202
Computer classroom	5	249.9
Auditorium	7	497.1
Offices	38	664.6
Rooms for assistant professors/doctoral students	5	165.9
Canteen	1	412.8
Library	1	32.9
Working rooms/workshop	8	222.2
Laboratory room	30	1788.2
Reading room	1	104.6
Instructors' offices	21	415.3
Warehouse	16	190
Hall	3	58
Server rooms	2	31.5
Student government and accounting office	2	68.1
Kitchens	6	34.2
Total	**151**	**5137.3**

Owing to a high level of digitalization, the available infrastructure and material and technical facilities for the implementation of the study direction "Environmental Protection" and corresponding study programmes provide an opportunity to increase the University's competitiveness, improve operational quality and efficiency, as well as to make information available by integrating IT solutions into administrative, academic and research processes of the University and providing administrative and academic staff with modern, reliable, secure and unified IT infrastructure and quality IT services. Methodological, informative and material and technical provisions fully comply with the study direction "Environmental protection" and the requirements set for it.

The technical support of research laboratories for the study process is continuing to intensify: computer equipment (monitors, computers, presentation lasers), laboratory equipment (data loggers, barometers, air humidifiers, gas analyser, set of cold cameras, climate station, weights, muffle furnace, drying cabinet, detector, gas sensor adapter, etc.), and equipment for study auditoriums. Research performance funding should be mentioned as one of the financial support instruments for improving the scientific research base.

For several years, support for improving the scientific research base (materials and equipment) of institutes has been available to RTU organisational units, as part of the funding of scientific performance. The available funding is variable year-on-year, as it depends directly on the funding allocated for scientific performance indicators. In 2017-2018, RTU IESE purchased measuring equipment for 82,289 EUR within the scope of this funding.

In addition, the material, technical and informative base of scientific research laboratories of the study direction "Environmental protection" is also improved through participation in local and international research projects. For example, the participation of RTU IESE in the TEST-4-SME

project (2017-2020) made it possible to improve and unify the management system of RTU's scientific research laboratories. Within the Horizon 2020 RiBuild project (2015-2020), RTU IESE Building Energy Efficiency Laboratory create a special module for determining energy efficiency of historical buildings, which has been successfully integrated in the study process – through laboratory works and students' diploma papers. The above-mentioned provision is available to all students for laboratory work, as well as for teaching staff and scientific staff for independent research.

In order to promote cooperation between science and industry, RTU has created and is actively operating six research centres of national importance providing company representatives with access to scientific infrastructure – "Energy and Environmental Resource Extraction and Sustainable Use Technology Research Centre of National Importance (including the development of the Transport and Mechanical Engineering Centre)", "Research Centre of National Importance of Nanostructured and Multifunctional Materials, Constructions and Technologies", "Research Centre of National Importance of Information, Communication and Signal Processing Technologies". The establishment of the centres focuses on the following target groups:

(1) ***Scientific institutions and personnel***. As a result of implementation of the project, the research institutions involved in the fields of energy, environment, transport and mechanical engineering will get new, modern scientific equipment and hardware, thereby significantly improving international competitiveness in the science area.

(2) ***Private sector***. In order to ensure the competitiveness of Latvian business, it is necessary to increase the volume of new products and technologies, but this can be done by providing Scientific Institutions with modern scientific infrastructure in order to promote the development of innovation in the private sector.

(3) ***Indirect target group***. Society as a whole should be mentioned as an indirect target group, since providing the highest level of research in synergy with the development of new products and technologies will increase Latvia's competitiveness in the international environment, thereby affecting the well-being of society.

RTU IESE is working actively (cooperation with companies in research, scientific research projects and contract work) within the Energy and Environmental Resource Extraction and Sustainable Use Technology Research Centre of National Importance.

3.3. Provide information on the system and procedures for the improvement and purchase of the methodological and informative provision. Description and assessment of the availability of the library and the databases to the students (including in digital environment) and their compliance with the needs of the study direction by specifying whether the opening times of the library are appropriate for the students, as well as the number/ area of the premises, their suitability for individual studies and research work, the services provided by the library, the available literature for the implementation of the study direction, the databases available for the students in the respective field, the statistical data on their use, the procedures for the replenishment of the library stock, as well as the procedures and options for the subscription to the databases.

Library plays an important role in the provision of methodological guides and educational resources to students. RTU Scientific Library (SL) (Scientific Library | Riga Technical University (rtu.lv)) is a

library of national importance, which has acquired its status in the process of library accreditation. The SL provides the necessary information to ensure RTU study process and research activities, as well as provides library, bibliographic and information services to RTU students, academic and general staff. The Library holds 1.4 million printed documents and e-resources in RTU industry specific databases. The Library stock is located at the Central Library, the Study Material Subscription, the Chemistry Branch, the Transport Branch and Study and Research Centres in Daugavpils, Liepāja, Cēsis and Ventspils.

In 2016, significant investments were made in the development of the SL infrastructure by building additional premises (2240 m^2). The total area of the SL premises is 6393 m^2, of which 3417 m^2 are reader service premises. There are 713 working places for SL users. The SL has four group rooms and six individual booths, a rare book reading room and a conference room. The SL is accessible for users with disabilities

In order to improve the RTU SL activities and to meet the information needs of academic and research staff, the Library Council has been established, which decides on replenishing the library collection with printed publications and subscribing to the necessary databases. The Library Council has approved the Compilation Policy of RTU SL Collection, which sets the basic principles of the collection development in accordance with the areas of RTU academic and research activities.

After the SL receives its funding from RTU, it calculates funding for the information resources for each study programme. The collection is replenished taking into account the recommendations of the heads of the study programme and researchers, in compliance with the allocated funding. By contacting the SL Collection Development Department regarding replenishment of collection, the desired editions can be ordered at the Library website by filling out an order form, an application form, contacting by phone 67089353, or visiting the Library at 5-105 Paula Valdena Street. The SL offers a guide, which includes websites of various Latvian and foreign publishing houses and bookstores for searching publications and e-resources.

Database subscription agreements are concluded both directly with the supplier and through the Cultural Information Systems Centre, which is the Latvian national representative for the international non-profit organization EIFL (Electronic Information for Libraries http://www.eifl.net/). The EIFL Licensing Programme offers libraries of state importance to subscribe to internationally recognized databases at a significantly reduced subscription fee that is not offered to individual subscribers, thus saving the financial resources of libraries.

Databases subscribed by the RTU Scientific Library (https://www.rtu.lv/en/studies/scientific-library/electronic-resources?highlight=electronic+resources):

- *ProQuest Ebook Central, Academic Search Complete EBSCOhost, Applied Science & Technology Source EBSCOhost, Business Source Ultimate EBSCOhost, EBSCOhost eBook Academic Collection, Wiley Online Library, SpringerLink, The International Monetary Fund*;
- Subscriptions financed by the Latvian MoES (*ScienceDirect, SCOPUS (Elsevier), Web of Science*);
- Latvian databases LETA, Letonika, database of Latvian standards (available only in library premises)**.**

The A-to-Z software provides all users of the library with a simple and comprehensive list of online journals available in the library. It was created based on recommendations of teaching staff and students. Users can quickly access e-journals of interest and their full texts. Information about databases is available on all computers registered in the Central Library, branch libraries, RTU network and in the RTU e-study environment ORTUS (Resources).

The use of SL databases has been growing since 2016. E-resource allocation has increased from 75,391 units to 525,194 units per year.

The SL new premises have made it possible to expand the range of services available to users. Since the opening of the new premises, the number of library visits increased from 103,825 to 235,600 in 2018. The SL Central Library is open to users from Monday to Saturday. There is a 24-hour reading room. During the summer period, the Central Library is open every working day with reduced hours. (https://www.rtu.lv/lv/studijas/biblioteka/pakalpojumi-3 (Latvian only))

The SL information sources are open access resources. Books and periodicals relevant for the study direction of RTU IESE are located in the main building of the Scientific Library (5 Paula Valdena Street, Riga) in compliance with UDC indexes. The last copy of the oldest editions that comply with RTU profile is stored in the library repository. They are always available to users.

The on-duty librarian helps find the necessary resources. More detailed information and consultations are provided by bibliographers. The SL has librarians responsible for particular fields of science. (https://www.rtu.lv/lv/studijas/biblioteka/nozaru-informacija (Latvian only)).

Searching for library resources is ensured by the *Primo Discovery* search tool (RTU Library (exlibrisgroup.com)). It allows searching for the information in the library catalogue, subscribed databases (https://kopkatalogs.lv/F/?func=find-b-0&local_base=rtu01), as well as in databases created by the Scientific Library(https://www.rtu.lv/lv/studijas/biblioteka/informacijas-meklesana/datubazes-eresursi/bibliotekas-veidotas-datubazes (Latvian only)). Searching for the information in the electronic common catalogue (https://kopkatalogs.lv/F), one can simultaneously obtain information about the available resources in 12 libraries in Latvia. Both the electronic catalogue and RTU portal ORTUS can be used to reserve the library resources remotely. Remote access to databases is also provided. Since the introduction of RFID technology, users have been able to use five book-dispensing self-service vending machines and return books to a book-sorting vending machine around the clock.

The SL provides students, academic staff and other interested parties with different types of individual consultations and group training in information literacy. (https://www.rtu.lv/lv/studijas/biblioteka/lietotaju-apmacibas (Latvian only)).

Editions that are not available in the Scientific Library are delivered through an interlibrary subscription or international subscription. Internet access is provided throughout the library. The SL provides copying, scanning, printing and binding services, as well as there is a self-service canteen.

In addition to the aforementioned, RTU IESE has a separate library providing students with study and reference materials within the study direction. The library of RTU IESE are located at Āzenes Street 12/1 on Floor 6. The Institute Library has literature in Latvian, Russian and English (an electronic catalogue of books is available). It is important that RTU IESE library also has a place, where students and interested persons have access to the books issued by RTU IESE and the books which were created with participation of RTU IESE teaching staff (see below the summary of such books): from 2013 to November 2020 RTU IESE issued 16 study and scientific books (1 of which was in English), as well as during this period RTU IESE teaching staff participated in the development of books issued by 4 international presses (WIT Press un Elsevier) (all in English). Link to the published books - https://videszinatne.rtu.lv/en/science/published-books/.

The literature in the RTU IESE Library can be used in the study process – for drafting of course papers, Bachelor's, Master's and doctoral theses – and covers the following areas related to environmental protection: resource management and environmental management, environmental pollution (water, air, soil), heat engineering and energy, alternative energy sources, energy performance of buildings, bioeconomy, biotechnologies, life cycle analysis, multi-criteria analysis,

etc. Books in the library are issued for both on-site use and taking. To take a book, it is necessary to present a valid student identity card.

In view of the above, it can be considered that the Library and the available databases fully meet the requirements and needs of the field of study; as well as the amount and content of available literature is appropriate for the implementation of the study field, the databases available to students provide the necessary information in the field of environmental protection and environmental engineering. Databases and library are intensively used in the study process.

3.4. Provide information on the procedures for attracting and/or employing the teaching staff (including the call for vacancies, employment, election procedure, etc.), and the assessment of their transparency.

The implementation of RTU personnel policy is stipulated in the Human Resources Development Plan, which focuses on three main goals within the professional development of the academic staff: renewal of the academic staff, by promoting academic work of Doctoral students, improvement of the professional competence of the existing academic staff and attraction of foreign academic staff. The action plan sets out, for each goal, the activities and sub-activities to be carried out, defines the results to be achieved, the responsible organizational units and the implementation schedule.

Elections of RTU academic staff are held in accordance with the requirements of the Law on Higher Education Institutions and Cabinet regulations based on the recommendations of the Council of Higher Education, in accordance with the Constitution of RTU and the regulations approved by the Senate "On the Procedure of Electing Professors and Associate Professors" and "On the Procedure Of Electing Assistant Professors, Lecturers and Assistants" (publicly available at https://www.rtu.lv/writable/public_files/RTU_nolikums_par_profesoru_un_asoc._profesoru_ievelesanas_kartibu.pdf (Latvian only)

https://www.rtu.lv/writable/public_files/RTU_rtu_docentu_lektoru_un_asistentu_ievlanas_krtba.pdf (Latvian only)

https://www.rtu.lv/lv/universitate/vakances-rtu/personalatlases-dokumenti (Latvian only)

as well as included in the file of Appendix 42-43 of the list of Internal regulations), as well as in compliance with other internal laws and regulations.

For academic positions of professors and associate professors, whose election period ends in the respective academic year, periodic evaluation of scientific and pedagogical qualification is performed in accordance with the Regulations on Periodic Evaluation of Professors and Associate Professors adopted by the RTU Senate on 29 June 2020 (publicly available on https://www.rtu.lv/writable/public_files/RTU_par_profesoru_un_asocieto_profesoru_periodisko_novertesanu_apstiprinasanu.pdf (Latvian only)). The Personnel Unit informs the head of the professor's or associate professor's organisational unit on the need to organise an evaluation of a professor or an associate professor. The evaluation of professors and associate professors is carried out by the Council of Professors in accordance with the Law on Institutions of Higher Education, the Regulations on Activities of Councils of Professors of RTU and in accordance with the Regulations on the Procedure of Electing Professors and Associate Professors approved by the RTU Senate. After the evaluation, the Council of Professors submits a report on the evaluation result to the rector and the Personnel Unit. Taking into account the evaluation of the Councils of Professors and the procedure and criteria defined by the higher education institution, the employment contract with

the associate professor or professor may be extended for a definite or indefinite time. If as a result of the evaluation the professor's or associate professor's scientific and pedagogical qualification meet the evaluation criteria set by the higher education institution, the employment relationship continues. If as a result of the evaluation the professor's or associate professor's qualification does not meet the evaluation criteria set by the higher education institution:

- the employment contract of the professor or associate professor is terminated;
- the organisational unit may take a decision on announcement of a new vacant position.

At the proposal of organizational units, the faculty council or the institute board shall consider and approve a reasoned proposal made by the head of a respective organizational unit for announcement of the competition for vacant academic positions, which expire in the respective academic year. The faculty council or the institute board shall submit the proposal under consideration to the RTU Personnel Unit together with the job description and qualification requirements, including the workload (full-time or part-time).

The Personnel Unit announces a competition for academic staff positions at RTU website, the Euraxess vacancy portal and at least in one mass medium distributed throughout Latvia. The applicant shall personally submit or send by email the signed application documents no later than one month after the date of competition announcement.

The employment relationship shall be established by means of a written employment agreement between the Employer and the Employee at least two working days before the commencement of employment. The employment agreement shall be drawn up in duplicate. One copy shall be kept by the Personnel Unit of the Department of Personnel and Working Environment (in accordance with RTU File Nomenclature) and the other shall be issued to the Employee. Prior to entering into the employment agreement, the applicant is acquainted with RTU Rules of Procedure.

Employee's duties are defined in accordance with the Classification of Occupations of the Republic of Latvia and RTU Position Catalogue, RTU Remuneration Procedure (https://www.rtu.lv/lv/universitate/skaitli-un-fakti/vienota-darba-samaksas-kartiba **(Latvian only)**), RTU Rules of Procedure and the requirements laid down in the job description, which is an integral part of the employment agreement. Job description shall be presented to and signed by the Employee. Job description shall be drawn up in duplicate; one copy shall be issued to the Employee and the other shall be kept according to RTU Case Nomenclature.

Before taking up the employment, the Applicant shall present an identity document – passport or identity card, the Foreigner shall additionally present a visa or residence permit, as well as a work permit if such a permit is required in accordance with regulatory enactments.

Visiting academic staff shall be employed in compliance with:

- Law on Higher Education Institutions (https://likumi.lv/doc.php?id=37967 (Latvian only));
- Labour Law (https://likumi.lv/ta/id/26019-darba-likums
- (Latvian only));
- Immigration Law (https://likumi.lv/ta/id/68522-imigracijas-likums
- (Latvian only));
- Cabinet Regulation No 568 "Regulations Regarding the Procedure by which a Research Institution Concludes and Terminates Employment Agreements with a Foreign Researcher" as of 21 July 2008 (https://likumi.lv/doc.php?id=178749 (Latvian only));
- Cabinet Regulation No 225 "Regulations Regarding the Amount of Financial Means Necessary for a Foreigner and the Determination of the Existence of Financial Means" as of 25 April 2017 (https://likumi.lv/doc.php?id=290808 (Latvian only));
- Cabinet Regulation No. 25 "Implementing Regulations for the First, Second and Third Project

Applications Selection Round of Specific Objective 8.2.2 "To Strengthen Academic Staff of Higher Education Institutions in the Areas of Strategic Specialization" of the Operational Programme "Growth and Employment"" as of 9 January 2018 (https://likumi.lv/doc.php?id=296513 (Latvian only));

- RTU internal regulations “Procedure of Involvement and Employment of Visiting Academic Personnel at RTU” as of 26 November 2018 (see the file of Annex 25 of the list of Internal regulations);
- RTU internal regulations "Unified Work Remuneration Procedure at Riga Technical University" as of 27 April 2020 (ar grozījumiem 28.09.2020.)(https://www.rtu.lv/writable/public_files/RTU_vienota_darba_samaksas_kartiba.pdf (Latvian only)).

According to the results of the applicant selection competition, the employment agreement with the visiting academic staff is signed within a month, specifying an hourly rate. Job description is also provided, which includes specific job responsibilities (delivering lectures, designing study courses, lecture cycles, supervising study papers, etc.).

The workload of the visiting academic staff member may include the provision of face-to-face work (delivering lectures, providing tutorials, conducting seminars, supervising graduation papers, etc.) and remote work if it complements the face-to-face work (video lectures, tutorials, supervision of graduation papers). If the work is to be carried out remotely, face-to-face visits (e.g., tutorials) should be provided at the organizational unit.

The visiting academic staff member shall enter into the employment agreement in compliance with the requirements of the Latvian regulatory enactments. During the term of the employment agreement, all assignable copyrights for the work created by the visiting academic staff member, including curricula, materials, and any other teaching aids developed by the visiting academic staff member, shall pass to the Employer. The visiting academic staff member, upon termination of the employment agreement, shall be obliged to transfer the work created within the framework of the employment agreement, including study materials, to RTU. Before terminating the employment agreement, the visiting academic staff member shall submit to the head of a respective organizational unit the reports and other documents stipulated in the employment agreement.

When starting work at RTU, new teaching staff from RTU has access to several free courses, including computer courses on modern study technologies and their use in the study process, courses of English, courses on pedagogical skills and time planning seminars – for more information see section 3.5.

In addition to RTU centralised activities

- new teaching staff are gradually integrated into implementation of study courses when they start performing their job duties; since 2018, at least two teaching staff have been involved in implementation of each study course, thereby ensuring necessary continuity and integrity of study process, as well as interactivity in implementation of study courses – by supplementing one teaching force with other (in particular, validity of interactivity between two teaching staff members and students was demonstrated by distance learning studies during COVID-19 restrictions). This approach allows new teaching staff to feel fully comfortable in study process and to take on details of study course. In addition, the European Social Fund project “Strengthening the academic staff of Riga Technical University in field of strategic specialisation” No. 8.2.2.0/18/A/017 in period from 2019 to 2020, with financial support of project towards studies entitled “Environmental protection” two doctoral candidates (future teaching staff) were provided, Ievas Pakeres (PhD Degree obtained in June 2020) and Maksima Feofilova (PhD Degree obtained in December 2020), involvement in

the RTU study process (work on improvement and implementation of study courses, assistance in development of diploma theses, etc.). After obtaining doctoral degree, both doctoral candidates continue their work in RTU IESE academic positions.

- Since 2016, job description methodological pages (algorithms) have been developed and used in training of new employees. These include practical knowledge of works to be performed, references to documents and links to materials in electronic sharing documentation folders, references to RTU regulatory enactments.
- Regularly (at least once a quarter and mandatory after a 3-month probationary period after taking office) individual meetings are taking place with an RTU IESE employee, RTU IESE management and with institute staff specialist. Purpose of such individual meetings is to express details of work process and to find necessary solutions for improving work process and working environment, including by preventing workers from being frustrated, which, in turn, would contribute to job efficiency, understanding individual motivating factors, regularly assessing worker's ability to work and offering them adequate job responsibilities and a team of job implementation.

3.5. Specify whether there are common procedures for ensuring the qualification of the academic staff members and the work quality in place and provide the respective assessment thereof. Specify the options for all teaching staff members to improve their qualification (including the information on the involvement of the teaching staff in different activities, the incentives for their involvement, etc.). Provide the respective examples and specify the way the added value of the possibilities used for the implementation of the study process and the improvement of the study quality is evaluated.

At the end of 2018, the Center for Academic Excellence (teaching and learning centre) was established at RTU in order to support RTU academic staff (in the areas of pedagogical, intercultural communication and self-development). The main tasks of the Center for Academic Excellence are as follows:

- to organize various educational events, such as seminars, thematic series of events, guest lectures, conferences, discussions with the participation of the Latvian and foreign specialists;
- to coordinate experience exchange activities within faculties and other organizational units;
- to inform (including posting to ORTUS) the academic staff about the latest teaching and learning trends that are appropriate for RTU;
- to provide guidance to academic staff on the use of teaching and learning methods, as well as on the assessment of students' knowledge, skills and competence;
- to inform students about learning opportunities, such as platforms, systems, applications, effective methods and forms of learning that can be used both in the study process and individually.

Each semester, a core set of activities is offered taking into account the professional competence and needs of the academic staff. As a basis for the list of professional development activities in the autumn semester of 2019, the academic staff survey that was conducted in 2018 was used, in which the academic staff mentioned the topics they would like to acquire. Such surveys are planned to be conducted every two years or as required.

The Center for Academic Excellence organizes two methodological conferences a year. The conference organized in the autumn semester is dedicated to the modern content of the study courses, while the conference held in spring focuses on modern teaching and learning methods. Materials of all events are available on ORTUS within the study course "Materials of the Center for Academic Excellence".

After each professional development event, participants complete assessment questionnaires, which enable organizers to improve the range of offered events. In order to promote the development of competences of the academic staff, the student surveys are analysed each semester, as well as discussions with the representatives of faculties, student self-governments and the instructors themselves take place.

Lecturers have the opportunity to improve their knowledge of English using the courses proposed by the Institute of Applied Linguistics and the courses provided by the RTU Riga Business School, which are organised thanks to the SO 8.2.2 project funding.

In case of emergency and when education switches to distance mode, the Centre of Academic Excellence prepared the website “Support for providing distance courses” on the ORTUS portal. The website consists of six sections: General information, Technical help, Pedagogical help, Experience stories, Distance examinations and Mutual support. Each section is regularly supplemented with new up-to-date materials. Lecturers highly appreciate the existence of such a resource, and recommend the materials to be placed there.

Since March 2020 there have been almost 80 webinars (organised by the RTU Centre of Academic Excellence and international, where RTU lecturers were invited to participate). The webinars organised by the Centre of Academic Excellence were recorded, more than 400 participants participated in them online, while recordings were watched almost 650 times.

Educational events are also organized by the Career Support and Services Unit, providing regular seminars to RTU academic and general staff on the following issues:

- cultural diversity;
- work productivity (time planning, conflict resolution, communication culture, etc.);
- critical thinking;
- work with students with reduced mobility.

For participation in seminars, employees receive professional development certificates issued by RTU Department of Further Education.

The themes of seminars and classes are offered taking into account the results of RTU staff surveys, as well as current trends at foreign universities. Information on seminars organized over the years is available at https://www.rtu.lv/en/studentservice/career-centre/projects-and-seminars/seminars-and-lectures.

RTU IT User Support Center regularly organizes training on IT systems and the latest technology tools for RTU academic and general staff. Training is organized on the following topics:

- e-learning environment (Moodle) for beginners;
- e-learning environment (Moodle) for advanced users;
- MS Outlook email and calendar;
- Office365 Teams and OneDrive;
- searching in subscribed databases;
- record-keeping systems;
- basic IT security issues working with RTU information systems.

In January of each year, competition organised by the RTU student parliament “The Annual Award of the Riga Technical University Students Parliament” takes place. During event, faculty members are honored in nominations "Most Active Teacher of the Year" and "Teacher of the Year", where academic staff members selected by the students are awarded. In 2016, Gatis Bažbauers, the teaching staff of RTU IESE, was awarded the title of the Most Active Teaching Staff at the Faculty of Energy and Electrical Engineering (FEEE).

To recognize and appreciate RTU academic staff, since 2018, RTU has been organizing contests “Annual Academic Excellence Awards” and “Young Academic Staff Member of the Year” in cooperation with the foundation “Riga Technical University Development Fund” and Industry Service Partner Ltd. The aim of these events is not only to award the best academic staff members, but also to promote creativity in the academic environment.

Training courses and seminars on latest teaching, teaching methods are organised for academic staff, as well as attendance of in-service training courses at both internal faculty events is encouraged, both at RTU level and internationally. The RTU Centre for Academic Excellence organizes activities for development of academic staff at university level. Academic staff have opportunities to supplement professional knowledge and gain valuable experience in a foreign university (using Erasmus and Erasmus +, COST or project mobility opportunities), which is coordinated with the European Higher Education Area development strategy, as well as internships in companies.

Academic staff involved in implementation of study programme conducts international research, which is also proved by performance of scientists (articles in journals, associated scientific projects and contract work), raising their qualifications and promoting scientific research activities (see biographies of teaching staff). Academic staff have opportunity to supplement their knowledge and gain valuable experience in one of foreign universities, which is in line with strategy for development of the European Higher Education Area.

In order to advance professional pedagogical competences of the academic staff, courses and seminars on the newest pedagogical methods are organized regularly. Qualification advancement is provided at both the University and faculty level, organizing academic conferences and methodological seminars. The Centre for Academic Excellence has been established and successfully operates at RTU; it organizes various events aimed at professional advancement of academic personnel at the University level. (in addition, see the description of each study programme).

In order to increase qualification of teaching staff and raise quality level of teaching staff's skills, academic staff of RTU IESE also regularly develops an action plan and offers various professional development activities and participation in seminars and working groups, where there is an opportunity to develop existing skills and learn new ones. In recent years, RTU IESE has been attracting industry personnel management professionals , for example, “SUPPORT” specialists of vocational training and development education establishment, and in response to developments in studies and research, following refresher seminars were organised for employees of RTU IESE: “Sarežģītas sarunas” (‘’Complicated talks’’) part 1 and part 2 (18.09.2019. and 27.09.2020), “Psihosociālie riski darba vidē” (‘’Psychosocial risks in working environment ‘’)(25.10.2020).

In accordance with the RTU IESE Strategy and the goals set by FEEE in study process excellence, an annual evaluation of professional qualifications of academic and scientific staff takes place within organisational units and recommendations are drawn up based on the evaluation results.

The **Latvian Council of Environmental Science and Education** (LCESE) plays an important role in the improvement of didactic abilities of the teaching staff of the RTU study direction

"Environmental protection". The purpose of LCESE is to develop environmental science and education in Latvia by improving the quality of the research programmes carried out, compliance with European level, promoting cooperation with potential employers and decision-makers (for additional information on the Council see section 5.1). The most important events of LCESE in improving the teaching capacity of teaching staff are:

- Round table discussions with the members of the Council with a view to developing and integrating the principles of education for sustainable development in study processes in university study programmes.
- Organisation of the Environment Education Conference. The conference brings together university teaching staff and school teachers from Latvia and Europe in the field of environmental protection in order to share the experience in new study methods in environmental education.
- Organisation of the "Environmental Science Award" contest, which rewards the most prominent teaching staff and environmental educators. In the contest, awards are presented in 5 nominations: "New Environmental Scientist", "Teacher of Environmental Science", "Group of Environmental Activists", "Environmental Scientists or University Teacher" (an overview of the "Environmental Science Award" contest is available on https://videszinatne.rtu.lv/en/environmental-science-award-2017/).

Participation of teaching staff in respective COST activities also plays a significant role in the integration of new study process methods in the study direction "Environmental protection". For example, participation of professor J.Gušča in COST 16229 "European Network for Environmental Citizenship", which particularly focused on integration of proper and innovative education models in environmental education.

Examples of the professional improvement seminars organised for academic staff of RTU IESE in the reporting period:

- seminar on the use of "Microsoft Office 365". The seminar covered the topics of editing and saving documents in web software (Word Online, Excel Online, PowerPoint Online or OneNote Online), as well as sharing opportunities in different workgroups providing for convenient and quick processing of documents and summarising of data;
- seminar on computer software used Microsoft Word, Microsoft Excel and Microsoft PowerPoint. The emphasis of the seminar was to encourage record-keeping staff to use the opportunities provided by computer software more widely keeping track of the most convenient software use options and thus maximally reducing the time for preparation of different documents and reports;
- seminar for office administrators and heads together with Deputy Director of the RTU Study Unit and head of the Study Organization Unit on latest developments in record-keeping organisation matters, incl. procedures and deadlines for record-keeping documents; electronic application for state scholarships;
- seminar for office administrators and heads on preparation of data for annual reports and statements.

The data obtained during professional improvement and improvement of qualification, as well as in research work are integrated in the study process thus improving it. Latest developments in the field are constantly followed-up in the study process – academic staff participates in projects, the results are used in updating the study curriculum. Local and international cooperation in research and academic works is an important element of development of staff. (for additional information see Chapters 4 and 5 of Part II of the Report). Professors and associate professors are repeatedly evaluated and elected every six years. Candidates for the position are obliged to meet certain

criteria for scientific activity, i.e. the number of publications or patents, the number of doctoral theses supervised, etc. (RTU Senate decision No. 594 “On RTU Regulations on Election of Professors and Associate Professors After Approval in the New Wording”, adopted on 30.11.2015). The right to supervise doctoral theses is awarded, if academic staff has the status of an expert in a specific field of science (RTU Senate decision No.602 “On Amendments to the Regulations for Doctoral Studies at the Riga Technical University”, adopted on 26.09.2016), which is possible only if criteria with regard to the number of publications/patents are met. The status of an expert is awarded by the Latvian Council of Science. The database of experts is published in the National Information System of Scientific Activity (NRIS; http://sciencelatvia.lv).

In January of each year, competition organised by the RTU student parliament “The Annual Award of the Riga Technical University Students Parliament” takes place. During event, faculty members are honored in nominations "Most Active Teacher of the Year" and "Teacher of the Year", where academic staff memebers selected by the students are awarded.

From 2018 RTU in cooperation with the foundation "Riga Technical University Development Fund", and thanks to financial support of SIA "Industry Service Partner", with aim to identify and evaluate RTU teaching staff, competitions are organised for award of the “Annual Academic Excellence Award” and the "New Teacher of the Year Award and Honorary Title". Aim of these events is not only to reward best teaching staff members, but also to promote creativity in academic environment. In 2020, award for academic excellence was received by the director of RTU IESE, director of the study field “Environmental Protection” and director of the study program “Environmental Engineering”, professor Dr.hab.sc.ing. Dagnija Blumberg.

For example, director of RTU IESE Dagnija Blumberga received the RTU Annual Award in valorisation in 2018. In the Latvian Academy of Sciences and Latvenergo competition, the “Annual Award” 2019, several teachers of RTU IESE received recognition for their achievements. Emeritus Professor Ivars Veidenbergs won an award for a significant contribution to energy, RTU IESE director Dagnija Blumberga won A.Vītola Award for an excellent contribution to energy, for a lifetime investment in Latvian energy, docent Vladimirs Kirsanovs won an award for energy success for new scientists, Ritvars Freimanis won AS Latvenergo the awarded “Annual Award” for final work of studies. In 2014, Mikelis Dzikevichs won the “Latvenergo” Annual Awards in the Master thesis category. In 2019, the REGIOSTARS award was received by RTU IESE professor Andra Blumberga in the category “URBAN DEVELOPMENT: Creating cities resistant to climate change”. In the past, teaching staff members of RTU IESE have also been rewarded for their success in science. For example, in 2017 the “Environmental Science Award” was launched by the Environmental Science and Education Council . In 2017, five RTU IESE teachers won the Environmental Science Award. Anna Kubule and Aiga Barisa won the award for “New Environmental Scientist 2017”, while Jelena Pubule and Francesco Romagnolli won the award for “Environmental Scientist or university Teacher 2017” RTU IESE Director Dagnija Blumberga was awarded the award “RTU Annual Scientist 2017”. Many from RTU IESE teaching staff have received recognition from the SIEMENS. For example, in 2012 Vladimir Kirsanovs won the Werner von Siemens Excellence Award in master's thesis competition and in 2014 Dace Lauka won the Werner Von Siemens Excellence Award. In 2020, Miķelis Dzikēvičs, an assistant professor of RTU IESE, was awarded as the young scientists of the year by Latvenergo.

SO 8.2.2 “Strengthening of academic staff of the Riga Technical University in strategic specialisation areas” funded by the European Social Fund and implemented by RTU makes a significant contribution to the improvement of qualifications of teaching staff. The objective of the project is to strengthen RTU academic staff in strategic specialisation areas in 10 study directions, including in the “Environmental protection” study direction by employing foreign academic staff, doctoral students and candidates for scientific degrees at RTU. The project activities focus in three

directions: (1) involvement of doctoral students in academic work at RTU, (2) employment of foreign academic staff at RTU, (3) improvement of the competence of existing academic staff, including traineeships of academic staff with an undertaking, teaching of business English to academic staff and specialised training for academic staff. One of activities of the project is directly focused on upskilling of teaching staff i.e. improvement of the competence of existing academic staff, including traineeships of academic staff with an undertaking, teaching of business English to academic staff and specialised training for academic staff. The activity is intended to cover:

- improvement of the competence of existing academic staff. Specialised training and upskilling activities for academic staff within the project, which will develop academic staff's leadership and cooperation competence with industry.
- teaching of business English to academic staff. Teaching of business English will be provided to academic staff who have assessed their knowledge at A and B levels to improve their skills.
- specialised training for academic staff. In order to support the development of the competences of academic staff, such as leadership and cooperation competence with industry, a cycle of seminars, discussions or conferences on different topics is planned within the framework of the Project.

3.6. Provide information on the number of the teaching staff members involved in the implementation of the relevant study programmes of the study direction, as well as the analysis and assessment of the academic and research workload. Provide the assessment of the incoming and outgoing mobility of the teaching staff over the reporting period, the mobility dynamics, and the issues which the higher education institution/ college must tackle with regard to the mobility of the teaching staff.

40 (i.e. 72%) of RTU IESE teaching staff members are involved in the implementation of the study direction "Environmental protection", all of whom are elected in some academic position at RTU. In addition, teaching staff from other structural units also participate in study process, of which 20 (t.i. 33 %) are elected to one of academic positions at RTU. The professional qualification of academic staff fully corresponds to implementation of study programs of the study field 49 persons (81.7 %) from academic staff elected by the RTU have a doctorate, 14 (16.7 %) – have master's degree and 1 person (1.7 %) has a Bachelor's degree. Extensive information on all the teaching staff of the study direction is available in Appendixes: List of academic staff and CVs.

The analysis of elected academic staff of RTU leads to the conclusion that the doctoral degree has been obtained in the field of science corresponding to the course being taught. . The majority obtained a doctorate in the "Environmental Engineering" sub-sector but, depending on course being taught, there are also representatives of academic staff with a doctoral degree in economics, engineering, pedagogy, social sciences, etc. 71% of all the teaching staff involved in the study direction are teaching staff of RTU IESE. In addition, the average age of teaching staff is **39.8 years** (on average, age structure of the RTU shows a high proportion of older people – 20% of workers are aged < 64, RTU IESE – 7%; in addition, see the diagram "*Distribution of elected RTU IESE teaching staff by age".* However, as mentioned before, over 81.7 % of all the teaching staff involved in the implementation of the study direction (from RTU IESE and other organisational units) have a doctoral degree (RTU IESE teaching staff – 75%), as well as all RTU IESE teaching staff with a doctoral degree are experts from the Latvian Council of Sciences in different subsectors of science. (e.g. Environmental Engineering and Energy, Earth Sciences, Physical Geography and

Environmental Sciences, Environmental Biotechnology, etc.) and experts from the European Union. These indicators are essential for ensuring quality, sustainability and continuity of study programmes.

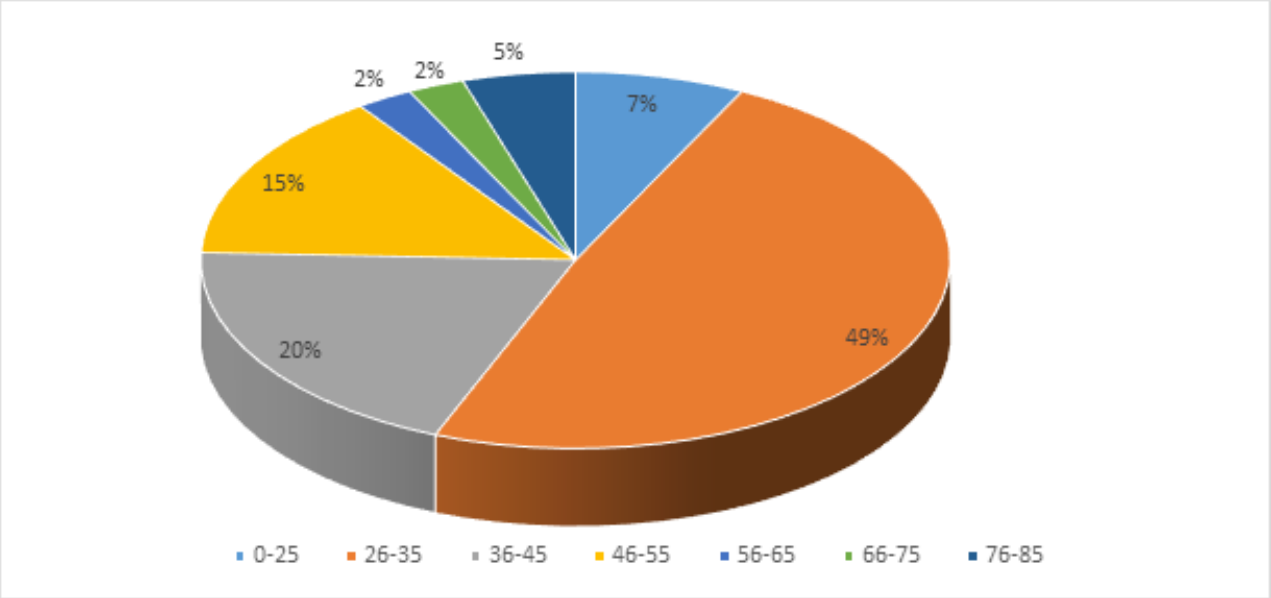

Figure: *Breakdown of elected RTU IESE teaching staff by age.*

15 (26%) academic staff representatives who have been elected as professors or associate professors participate in the implementation of studies. 17 (30 %) are assistant professors, 13 (23 %) are researchers-doctoral students, 1 (2 %) is a scientific assistant and 1 (2%) is a lecturer.

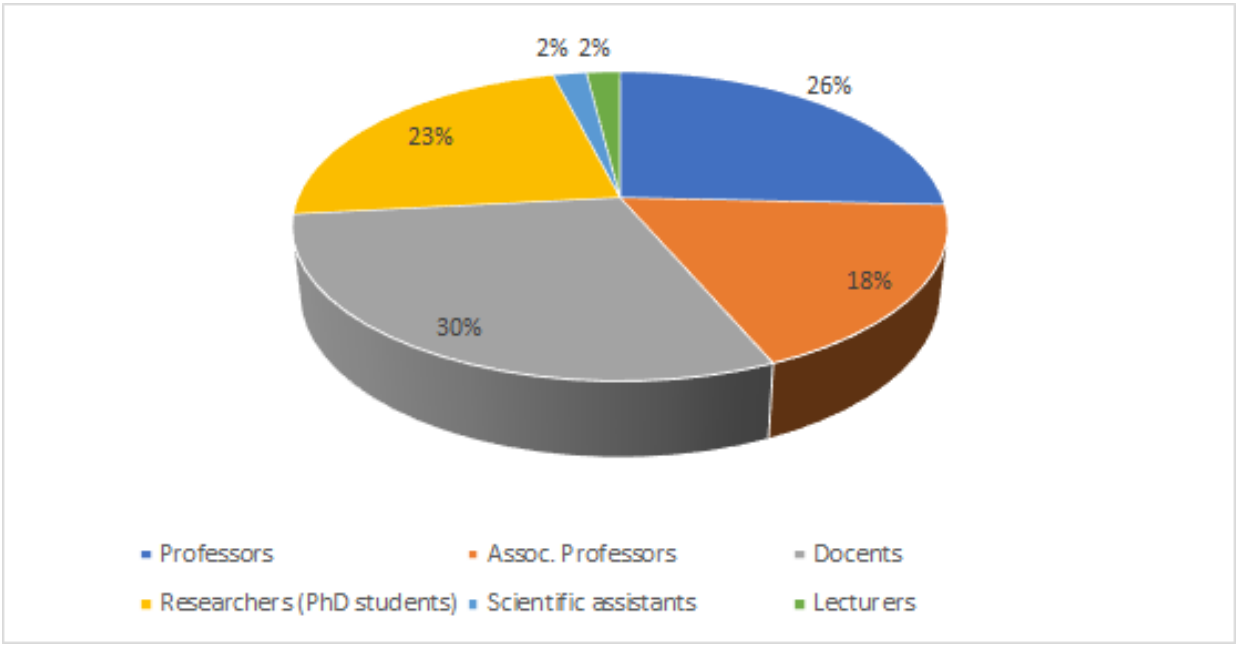

Figure: *Breakdown of total elected teaching staff into groups of positions*

Of them, the study direction currently employs 9 professors and 4 associate professors (32% in total), whose main responsibility is development and improvement of study courses, work with doctoral students and Master students, as well as they have higher workload in research work and work in scientific projects. The assistant professor's position has comparatively the highest academic load with 14 (34%) persons elected. Most of RTU IESE teaching staff consists also of 13 (32%) researchers-doctoral students and 1 (2%) scientific assistant. The RTU IESE academic staff, whose main priority is scientific research work, are 30 leading researchers, 47 researchers and 34 scientific assistants.

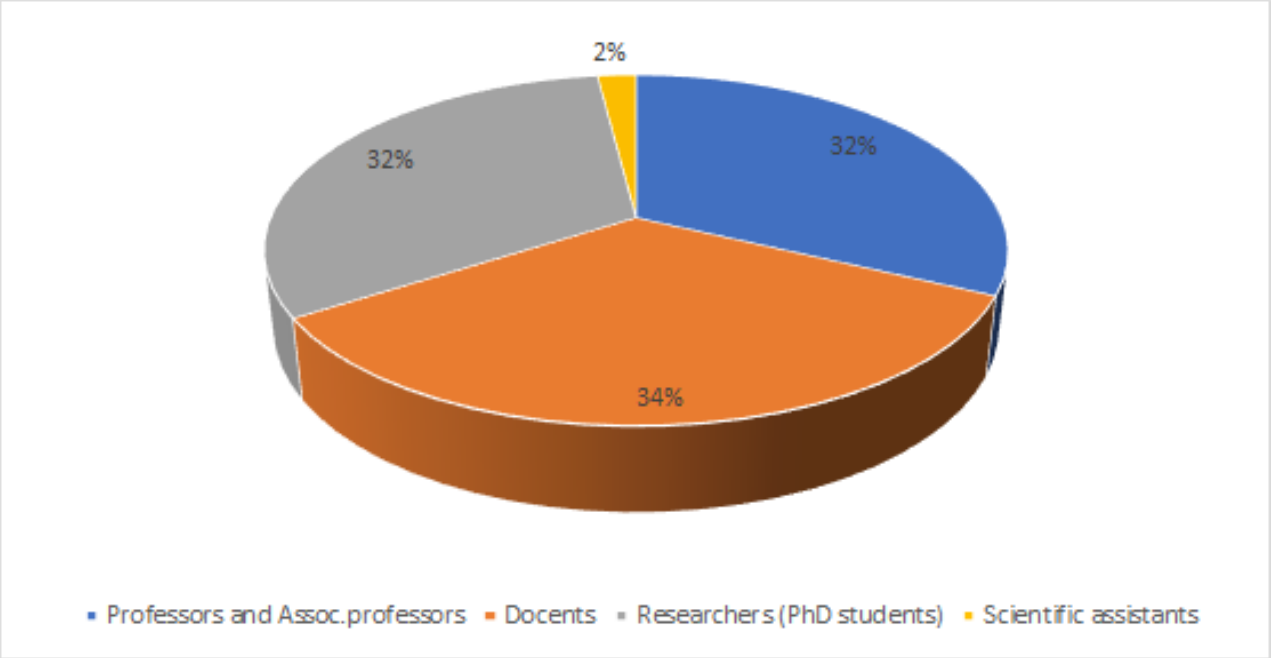

Figure: *Breakdown of RTU IESE elected teaching staff into groups of positions*

The evaluation of academic staff representatives involved in the implementation of studies and holding a doctoral degree leads to the conclusion that this group includes all the 15 elected professors and 10 associate professors, as well as 17 assistant professors. Out of 2 of the teaching staff members elected into a scientific position 2 hold a doctoral degree and have been elected as researchers.

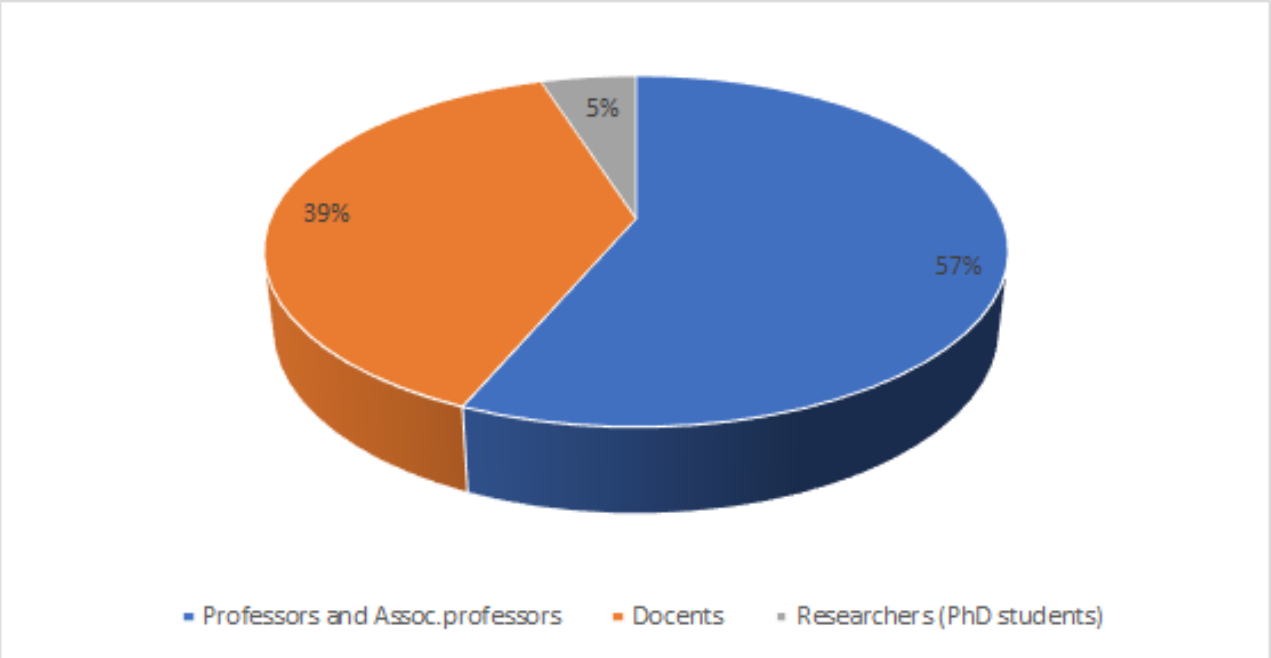

Figure: *Breakdown of positions of elected teaching staff holding a doctoral degree in the study direction "Environmental protection"*

Out of the above-mentioned 44 teaching staff members involved in the study direction and holding a doctoral degree, RTU IESE academic staff consists of 29 teaching staff members (66%of total teaching staff). The share of these 29 teaching staff members who hold a doctoral degree are: 9 professors, 4 associate professors, 14 assistant professors and 2 researchers (with a doctoral degree).

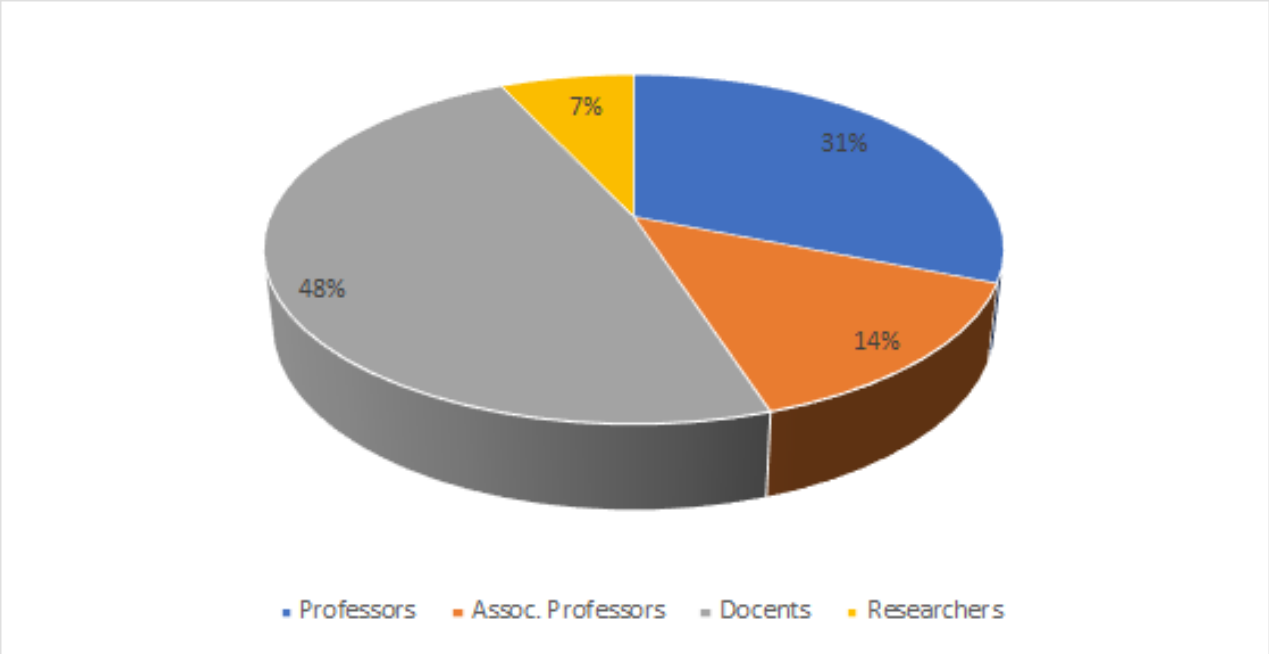

Figure: *Breakdown of positions of elected RTU IESE teaching staff holding a doctoral degree*

Furthermore, out of 12 academic staff representatives without a doctoral degree, who are involved in the implementation of study programmes, 11 do academic work as researchers and 1 person as a scientific assistant with a Bachelor's degree.

Every day, staff responsibilities overlap, and all elected academics have both academic and research and, in some cases, administrative work. The RTU does not make a strict distinction between academic and research tasks, the proportion of which is determined individually for each academic staff representative when planning a staff load in department, as well as, in the light of his or her position, involving in project implementation, professional expertise and experience. The qualifications of academic staff in field of studies are very high, particularly importantly, that vast majority of academic staff with a PhD are leading professors and leading researchers in their field with significant international experience. This is reflected in scientific performance of teaching staff: the average **Hirsch (H) index** for teachers involved in implementation of study programmes is **5.93.**

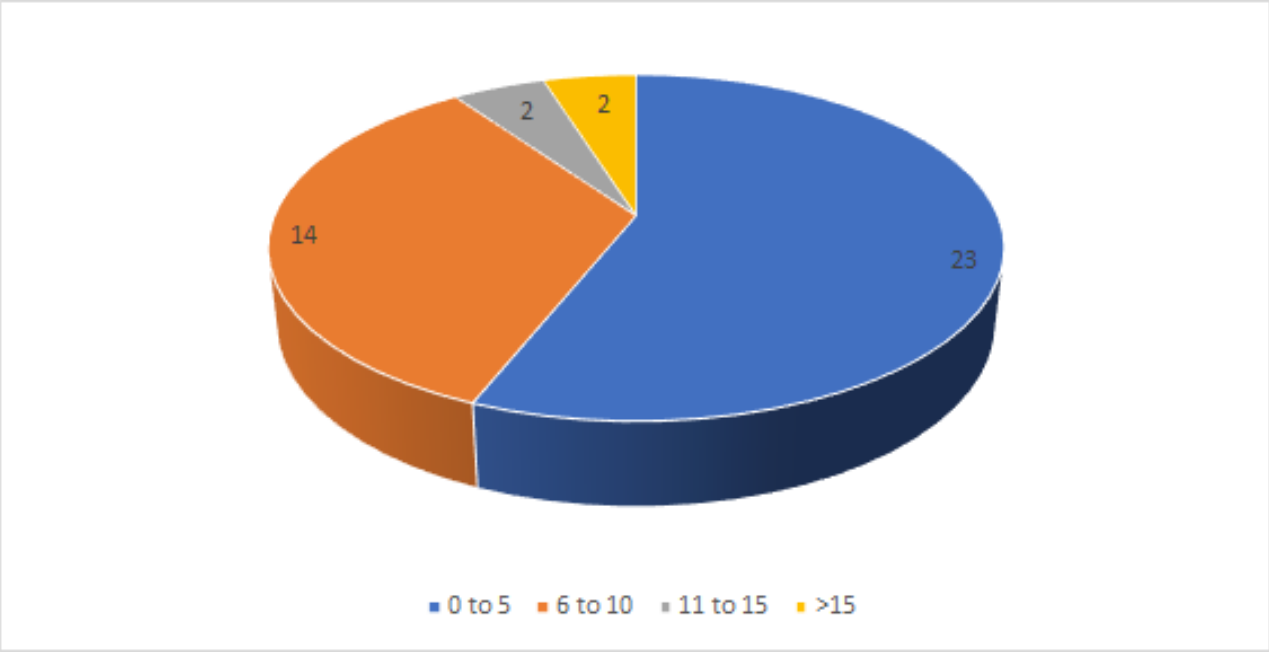

Figure: *Breakdown of RTU IESE teaching staff involved in the study direction by Hirsch indexes*

But no less important is the fact that those from teaching staff who currently have only a master's degree are, in most cases, working under leadership of professors and associate professors. Most of these teaching staff are doctoral candidates or applicants for a scientific degree. RTU IESE has since 2012 introduced a system for development of the study process involving the responsible faculty in implementation of each study course (experienced teaching staff) and a teaching assistant (new science doctorate or phD student). Such a division of positions marks a strong tendecy towards knowledge transfer and ensuring sustainability, so that course of studies can continue in the fields of high quality work, as well as in fields of research and innovation.

RTU IESE **academic staff actively participates in scientific and advisory work and** in recent years the main areas of research papers have been smart energy, bioeconomy, energy performance of buildings, biotechnologies, 4th generation heating systems, recovery of resources, resilience of systems. However, every year RTU IESE extends its scientific research activity by including new environmental protection thematic areas. Teaching staff of the **doctoral study programme** also works in the Doctoral Council and in Doctoral Councils of other universities as reviewers, e.g., University of Latvia, Latvia University of Life Sciences and Technologies, Vilnius Gediminas Technical University (Lithuania), Kaunas University of Technology (Lithuania), Estonian University of Life Sciences (Estonia), Tallinn University of Technology (Estonia), Brno University of Technology (Czech Republic), Mykolas Romeris University (Lithuania), Aalto University (Finland), Technical University of Denmark (Denmark), Chalmers University of Technology (Sweden), Aalborg University (Denmark). For additional information on the doctoral study programme and its significance see Part III of the description of the doctoral study programme “Environmental Engineering”.

RTU has several **support mechanisms for the involvement of academic staff in scientific activities**, of which the RTU Research Support Fund and the Research Platforms can be mentioned as the most important. RTU Research Support Fund (decision of RTU Senate No. 585 "RTU Regulation of Research Support Fund" as of 15 December 2014) aims at providing financial support for various research related activities, such as support for maintenance of research equipment, protection and licensing of intellectual property, covering of expenses related to the Doctoral study process, publishing of scientific journals, participation and organization of scientific conferences, support to researchers in establishing new laboratories in a prospective research field. The Research Support Fund is an instrument to support research activities, which foster the development of the strategically important research fields. At RTU level, in 2013, six research platforms were set up in the RTU’s main strategic research directions as an instrument to promote interdisciplinary and interfaculty cooperation between researchers in areas of industrial and societal importance. These platforms are: “Energy and environment”, “Cities and Development”, “Information and Communication Technologies”, “Transport”, “Materials, Processes and Technologies”, “Security and Defence”. Each platform has a coordinator, who together form the Council of Coordinators responsible for the implementation of activities on the platforms. The Council is subordinated to the Office of Vice-Rector for Research (RTU Senate decision No. 600 of 23 May 2016 “On the approval of the Regulations of Coordinators of the Research Platform of Riga Technical University). Like faculties, platforms have a research programme (RTU Senate decision No. 590 of 27 May 2015 “On the authorisation of the RTU Research Council to approve an RTU Research Programme; “Riga Technical University Research Programme for 2016-2020”), an annual action plan and funding from the Research Support Fund. Internal project competitions are organised every year, granting 90 – 120 thousand EUR for the projects selected in a competition. The mandatory requirement for projects is 20% industry co-funding and the participation of more than one faculty. Between 2016 and 2020, 16 projects with a total co-funding of nearly 300 thousand EUR were supported in this way. The Research Platforms regularly organise workshops on the transfer of best practices, tours of companies to promote networking opportunities and

cooperation with industry representatives, as well as other activities. **The knowledge and experience acquired is used in the studies, ensuring integration of the scientific process into the study process**. The objectives of studies and research at RTU IESE are aimed at promoting successful research, its link it to academic studies and integration into them, and helping early-stage researchers to successfully enter the profession.

The interdisciplinary role of the study process and research, including the scientific-research symbiosis of RTU institutes and faculties, is ensured through participation in the work of RTU Research Platforms aimed at providing interfaculty, interdisciplinary research in areas relevant to the economy and society. The Research Platforms are a cooperation coordination mechanism which aims to analyse the needs of companies and different national authorities in order to define potential research directions in line with RTU's competences, to organise relevant internal project competitions, applications for international projects, cooperation with companies and national authorities. RTU IESE together with other FEEE institutes, participates in the RTU research platform "Energy and Environment" coordinated by RTU FEEE.

The link of the study process to scientific research is ensured using potential knowledge transfer principles and continuous improvement of competences, which manifest in integration of research results in study courses and study process, involvement of students in research, familiarising of students with latest research results, enabling them to conduct research work independently or in cooperation (team work). The link of science and research to the study process is ensured also by involving visiting lecturers in lectures and practical classes, active participation of students in international conferences and seminars, preparation of international scientific publications and participation in international cooperation research projects; thus developing their research skills during all studies, at the same time fostering that students become young scientists. During studies RTU IESE encourages Bachelor, master and doctoral students to get actively involved in research, to foster interaction with research staff and get to actively involved in scientific research activities. Students of the study direction "Environmental protection" actively participate in the development of spin-offs (e.g. the students of the Master programme Mārtiņš Karols), where researchers ad graduates continue to successfully develop scientifically and economically successful results affecting the economy, society and culture. Such activities increase the sustainability of study programmes by encouraging students to work in science, to select future doctoral studies as well as doctoral students, to continue their scientific activities after obtaining a doctoral degree at IESE and in others scientific institutions.

The effectiveness of the study process and scientific research is confirmed by the fulfilment of the targets and outcome indicators set by RTU IESE and their growing dynamics. Thus, for instance, an increase in the number of reports of students has been observed at the international scientific conference CONECT organised by RTU IESE every year since 2014 (21 in 2014, but 60 reports in 2020), elements of research were included in about 47% of courses in study programmes in 2013 and in about 84% of courses in 2020. Close cooperation with industry, businesses, associations (active membership of teaching staff in associations) and other stakeholders in the sector, and therefore the implementation of applied scientific projects, increases the possibilities of integrating the most appropriate scientific solutions into the study process.

Undeniable ensuring of sustainability of balanced development of scientific research of RTU IESE is cooperation and strong cooperation partners in Latvia, other European Union Member States, Scandinavian countries, Russia, Kazakhstan, Uzbekistan, Ukraine, Moldova, the United States, Canada, Taiwan, India and other countries. RTU IESE participates in joint Baltic Sea Region, Horizon 2020 and Nordic Energy Research programmes and projects whose results have contributed to the development of environmental engineering studies and resolution of practical challenges for industry companies. It is the scientific research capacity and achievements of RTU IESE that are the

main prerequisites for the successful improvement of study programmes of the study direction “Environmental protection” and for the development of science-based study programmes. Obviously, doctoral programmes (“Environmental Science” and “Environmental Engineering” study programme) contribute to and at the same time gain from the implementation of institutional activities based on scientific progress.

The most important form of integration of scientific and research activities in the study process is participation in international scientific research projects, conducting research commissioned by the state and industry resulting in scientific publications, patents and participation and reporting at international and local conferences. Taking into account that research in the field of environmental protection, in essence, mainly is applied and interdisciplinary research, part of research of the direction also belongs to this group.

The involvement of foreign visiting docents and visiting professors in study process is distributed separately. This number is variable and depends on a number of factors, such as the availability of visiting professors in a given study year, schedules of study courses and the need to associate teaching staff of the specific specialisation, as well as the financial means available. Foreign visiting professors elected in 2019./2020 (with employment at the RTU for at least 6 months) represented 7% of the total number of teaching staff. In general, 6 people were employed in the “Environmental protection” course during this period, i.e. 19% employed in academic positions; they represent Italy, Colombia, Norway, India and Estonia . Based on the new RTU development strategy 2021-2025, work is underway to create a stable long-term system for provision of visiting professors at the RTU in order to ensure sustainability and quality of the study process.

The proportion of temporary teachers in the study direction “Environmental Protection” is minimal - in the period from 2013 to 2020 year there were 19 people, all with a master's degree.

Academic staff from other departments and sectors with appropriate professional experience is also involved in implementation of the study process.

In addition, high-level specialists (guest lecturers) from industry, public authorities, non-governmental organisations, etc. are actively integrated in course of study, in line with the needs and specificities of each study course. The main goal of attracting such teaching staff is to increase the quality of the content of studies and to carry forward current industry trends in the content of studies. Such a requirement has been defined at the meeting of RTU IESE and has been in force since 2015 for all studies under the heading the “Environmental Protection”. The aim of requirement is to ensure close cooperation between academic process and industry and to reduce the thematic and development gap between each other. In the period from 2015-2020. In total, there were 42 people involved in implementation of the study programs of the study direction “Environmental Protection”. A large part of guest lecturers are partners for the RTU IESE's scientific-research activities as well as former graduates. The distribution of invited visiting lecturers according to the obtained academic degree is given in the figure.

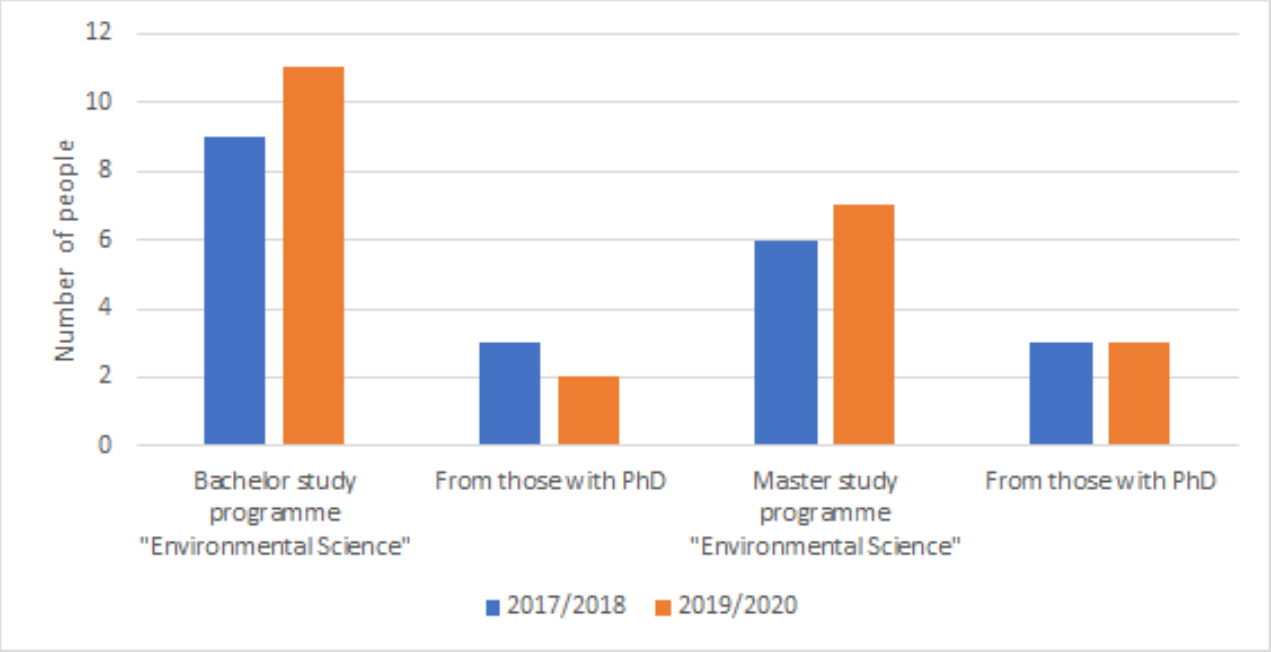

Figure: *Breakdown of invited (short-term) visiting teaching staff from industry by obtained academic degree*

Improving skills of teaching staff through mobility programmes, as well as attracting foreign lecturers, are essential to ensuring the quality of the study process. The mobility of teaching staff in course of study is considered to be very high and has taken place in different forms. Many teachers have improved their qualifications by participating in international teacher exchange programs (eg ERASMUS +, COST mobility and others). During the reporting period, academic staff and administrative staff actively participated in international exchange programmes and conducted guest lectures abroad.

During the reference period, about 170 visits took place with the aim to participate in international conferences and seminars, more than 20 experience exchange trips and meetings to discuss possible cooperation, and there was regular participation in working groups of international project partners.

The Erasmus + program is of particular importance in international cooperation between universities. RTU IESE teaching staff used teaching or scientific research mobility opportunities 66 times per year on average from 2013 to 2020. Kazakhstan was most visited (18 visits) to *Rudnenskiy Industrial'nyy Institut* (Kazakhstan) and *Kostanay State University* (Kazakhstan), where RTU IESE teaching staff went to teach within the *TEMPUS* project "*Green Engine*". Other countries visited for the purposes of teaching, mainly within *ERASMUS+* and scientific research projects, were Lithuania (15 times), Uzbekistan (8 times), Italy (9 times) and Scandinavian countries (Finland, 7 times). The number of visits depends on individual factors related to succession of cooperation. The total number of mobilities has generally increased in recent years – due to active participation of RTU IESE teaching staff, for example, *COST* teaching staff mobility activities and more active use of teaching staff mobility scholarships within the *ERASMUS+* programme and academic project cooperation. A table with data on participation in the *Erasmus+* programme is enclosed in Annex "Incoming_outgoing mobility of teaching staff".

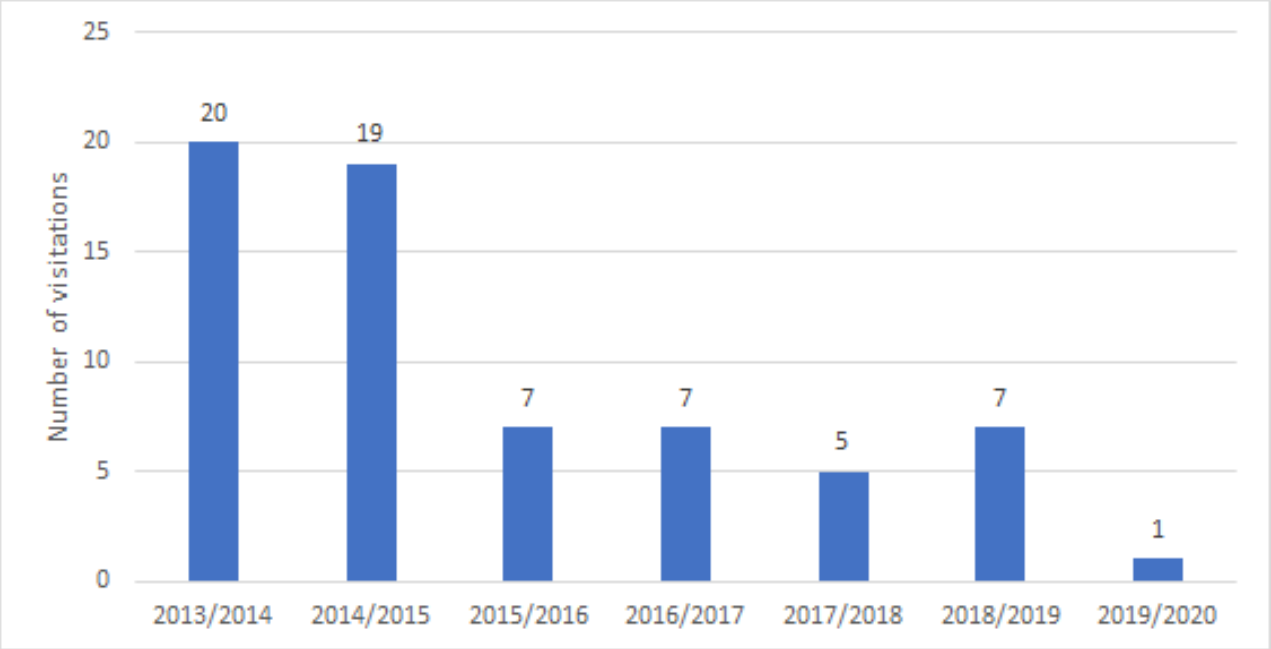

Figure: *Number of teaching and scientific research mobilities in the reporting period*

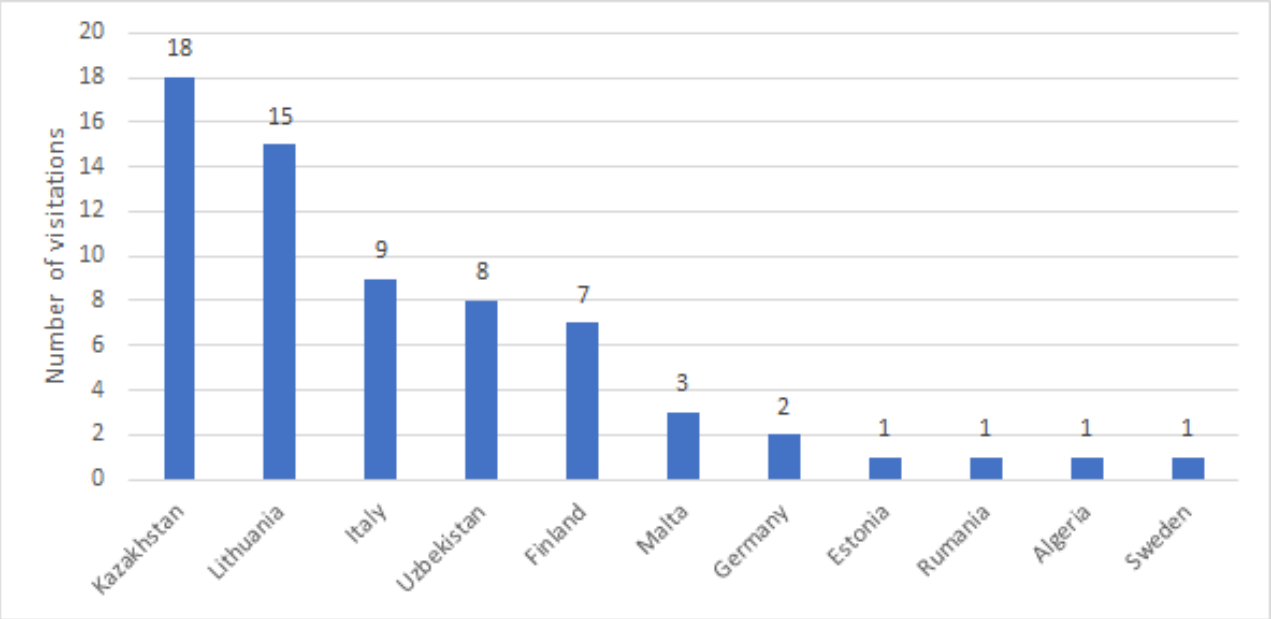

Figure: *Breakdown of teaching and scientific research mobilities by countries.*

In the reporting period, teaching staff of the study direction “Environmental protection” read visiting lectures in several countries using exactly the opportunities provided by ERASMUS+. For instance:

- In the year of studies 2013/2014, within the *TEMPUS* project “Green Engine” a delegation of RTU IESE teaching staff (5 teaching staff members – *hab.sc.ing.* professor Dagnija Blumberga, assistant professor *Dr.sc.ing.* Elīna Dāce, assistant professor *Dr.sc.ing.* Valdis Vītoliņš, assoc.professor *Dr.sc.ing.* Edgars Vīgants, researcher *Dr.sc.ing.* Jeļena Ziemele) went to Kazakhstan three times to read lectures at *Rudnenskiy Industrial'nyy Institut* (Kazakhstan) and *Kostanay State University* (Kazakhstan) on energy efficiency measures at industrial companies.
- In the year of studies 2014/2015 within bilateral cooperation with Uzbekistan a delegation of RTU IESE teaching staff (4 teaching staff members – *hab.sc.ing.* professor Dagnija Blumberga,

assistant professor *Dr.sc.ing.* Aivars Žandeckis, assistant professor *Dr.sc.ing.* Elīna Dāce and assoc.professor *Dr.sc.ing.* Edgars Vīgants) went for teaching mobility to *Urgench State University* (Uzbekistan) to read lectures and practical work on energy management and environmental management.

- From the year of studies 2013/2014 to the year of studies 2018/2019 (teaching on-site was replaced with e-classes due to the COVID-19 restrictions in the year of studies 2019/2020), within the double Master diploma programme, there is teaching at the Vilnius Gediminas Technical University (Lithuania), where RTU IESE teaching staff, for example, lecturer Karīna Bāliņa, assistant professor Dāce, associate professor Jūlija Gušča and RTU IESE director, professor Dagnija Blumberga lead lectures and practical work.
- In 2016, Assistant Professor Dzintars Jaunzems gave lectures at the University Abdelhamid Ibn Badis Mostaganem and University des Sciences et de la Technologie d'Oran (Algeria).
- In 2018, associate professor Francesco Romagnoli went to University of Perugia, Faculty of Agronomy (Italy), to guide lectures to students. Even this year, ERASMUS + mobility opportunities were also used by docent Dzintars Jaunzems to Uppsala University, Faculty of science and technology (Sweden).
- In 2019, associate professor *Francesco Romagnoli* went to Sapienza University of Rome (Italy) to read lectures on life cycle analysis to students.

Foreign teaching staff have been involved in study process in the direction programmes throughout the reporting period. The Erasmus + mobility programme, COST mobility, Nordic mobility support instruments, as well as other opportunities related to participation in joint international projects, participation in scientific research, etc., are used to attract guest lecturers.

Between 2013 and 2020, 117 academics from 15 different countries around the world participated in implementation of study programmes under the “Environmental Protection” heading. Most of foreign visiting university lecturers were attracted in the year of studies 2014/2015. Foreign academic staff has represented 22 different universities and international institutions.

According to Section 3(7) of the Law on Higher Education, which entered into force in 2018, at least five per cent of the number of academic staff in higher education shall be guest professors, associated guest professors, guest docents, guest lecturers, professors, associate professors, docents and lecturers, who have been continuously employed in an academic position in one of the accredited universities of the European Union, the European Economic Area or the Organisation for Economic Cooperation and Development, except Latvia, during the previous five years. In course of studies, the dynamics of foreign guest lecturer mobility changes every year and it has a steadily increasing tendency - from 8 % 2013/2014. in the study year up to more than 31 % 2014/2015. study year.

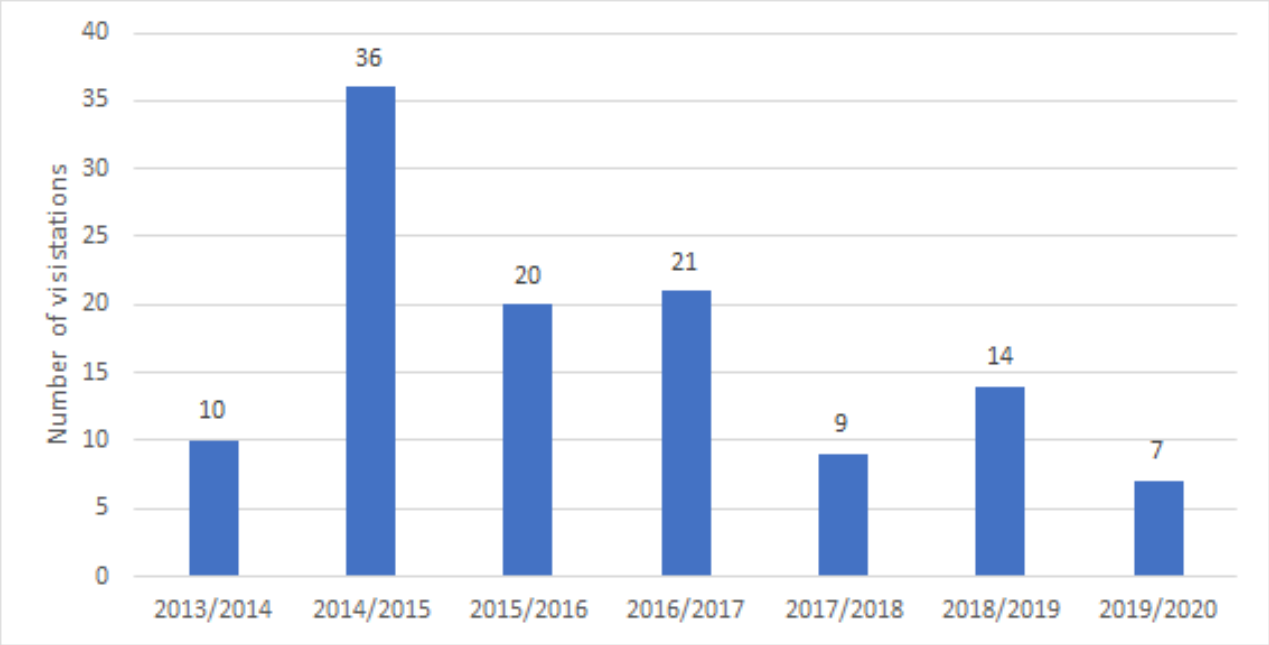

Figure: *Ingoing mobility during the reported period, number of lecturers*

The most lecturers have thaught from Lithuania (58 times), followed by Norway (13 times) un Finland (12 times). The repetition of countries is legal, since successful cooperation with specific universities is often established. For example, in Lithuania, such is Vilnius Gedimins Technical University, in Finland Aalto University, in Estonia Tallinn Technical University.

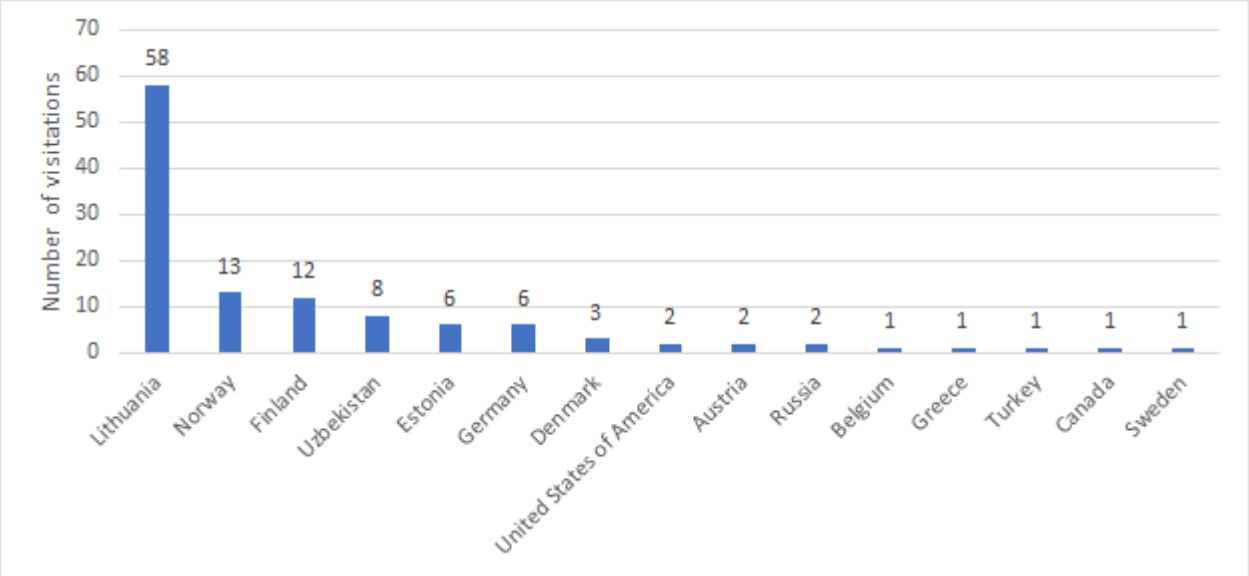

Figure: *Breakdown of incoming mobility by countries represented by lecturers*

The following are some examples of incoming mobility of visiting teachers during the reporting period, conducting guest lectures and participating in research activities:

- Every year of studies, within the double Master diploma programme RTU IESE was visited by associate lecturers from *Vilnius Gedeminas Technical University* (Lithuania), who red visiting lectures to students of the Master's study programme "Environmental Science". For example, in 2015, professor Kristina Bazienė from *Vilnius Gedeminas Technical University* (Lithuania), who read visiting lectures, in the year of studies 2017/2018, professor *Vasarevičus Saulius* and associate professor *Kristina Bazienė* from *Vilnius Gedeminas Technical University* (Lithuania), who read visiting lectures on pollution prevention methods, in 2019/2020, associate professor Raimondas Grubliauskas, associate professor *Dainius Paliulis* and

associate professor *Vaida Šerevičienė* from *Vilnius Gedeminas Technical University* (Lithuania), who read visiting lectures on air pollution (noise, emissions) and integrated environmental impact assessment.

- In the 2013/2014 study year, industry expert Zhubeckis Arnold came from the European Commision Directorate-General for Translation (Belgium) and led the lecture
- In the year of studies 2014/2015, in a bilateral cooperation project with Uzbekistan, assistant professor Kan Elena, professor Rudenko Inna, professor Azizjanov Khushnud, assoc.professor Saidmamatov Olimjon and professor Boyjanov Islom from Urgench State University (Uzbekistan) read a cycle of lectures at RTU IESE on the topic of "Developing and implementing environmental projects. Example of Uzbekistan."
- In the year 2015./2016, Professor Mada Kannan Arunachala Nadar of Arizon State University (US) conducted lectures on "Renewable Energy Resources and Energy Security".
- In the years 2015/2016 and in the years 2016/2017, Professor Weidlich Ingo from Hafen City Univercity Hamburg (Germany), under THE ERASMUS + programme, conducted lectures on mechanical ageing processes interacting pipelines with soil in the study course "Optimization of Heat Supply".
- 2018/2019. During study year, Professor Davidsen Paal Ingebrigt from the University of Bergen visited RTU IESE within the framework of scientific and academic work.
- In the year of studies 2018/2019, within the scope of scientific and academic work RTU IESE was visited by *sc.ing.* Anna Volkova from the Tallinn University of Technology to share experiences with RTU IESE teaching staff on the implementation of study courses in the field of heat supply.
- 2019/2020. Professor Lund Peter David from Aalto University (Finland), who specializes in power system modeling and participated with doctoral candidates, including reviewing doctoral theses, visited RTU IESE during his academic year.
- In the year 2019./2020. (October 2019), Charlotte Kendra Gotangco Gonzales, MEM, PhD, associate professor from Ateneo de Manila University (Philippines), attended the academic work of RTU IESE. The associate professor conducted lectures on the topic "Systems Thinking for Resilience and Sustainability in Research and Practice" for the students of the master's study program within the study course "Risks and resilience".

The bureaucratic burden in concluding staff contracts is a limiting factor in attracting new guest lecturers. Cooperation tends to be limited by financial aspects, which is directly reflected in list of guest lecturer countries, mostly within Europe. A much larger amount of funding is needed to attract academic staff from the world's leading universities.

The professionalism and competence of academic staff involved in studies and programmes for implementation of quality study programmes is high and continuously improved. State aid programmes for improving the quality of study programmes plays an important role in improving study programmes and ensuring continued sustainability of study programmes. For example, project SO 8.2.2. financed by the European Social Fund implemented by the RTU "Strengthening the academic staff of Riga Technical University in areas of strategic specialisation" aims to strengthen academic staff of the RTU in areas of strategic specialisation in 10 courses of study, including in the "Environmental Protection" course of studies, employing foreign academic staff, doctoral candidates and applicants for scientific degrees in the RTU. (for more information on the project also see section 3.5).

In the context of preparation of the new teaching staff, two activities of the SO 8.2.2 project is highlighted in particular: **participation of doctoral candidates in academic work at RTU and internship of academic staff at the merchant.** Within the project of the study course "Environmental protection" two doctoral candidates – Ieva Pakere and Maksim Feofilov – and

applicants for a scientific degree who have not yet been elected as lecturers were involved with academic work for at least 12 months, providing employment in accordance with the employment conditions of elected academic staff and not exceeding 50 percent of the full-time pedagogical workload. In this way, doctoral candidates were more focused on RTU and prepared for academic careers in a timely manner, supplementing their practical skills in lectures and/or preparing study courses. On the other hand, the **internship of the academic staff** at the merchant within the study field was used by 8 persons from teaching staff, including 6 new persons from teaching staff (docent Dr.sc.ing. Dace Lauka, docent Dr.sc.ing. Vladimir Kirsanov, docent Dr.sc.ing. Indra Muizhniece, doctoral candidate M.sc. Ketija Bumbiere, future doctoral candidates and assistants in academic work Lauma Balode un Beate Zlaugotne), who, between 2019 and 2020, completed 200 hours of internships in waste management companies (AS “BAO”, SIA “ZAAO”), heat supply company SIA “Salaspils siltums”, heating equipment manufacturing company SIA “Komforts Industries”. Practical experience gained during the internship was integrated in implementation of study courses through practical work, modeling of problem situations, etc.

As part of the **“Employment of Foreign Academic Personnel in RTU”** project activity**, two teaching staff** were attracted in course of studies:

- In course of the 2018/2019 study year, during the 12-month period at RTU IESE worked as a guest professor from Tallinn Technical University (Estonia) Professor Andres Siirde, who specialised in modelling of heat processes and conducted guest lectures on the Bachelor and Master Studies Courses “Combustion Processes”, “Heating Systems” and “Energy Technology” and gave advice to doctoral candidates in the field of thermal energy.
- In the year 2018/2019, during the 7-month period, RTU IESE had a guest professor from Virginia Western Community College (US), Bergen University (Norway), ISM University of Management and Economics (Lithuania), National University of Kyiv-Mohyla Academy (Ukraine), Professor Ira David Wheat JR. D.wheat specialisation is system dynamics modelling. During his visiting professorship, he led a system dynamics course for doctoral candidates and master's students (doctoral study course “Problems of Modern Environment. Solutions. Modelling” and in the framework of the Master's level study course “Environmental Policy and Economy”), as well as participated in advising doctoral candidates on development of doctoral theses. The visiting professor ensured the course of the study process both in person and online, using the developed MOOC approach.

The activities to be carried out under the project for development of the competence of existing academic staff are described in more detail in section 3.5

Not only academic staff in course of studies are involved in study process, but also Latvian industry professionals and foreign guest lecturers, who provide lectures both in person and using video-conference technologies (for more information on the involvement of industry specialists see section 5.2).

3.7. Assessment of the support available for the students, including the support provided during the study process, as well as career and psychological support by specifying the support to be provided to specific student groups (for instance, students from abroad, part-time students, distance-learning students, students with special needs, etc.).

RTU Career Support and Services Unit provides students with a wide range of career and psychological support services.

Career development support involves:

For prospective students:

- consultation on study programme selection;
- consultation on study selection and skills profiling;
- career choice seminars within RTU Open Days and upon request;

For existing students:

- regular seminars and individual consultations on the development of career;
- management skills, writing CVs and cover letters, job interview process;
- seminars on the development of entrepreneurial skills;
- project "RTU Golden Fund" to honour the best graduates and to promote new opportunities in the labour market; o student summer camps for the development of career management and social skills and competences; online resource https://ekarjera.rtu.lv/ (Latvian only);
- an annual career day aimed at informing students majoring in engineering, natural and social sciences about the best and leading companies in the respective fields, and bringing them closer to potential partner companies for undertaking internship and employers.

Psychological support involves:

individual consultations and support in case of difficulties with studies (time planning, lack of motivation, social anxiety, adaptation difficulties) and individual psychologist consultations on personal issues and difficulties (including crisis intervention);

Seminars and workshops on the following topics:

- adaptation events for first-year students - informative classes within the study course "Introduction to Study Field", seminars on the development of learning and communication skills;
- stress management methods;
- time planning methods; self-motivation;
- emotion management and development of emotional intelligence;
- public speaking skills.

Support is differentiated by the target groups (https://www.rtu.lv/en/studentservice/career-centre/psychological-support):

- prospective students (secondary school pupils, vocational school graduates, other prospective students): consultations concerning the studies are available, including skills diagnostics;
- first-year students: informative classes within the framework of the study course "Introduction to Study Field"; seminars on the development of learning skills; information letters on career and psychologist support opportunities; individual career and psychologist consultations; and other activities in cooperation with businesses and non-governmental organizations;
- all RTU students: individual career and psychologist consultations, seminars and classes, guest lectures, RTU Career Day;
- foreign students (Erasmus+ mobility and full-time): individual and career support consultations are available in English; wherever possible, seminars and classes are conducted in English, such as seminars on writing CVs and cover letters, time management;
- students with special needs: psychological and career support consultations are provided upon request; physical access to the room; opportunity to come with one's mentor or interpreter.

- graduates: career support consultations are provided if necessary; consultations on writing CVs and cover letters, job interview process, career opportunities.
- staff: consultations on work and study related issues are provided to RTU academic and general staff members, if necessary.

Under the influence of COVID-19, the supply has become even more available, because consultations and also career classes can be offered online.

In 2014, the Student Services Center was opened in Kipsala campus. It provides day-to-day support under the supervision of the Career Support and Services Unit:

- provides answers to various questions that students may have;
- provides printing, copying and binding services;
- issues identification cards;
- draws up references, if necessary.

More information is available at: https://www.rtu.lv/en/studentservice/student-service.

In 2019, work was started on strengthening of support for students with reduced mobility and in 2020 guidelines were issued providing recommendations for effective communication and improvement of the study environment for people with reduced mobility and special needs: https://www.rtu.lv/lv/studentuserviss/par-mums-ssd/noderigi-ssc/noderigi-materiali-1/ka-komunicet-un-nodrosinat-piemerotu-studiju-vidi-personam-ar-invaliditati-un-specialam-vajadzibam (Latvian only).

RTU International Cooperation and Foreign Students Department has academic consultants who consult foreign students on studies and practical issues. Academic consultants keep track of the students' academic performance and attendance, as well as meet students on a regular basis to make sure their studies are successful, both in and outside the classroom. Shortly after the arrival of students, academic seminars are held, which are compulsory for all new students. Academic seminars are held approximately twice a week at the beginning of each semester, in line with the student influx. During these seminars, academic consultants introduce students to RTU internal rules, their responsibilities and rights, academic integrity, and various other practical aspects. In the future, it is planned to divide the students into groups according to the study programs and to involve the heads of the study programme in the seminars so that the students would get acquainted with the management of the programme in due time. If during the semester a student is observed to face difficulties with the study process (attendance, academic arrears), the student is invited to an individual meeting with his/her academic consultant to discuss the best possible solutions to the problem. Each academic consultant has to arrange meetings with 2-5 students per week. After a month, students are invited to the meeting again to discuss their progress and make sure the situation has improved.

At RTU International Cooperation and Foreign Students Department, students have a contact person for facilitating the immigration process. The contact person organizes immigration seminars and document examination at the beginning of the semester. The Department arranges an appointment for students with the Office of Citizenship and Migration Affairs of the Republic of Latvia.

The Dean’s Office of RTU FEEE in cooperation with RTU FEEE Self-Government acts as an Information and Service Centre, which helps to improve student service at the faculty, as well as to improve the general image of the faculty and RTU. The centre provides the following services: copying, printing of documents; issuing of keys (for study and common use audiences), storage of the first aid kit, advising students, guests, providing and placing of information (on message boards in faculty rooms, on faculty website and in other media).

In addition to that, since 2015 the RTU FEEE Self-Government has been practicing a special support programme for first year students. Within the scope of the programme, a mentor from the RTU FEEE Self-Government was linked to each 1st year Bachelor level study programme of each study programme. The mentor answers questions related to the study process, motivates to study (if a deeper support is necessary, then representatives of the RTU FEEE Self-Government organise work groups, which helps students to master the missed topic, etc.), initiates meetings with teaching staff and administration of the study programmes, if necessary. First year students appreciate the work of study self-government in mentoring, and the effectiveness of such a programme is also shown by changes in the dynamics of students – a decrease in the number of students who take an academic leave or drop out because of facing difficulties in mastering study courses.

In the field of continuing education, the study direction is actively cooperating with the RTU Division of Continuing Education. The purpose of the RTU Division of Continuing Education is to promote the willingness of any interested person to complement their knowledge, as well as to raise qualifications according to individual interests and the level of education previously acquired. RTU offers the possibility to apply for the licensed study programmes as listeners, to master continuing education courses organised by faculties and institutes, or to develop and provide the courses necessary for upskilling of employees in cooperation with the company, according to the specifics and needs. Mastering of individual courses as a listener is an excellent way to improve own knowledge, acquire new skills, competencies and increase competitiveness in line with labour market requirements. Any interested person with completed secondary education may apply as a listener – this opportunity is also actively used by graduates of schools (pupils of grades 11 and 12). The courses listened at RTU in the process of continuing education, following the RTU procedure on recognition of previously obtained formal and non-formal education, can be made equivalent to courses in study programmes. The cooperation between the study direction and the RTU Division of Continuing Education has been long and manifests as follows:

- Every year the RTU Division of Continuing Education conducts a survey of implementers of study programmes on **current study courses**, which may be learned in continuing education. Continuing education students join the study courses implemented by study programmes together with full-time students. The continuing education student obtains a certificate of mastering the study course from the RTU Division of Continuing Education. In recent years, courses like “Energy Efficiency of Buildings”, “Introduction to Environmental System Dynamic Modelling”, “Eco-Design and Life Cycle Analysis” were in demand within the study direction among continuing education students.
- Since the spring semester of 2007, RTU IESE has been organising an **open public course ‘Environmental Engineering Science”** of 2 CP (3 ECTS). The cycle of lectures has been designed so that participants learn the knowledge about the environment, climate, energy and technology innovations in Latvia and the world in an interactive way, but it should be noted that every year the theme of the course changes and is adapted to the developments in the field of environmental protection in the country and globally. Those who complete the course (representatives of local governments and public authorities, employees of industrial enterprises, representatives of non-governmental organisations, students of study programmes not related to the environmental protection study direction, secondary school graduates (pupils of grades 10-12), house managers, etc.) receive certificates issued by the RTU Division of Continuing Education on mastering of a 2 CP study course.

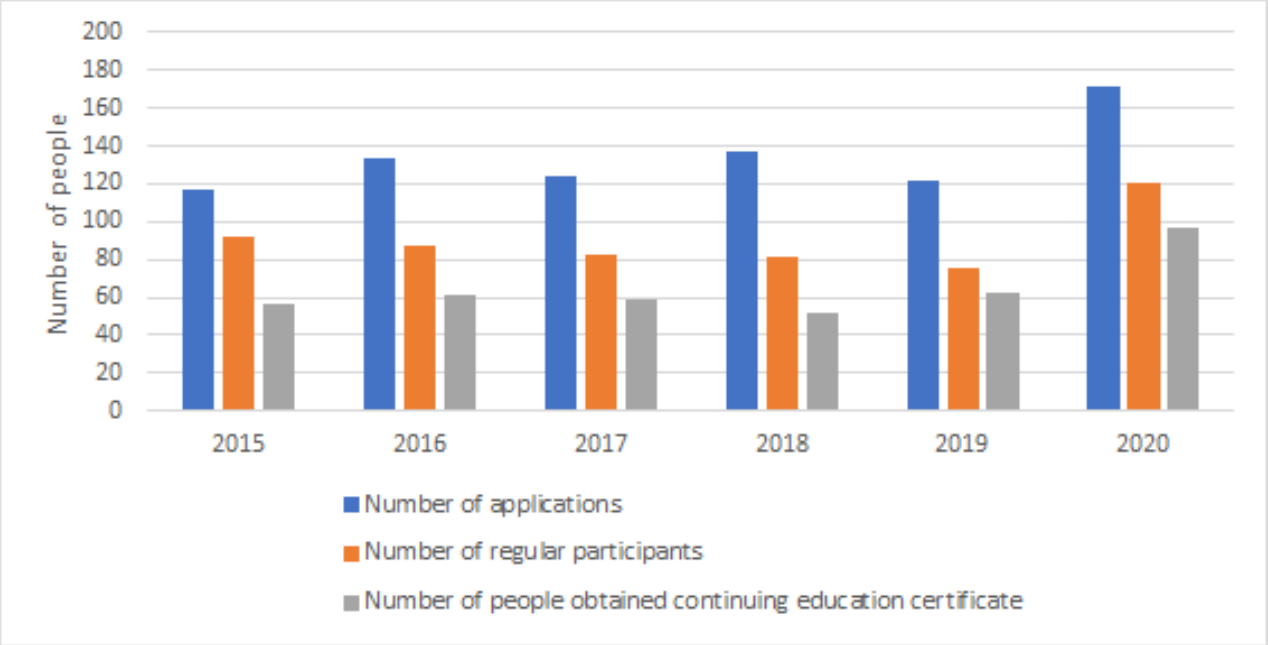

Figure: *Student dynamics in the implementation of the continuing education course "Environmental Engineering Science" from 2013 to 2020.*

- **Organisation of summer schools.** RTU IESE or RTU IESE in cooperation with the RTU International Cooperation and Foreign Students Department organises summer schools for different target groups on a regular basis, including by applying for organisation of summer schools for available financial support programmes, for example, the State Education Development Agency, COST promotions, local government). Summer schools, depending on the call, are organised both in Latvian an English. The composition of target groups of the summer schools is also variable: these may be international students, local students and employees of companies, local governments, public authorities. The last summer schools organised within the study direction were: "Ticket to the Future" (in English; 22 students of study programmes of different study directions from 4 countries; 2015), "Energy Aspects of Biogas" (in Latvian; 28 participants: students, employees of companies and local governments, 2017); "Latvian Biocapacity" (in English; 13 participants from 11 countries: students of foreign universities; 2018). Those who complete summer schools by meeting specific summer school content programme mastering requirements, receive certificates issued by the RTU Division of Continuing Education.
- **Implementation of specialised study courses for representatives of companies.** RTU IESE in cooperation with industry develops specialised study courses for the needs of cooperation partners within scientific research projects or contract work. Thus, for instance, in 2017, at the order of the Latvian Association of Heat Supply Companies, RTU IESE developed and implemented a study course on operation of biomass cogeneration plants of the new generation. 22 representatives of Latvian heat supply companies participated in an educational seminar (5 CP). Those who complete the course by meeting specific content programme mastering requirements, incl. by passing a test, receive certificates issued by the RTU Division of Continuing Education.
- Organisation of **thematic continuing education seminars** within scientific research projects. By actively participating in the implementation of scientific research projects, RTU IESE organises thematic continuing education seminars (paid and free) on a regular basis. The target audience of seminar visitors is wide (students, employees of companies, local government, public authorities, specialists, consultants of non-governmental organisations, etc.). Such seminars take place on -site and remotely, for example, using MS Teams or Zoom

platforms. Those who complete the thematic continuing education seminars by meeting specific content programme mastering requirements, incl. by passing a test, receive certificates issued by the RTU Division of Continuing Education. One of the last such educational seminars was held in November 2020 – the online educational seminar "Improving Energy Efficiency and Environmental Performance in Companies" within the Horizon 2020 project "Improving Energy Efficiency of a Cold Supply Chain". In the future, RTU IESE is planning to continue work on the creation of continuing education modules in the study direction "Environmental protection", for example: (1) in 2020, within the project "TRAIN-ECO: TRAINing for professionals and entrepreneurs on ECO-innovation in electronics product development" applied and obtained under the ERASMUS+ programme (priority "Cooperation for innovation and the exchange of good practices") it is planned to develop and approbate a study course for professionals and businesses on eco-innovations and quality management in the development of electronic products. The development of such a course will integrate in the RTU IESE continuing education module and in the academic Master's study programme "Environmental engineering", study course "Eco-Design and Life Cycle Analysis" (6 CP, 9 ECTS). (2) in 2020, within the project "SWEDA: Sustainable Wellbeing Entrepreneurship for Diversification in Agriculture" applied and obtained under the ERASMUS+ programme (priority "Cooperation for innovation and the exchange of good practices") it is planned to develop a study course on sustainable use of agricultural resources. The development of such a course will integrate in the RTU IESE continuing education module and in the academic Bachelor's study programme "Environmental engineering", study course "Introduction to Biotechonomics" (6 CP, 9 ECTS).

The contemporary dynamic and changing world forces any of us constantly educate and improve to achieve own goals. Therefore, part-time (extramural or evening) studies are one of the tools helping to achieve goals, professional and personal growth, offering qualitative, intensive, creative and exciting study process, which can be combined with work. None of the study programmes of the study direction "Environmental protection" applied for accreditation (academic Bachelor's study programme "Environmental engineering", academic Master's study programme "Environmental engineering", doctoral study programme "Environmental engineering") is implemented as part-time studies. However, in order to offer more comfortable types of studies to working students, for example, the implementation of the academic Master's study programme "Environmental engineering" takes place on working days in the evening. The implementation of such a type of studies has proven itself since 2003, when the implementation of the academic Master's study programme "Environmental Science" was launched in the evenings. An average of 90-95% of all Master students in the study direction "Environmental protection" are working and up to 86% are employed in the field related to environmental protection. RTU IESE appreciates that students have an opportunity to complement their knowledge and professional skills in practice, working in the sector. However, the administration of study programmes is also clearly aware of the risks associated with combining of studies with work. Therefore, different mechanisms are being sought to adapt the type of studies to the needs of students. For example, in the evenings, studies can be combined with work, even with the rapid fatigue of students during classes. In order to ensure fully-fledged participation of students in the study process, since 2017 RTU IESE has divided each class (2 x 90 minutes) into theoretical and practical parts, where particular attention is focused on the integration of the reciprocal cooperation model.

It should be noted that distance studies were updated in 2020 due to COVID-19 assembly restrictions, including restrictions on on-site classes. According to the Rector's order, the study programmes had to ensure that the study process was carried out remotely. The European Social Fund project "**SO 8.2.3 Development of Efficient Management of Riga Technical University**", launched before the epidemic and focusing on the improvement of the study process,

also played an important role in the distance study process at RTU. Some of project activities focus directly on the improvement of type of studies like, for instance:

- **Creating of audiovisual learning tools for a virtual learning environment**. As part of this activity, it is intended to digitize general study courses (such as physics, mathematics, entrepreneurship and innovation), as well as other courses according to the needs of faculty and the specificities of teaching. As part of the study direction "Environmental protection", six study courses at different levels of study programmes will be digitised by 2022. On the other hand, the digitisation of one of the Master's level study courses "Renewable energy sources" was completed in December 2020. The implementation of this activity will clearly contribute to the wider integration of part-time studies, distance learning and continuing training into RTU study programmes, as well as to the lifelong learning opportunities at RTU, which is one of the priority objectives of RTU within the framework of the quality education objective (between 2012 and 2017 a total of 9910 persons have been involved in the continuing training at RTU, on average, around 400 persons per year).
- **Adapting the distance learning platform to the needs of RTU**. The activity will improve the supply of RTU educational content to organise distance learning and lifelong learning, ensure that the existing study provision *Moodle* platform complies with the standards for advanced training platforms (e.g. edX, MOOC). The introduction of this activity is essential as part of the study direction "Environmental protection", since in 2020 RTU IESE has started the implementation of the Erasmus international cooperation project "Systems analysis MOOCs for sustainability transformation" under the leadership of the University of Bergen (Norway), along with universities from Switzerland, the Netherlands, Turkey, Portugal. The project aims to develop several MOOC courses in the field of system dynamics. Therefore, the adaptability of the existing Moodle system of the RTU's existing MOOC standards is particularly important in order to successfully take over the system dynamics MOOCs developed within the ERASMUS project and successfully integrate them into the content of the study direction "Environmental protection".

By promoting and ensuring access to higher education and free access to all students and visitors with reduced mobility, the building of the Faculty of Electrical and Environmental Engineering on Āzenes Street 12/1, as well as other buildings implementing study courses for the study direction "Environmental protection" (Āzenes Street 12 and Āzenes Street 6) are adapted to persons with reduced mobility: entering a building through a basement to which a wheelchair-suited road leads; an elevator is available in the building; specially equipped facilities for persons with reduced mobility; the width of the doors of auditoriums is appropriate; easy access to the canteen.

No student with reduced mobility currently (during the accreditation period) with reduced mobility studies in the study programmes of the study direction "Environmental protection". However, there are two students in the Bachelor's level study programme "Environmental Science", who studies according to individual timetables because of health problems (such as epilepsy). An individual timetable is aligned with the students and the teaching staff involved in the study process, adapting individually to the medical and rehabilitation process of each student. It should be noted that the assembly restrictions in universities and the provision of distance learning (e-study courses (lectures, practical works and test works) due to COVID-19 improved the integration of such students in the joint study process.

In general, the FEEE Student Self-Government works carefully and organises a wide variety of events for student's team building, entertainment, sport and personal and knowledge development. The following activities were organised in academic years 2018/2019 and 2019/2020:

In general (at RTU), in the reporting period from 2013-2020 the Self-Government of the Faculty of

Electrical and Environmental Engineering in cooperation with the Student Parliament organised 115 events for students' team building, competence building, provision of psychological support and the successful inclusion of foreign students in the RTU study environment.

Nine events were organised by the Self-Government in 2013. For example, the event organised by RTU students "Running with the wind" on 04.12.2013. FEEE students were able to verify their knowledge during their studies, performing a variety of tricky tasks and tests to obtain all the parts needed to design a wind generator and finally to prove that they are the best engineers and capable of building the most efficient generator.

In 2014, 15 events were organised by the Self-Government. In general, the activities focused on team building of students, educating and providing support for students, such as the "Educational Evening" event of 6 November 201, aimed at helping students prepare for the final and session of the semester. Various visiting lectures were also organised to educate students and provide additional competencies. An interactive class was also organised, where Atis Ķeņģis read a lecture sharing his thoughts on the subject of "What studies are?". On 7 April 2014, students had the opportunity to listen to the lecture of the RTU Vice-Rector for Research Tālis Juhna on drinking water and its quality, on the water path in modern life, including energy.

In 2015, 17 events were organised by the Self-Government. A variety of team building events, several visiting lectures and tours to companies were organised. For example, the visiting lecture by Mārtiņš Pelšs, the head of the "Agro Iecava" biogas plant, on the operation of a biogas plant and on how to achieve own objectives. An inspiring visiting lecture from Andrejs Gavrilovs "You can achieve more than you imagine!". Visiting lectures on the use of solar energy were read, discussions and designs (the most competitive light object) were also organised. As in previous years, an educational evening was held to support students and help prepare for the session. A trip to CHPP-2 was organised.

In 2016, 14 events were organised by the Self-Government. The events included visiting lectures, trips, erudition contests and team building events. RTU students listened to an impressive visiting lecture from Artis Daugins, the founder of Blue Shock Bike. He shared his experience and told how to achieve own goals, how to realise own ideas and simply on more favourable decisions for own career and welfare. On November 23, a trip to the leading global professional services company "Accenture" was organised. At the erudition contest "Tea at Einstein's", students had the opportunity to check and prove their knowledge obtained during studies. At team building events "EEF Gāziens", "Full house of engineers", "EEF dienas" students had the opportunity to become better acquainted with their study peers in a less formal atmosphere and to establish new contacts.

In 2017, there were 15 events organised by FEEE Self-Government, where students had an opportunity to go on a trip, listen to visiting lectures and participate in team building events. In 2017, students used the opportunity to participate in trips organised by FEEE Self-Government to CHPP-2 and Kegums HPP, where there listed to its operating principle and technologies used. At the visiting lecture "Next generation applications with Microsoft.NET", students had an opportunity to learn that .NET can help to create adaptable, easy to maintain web apps. Team building was implemented through events "Camp for first year students SPER GAISĀ X10", "Mehu un enerģētiķu bilijards", "Holywood in real life".

In 2018, 17 events were organised by the FEEE Self-Government. The students had the opportunity to listen to visiting lectures, go on trips with a company and to engage in team building and meet with other students. In 2018, Schneider Electric read visiting lectures telling about the Schneider Electric plant, operations of the company, support functions and different projects, as well as on career growth opportunities in the company. A trip to Schneider Electric was organised, where students were told more about developments in the energy world, work at Schneider Electric and

latest implemented projects. Sport and team building events were “Bicycle orientation competition Gāziens”, “Camp for first year students SPER GAISĀ X11”, “Lauziens” and other. As in previous years an educational evening was held to support students and help prepare for the session.

In 2019, the FEEE Student Self-Government organised 18 different events, where students had the opportunity to receive information on ERASMUS+ study opportunities, different sports games organised, meeting events for energy specialists and tables game evenings. During events “Annual Meetings of Energy Specialists” and “Picnic of Energy Specialists” students had an opportunity to meet energy activists from different generations, to gain inspiration, to establish new contacts and discuss energy news. The visiting lecture was read by SIEMENS. During the visiting lecture students had the opportunity to get acquainted with lines of business of the international company Siemens, future plans and expectations, as well as to extend knowledge of students and interested persons in the field of electrical technology. Several team building events were held in 2019 to help students to fit into the new study environment and to promote the establishment of peer contacts in a less formal atmosphere, for example, at events “Bicycle orientation competition Gāziens”, “SPER GAISĀ X12”, “Table football tournament and Rector’s novuss cup”. In order to organise team building between students and teaching staff, a patriotic event “EEF Sadziedāšanās” was organised for the Latvian holiday, where Latvian songs were sang and big pretzel was enjoyed. A charity activity was first organised in December, where with participation of faculty students and employees, three families with many children were cheered up on holidays.

In 2020, the FEEE Self-Government has organised six events so far. Many events had to be postponed due to Covid-19 restrictions, however, the Student Self-Government attempts to organise events in lines with the requirements set in CM Regulations and the law as much as possible. Until now, in 2020, there were different team building events and remote competitions, where students could act. For example, before the announcement of the emergency situation, the event “Mehu un Enerģētiķu biljarda turnīrs” was organised every year fostering friendship between RTU faculties. A remote competition “Spindzeles izaicinājums” was organised to foster students to continue sporting individually also during the emergency situation. At the beginning of September, there was a seminar for first year students “SPER GAISĀ X13”, where new students could get acquainted with the study process, the Student Self-Government and other important things. Also this December the Self-Government organised a charity action to help and create a sensation of celebration for those large families with children, which do not do so well.

II - Description of the Study Direction (4. Scientific Research and Artistic Creation)

4.1. Description and assessment of the directions of scientific research and/or artistic creation in the study direction, their compliance with the aims of the higher education institution/ college and the study direction, and the development level of scientific research and artistic creation (provide a separate description of the role of the doctoral study programmes, if applicable).

It is a requirement of RTU that academic staff are actively involved in research apart from their involvement in the study process. Professors and associate professors are re-evaluated and reelected every six years. Candidates are obliged to comply with certain criteria in terms of scientific research, i.e., number of publications or patents, supervised Doctoral candidates, etc.

(Decision of RTU Senate No. 594 “On RTU Regulation regarding the Approval of the New Edition of Procedure of Electing Professors and Associate Professors” as of 30 November 2015). In order to be allowed to supervise Doctoral students, the academic staff have to be approved experts in their fields, which is possible only if criteria regarding the number of publications/patents are met (decision of RTU Senate No. 602 “On Amendments to RTU Regulation on Doctorate” as of 26 September 2016). Approval process for the experts is organized by the Latvian Council of Science. The database of the experts is published in the National Research Information System (NRIS; http://sciencelatvia.lv)

Every year, the Rector and faculty deans sign agreements by which each faculty undertakes to achieve certain key performance indicators, many of which are based on research output, e.g., the number of publications/patents, obtained research project funding, etc. Achievement of these indicators has an impact on financing received by the faculty from the so-called performance-based funds.

The study programmes included in the study direction fully comply with the goal of the strategy of the RTU Faculty of Electrical and Environmental Engineering for 2014-2020 – by 2020 to become Latvia’s leading internationally recognised study, science and innovation institution in the fields of energy, electrical engineering and environmental science, ensuring a high quality study process, internationally recognised scientific research and sustainable innovation, commercialisation and knowledge transfer in the economy.

The RTU Institute of Energy Systems and Environment (RTU IESE) has developed a development concept of the Department of Energy Systems and Environment (2016-2020), which includes 4 strategic goals with regard to the quality of the study process and awareness of the nature and high quality of the programme, awareness of IESE as an international and local brand, development of IESE as the leading institution in Latvia, which offers scientific services in the fields of environmental protection and energy to the private sector and improvement of scientific quality of IESE. The implementation of the study programme helps to achieve these goals, because it prepares specialists with the highest level of knowledge in environmental engineering and energy.

The summary of RTU IESE **priority areas of scientific research** is provided in the figure.

Sustainable production	• Eco-design and environmental performance of products and services • Life cycle assessment of products and services, life cycle cost analysis and social impact life cycle assessment • Cleaner production • Valorisation of low quality resources to value added products • Industrial symbiosis • Optimising energy, water and material flows in industrial enterprises by implementing technological solutions to reduce energy, water and material consumption • Production of high value added products in biotechnological processes
Sustainable energy and transport	• Renewable energy • Efficient incineration, drying and gasification processes • Production of biocoal and syngas and optimisation of the gasification process • Low-temperature district heating systems • Climate technologies and carbon capture, use and storage • Biomethane and biogas production processes • Sustainable low-emission transport • Fuel combustion processes and optimisation • Smart energy consumer management • Energy efficiency solutions in buildings and energy efficiency of historic buildings • Biomimicry • Heat and mass exchange processes • Air pollution reduction technologies • Fuel combustion
Sustainable society	• Biotechonomics (bioeconomy) and circular economy • Regional development to improve public welfare in conditions of circular economy • Waste management and recovery of resources from waste • Indoor climate of buildings • Monitoring of environmental quality parameters • System dynamics modelling of environmental, economic and social processes • Infrastructure resilience to natural disasters and risk analysis • Environmental education • Assessment of sustainability in society

Figure: *RTU IESE priority areas of scientific research.*

Engineering specialists in the field of environmental engineering will be needed at present and in the future to implement scientific research in the priority axes indicated above, to introduce the latest scientific research results and technologies in the economy, to achieve a reduction in production processes and the impact of consumption on the environment, and to create a regulatory framework ensuring the sustainable development of Latvian and European societies. It is very important to prepare environmental engineering specialists exactly in Latvia for the following reasons:

- programmes of the study direction are specific due to the fact that they combine studies related to the environmental impact of products and product-service systems during the life cycle, the environmental aspects of energy technologies, energy efficiency and energy

system optimisation solutions, the theoretical aspects of environmental policy and climate technology, and the use of renewable energy sources. The referred to set of knowledge to be learned makes the study programmes unique of the study direction “Environmental protection” unique among other study programmes and suitable for the conditions of Latvia.
- most of the environmental impact aspects are characteristic to the specific geographical region, and it is therefore very important to learn study programmes in parallel with scientific research under Latvian conditions;
- the study programme ensures that activities in the field of environmental protection and energy supply technologies take place in Latvia, thereby helping Latvia to avoid falling into technological backwardness and becoming only a recipient country of technology.

The Institute of Energy Systems and Environment (IESE) is one of the leading research institutions in the field of environmental engineering and energy research in the Baltic States. IESE is developing research in various areas related to energy and the environment, such as climate change and climate technologies, renewable energy sources, 4th generation heating, bioeconomy, fuel combustion, circular economy and resource management, environmental management systems. Researchers working in the Institute have gained international visibility in adapting and integrating system dynamics modelling in other environment-related areas. The Information and Study Centre on Sustainable Development is operating within the study direction, which hosts scientific research in the areas of urban resilience, system dynamics and environmental management. RTU IESE has 5 laboratories: Environmental Monitoring Laboratory, Biosystem Laboratory, Combustion Research Laboratory, Solar Energy Systems Laboratory and Building Energy Efficiency Laboratory.

Environment Monitoring Laboratory

Environment Monitoring Laboratory of IESE has been accredited for the testing of solid energy resources (including biofuels) – ash content, moisture content, combustion heat (highest and lowest) testing and other parameters It is located on Āzenes street 12/1, Riga. The Environmental Monitoring Laboratory offers services performed by high-skilled specialists, in accordance with internationally developed (ISO) and approved in the status of Latvian State Standards methods.

Solar Energy Systems laboratory

The aim of the Solar Energy System laboratory is to research, simulate and develop solar heating systems Studies carried out in the laboratory are related to studies of solar collectors; research into heat storage systems and their control systems; modelling and improving systems using modelling programmes; research on phase transition materials. In laboratory it is researched and developed capability of using phase change materials in heat accumulation systems and employ computational fluid dynamic (CFD) software to analyse and optimize solar systems.

Biosystems laboratory

The idea about the Biosystems laboratory was born in the summer of 2014. The establishment of the laboratory is based on the ideas developed by the Institute of Environmental Protection and Heating Systems in recent years. The aim of this laboratory is to research and develop bio-systems. Studies and developments carried out in the biosystem laboratory relates to scientific studies and academic learning process.The main research activities are based on: Research of algae as a resource, Development and research of innovative materials, Research of biogas, Research of

electrolysis and methanation processes.

Building Energy Efficiency Laboratory

The laboratory researches the quality of building materials, indoor quality and the potential of improving their energy efficiency. Within the framework of several projects, the identification of building materials of Latvian historic buildings and determination of their hygrothermal properties are made in order to facilitate forecasts on the influence of internal insulation on the exterior wall. The Laboratory's offered services and measurements inclue determination of hygrothermal properties of building materials,building energy efficiency assessment, building construction energy efficiency assessment and energy modelling of buildings.

Combustion Research Laboratory

The main research directions of the laboratory are to research and optimize combustion processes. The laboratory is equipped with modern equipment which allows to measure the efficiency of heating systems and amount of emissions created. Furnace efficiency and amounts of emissions are determined according to Latvian Standard methods (LVS NE 303-5 and LVS NE 13240/AC). In addition, research is conducted about methods of reducing harmful emissions from combustion processes. Some of these methods are patented and are practiced in Latvia. The Laboratory provides: testing of combustion equipment, measurements of energy efficiency and emissions in boiler houses, factories and other sites, boiler house audits including full or partial energy and mass balance calculations. In the near future the laboratory plans to begin research on biomass gasification processes, which include both, theoretical and practical research.

Information and Study Centre on Sustainable Development

The Centre for Sustainable Development is a department of Institute of Energy Systems and Environment founded in 2010 with the aim to introduce the sustainable development principles into the study and research processes. The centre for Sustainable Development is covering such research themes as resilience, system dynamics and environmental management. The Creative Ideas group is working on the scientific development of new ideas and on the transformation of these ideas into the products. At the PhD garage, the results of PhD students scientific researches are analysed and scientific communication is under a process of constant development.

Bioeconomy Research Center

This research centre is proposing to use biotechonomy principles into different fields of research involving engineering, biological, economic and financial disciplines in a framed and organized overarching collaboration. This inter- and multi-disciplinary approach (e.g. among the others ecology, material science, biology, energy efficiency, cleaner production, renewable energy technology, together with System Dynamics and LCA modelling, analytical and software-based modelling) would be beneficial to provide an holistic view within the more efficient use of bio resources. The main goal of Bioeconomy Research Centre is to merge science and technologies to create innovative technological solutions aimed to increase the added value of specific products merging the contribution of academia and private sectors. The synergy will create the inspired background for more sustainable product development starting from innovative preliminary ideas to the final concept and potentially marketable product. Bioeconomy Research Centre has been

involved in projects in cooperation with local and international partners mostly oriented towards the design and commercialization of innovative bio-products, bio-technology and market strategy.

The academic staff of RTU IESE **participate actively in scientific and consultative work**. In recent years, the main areas of research are smart energy, bioeconomy, energy efficiency of buildings, biotechnologies, 4 th generation heating systems, resource recovery, resilience. However, every year RTU IESE extends its scientific research activity by including new environmental protection thematic areas. **Teaching staff members of the doctoral study programme** also work in the Dissertation Committee and as reviewers in other institutions of higher education Disertation Committees, such as the University of Latvia, Agricultural University of Latvia, Vilnius Gedimina Technical University (Lithuania), Kaunas University of Technology (Lithuania), Estonian University of Science (Estonia), Tallinn Technical University (Estonia), Brno University of Technology (Czech Republic), Mykolas Romeris University (Lithuania), Aalto University (Finland), Danish Technical University (Denmark), Chalmer Technological University (Sweden), Aalborga University (Denmark). In addition, about doctoral study program and its meaning, see III. in description of doctoral study program “Environmental Engineering”.

RTU has several **support mechanisms for the involvement of academic staff in scientific activities**, of which the RTU Research Support Fund and the Research Platforms can be mentioned as the most important. RTU Research Support Fund (decision of RTU Senate No. 585 “RTU Regulation of Research Support Fund” as of 15 December 2014) aims at providing financial support for various research related activities, such as support for maintenance of research equipment, protection and licensing of intellectual property, covering of expenses related to the Doctoral study process, publishing of scientific journals, participation and organization of scientific conferences, support to researchers in establishing new laboratories in a prospective research field. The Research Support Fund is an instrument to support research activities, which foster the development of the strategically important research fields Six research platforms in the main strategic research areas of RTU were established in 2013 as an instrument for fostering inter-disciplinary and inter-faculty cooperation of researchers in the areas of importance for industry and society. These platforms are as follows: “Energy and Environment”, “Cities and Development”, “Information and Communication Technologies”, “Transport”, “Materials, Processes and Technologies”, “Security and Defense”. Each platform has a dedicated coordinator and they comprise the Council of Coordinators responsible for implementing the activities within platforms. The Council is supervised by the Office of Vice-Rector for Research (Decision of RTU Senate No. 600 “On Approval of the Regulation of the Council of Coordinators of Research Platforms at Riga Technical University” as of 23 May 2016). Similar to the faculties, the platforms have the Research Program (Decision of RTU Senate No. 590 “On Authorization to Approve RTU Research Program by RTU Scientific Council” as of 27 May 2015; “Research Program of Riga Technical University 2016–2020”), annual action plan and dedicated funding from the Research Support Fund. Internal project calls within the platforms are organized every year, allocating 90–120 thousand EUR in total to six projects selected on a competitive basis. A mandatory requirement for the projects is a minimum 20% industry co-financing and participation of more than one faculty. In the period of 2016–2020, 16 projects were supported and nearly 300 thousand EUR of funding was allocated to the projects. The Research Platforms regularly organise workshops on the transfer of best practices, tours of companies to promote networking opportunities and cooperation with industry representatives, as well as other activities.

Efficiency of these mechanisms can be illustrated by growth of SCOPUS indexed publications in the period of 2013–2020. **The total number of the publications in the university** increased from approximately 440 publications per year in 2013 to 865 in 2019. Number of SCOPUS publications

per researcher (expressed in full-time-equivalent (FTE)) increased from circa 0.9 in 2013 to circa 1.5 publications/FTE per year in 2018 (the data were obtained from Elsevier “SciVal” database on 17 June 2019).

The results of scientific research are used in the development and renewal of study courses. Study courses are reviewed annually and are regularly supplemented with latest research results. Activities of RTU IESE academic and scientific staff in scientific research projects plays a big role in this process.

In the period from 2015 to 2020, publications of RTU IESE teaching staff made a contribution to the development of 158 thematic areas (76 thematic clusters).

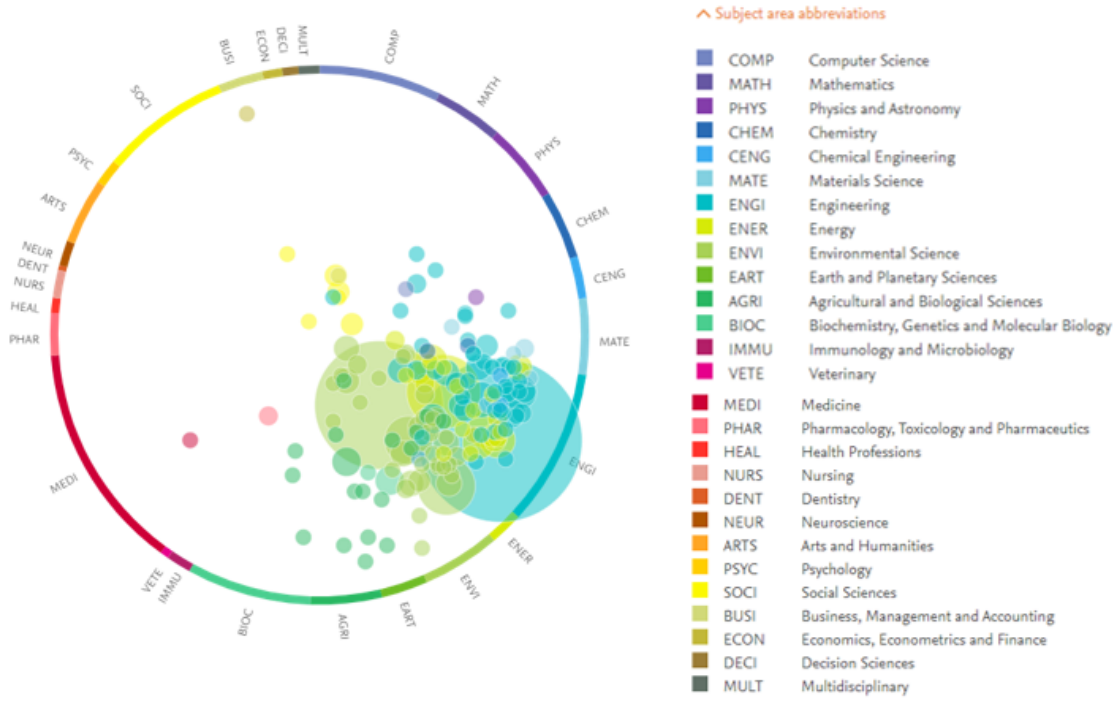

Figure: *Contribution of SCOPUS-indexed publications of RTU IESE teaching staff (in 2015-2020).*

In the reporting period from 2015-2020, 418 publications were cited 2515 times, 6 citations per 1 publication on average.

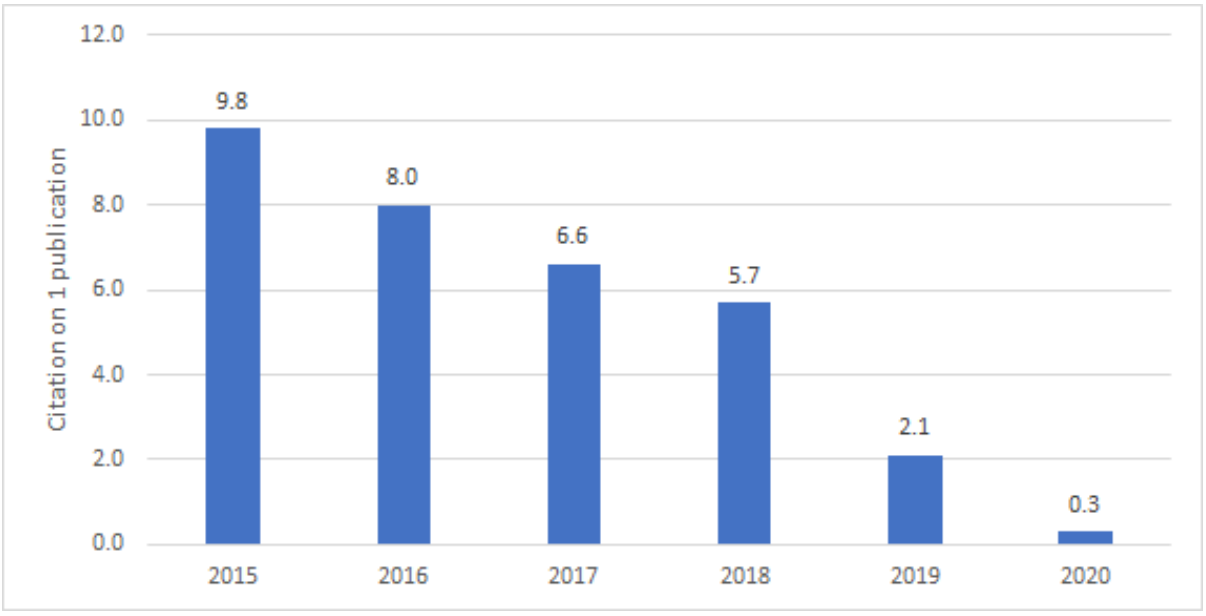

Figure: *Citation rate of SCOPUS-indexed publications of RTU IESE teaching staff (in 2015-2020)*

The most cited publications of RTU IESE teaching staff (in 2015-2020 based on *SciVal* data) are:

1. Barisa A., Romagnoli, F., Blumberga A., Blumberga, D. Future Biodiesel Policy Designs and Consumption Patterns in Latvia: a System Dynamics Model. Journal of Cleaner Production, 2015, Vol. 88, pp.71-82. ISSN 0959-6526. Available from: doi:10.1016/j.jclepro.2014.05.067 **(cited 46 times)**
2. Zoss T., Dāce E., Blumberga D. Modeling a Power-to-Renewable Methane System for an Assessment of Power Grid Balancing Options in the Baltic States' Region. Applied Energy, 2016, Vol.170, pp.278-285. ISSN 0306-2619. Available from: doi:10.1016/j.apenergy.2016.02.137 **(cited 40 times)**
3. Dāce E., Muižniece I., Blumberga A., Kaczala F. Searching for solutions to mitigate greenhouse gas emissions by agricultural policy decisions — Application of system dynamics modeling for the case of Latvia. Science of the Total Environment, 527-528, pp. 80-90. Available from: doi:10.1016/j.scitotenv.2015.04.088 **(cited 35 times)**
4. Bāliņa, K., Romagnoli, F., Blumberga, D. Seaweed Biorefinery Concept for Sustainable Use of Marine Resources. Energy Procedia, 2017, Vol. 128, pp.504-511. ISSN 1876-6102. Available from: doi:10.1016/j.egypro.2017.09.067 **(cited 34 times)**
5. Timma, L., Zoss, T., Blumberga, D. Life after the Financial Crisis. Energy Intensity and Energy Use Decomposition on Sectorial Level in Latvia. Applied Energy, 2016, Vol.162, pp.1586-1592. ISSN 0306-2619. Available from: doi:10.1016/j.apenergy.2015.04.021 **(cited 34 times)**

4.2. The relation between scientific research and/or artistic creation and the study process, including the description and assessment of the use of the outcomes in the study process.

The RTU Research Programme for 2016–2020 (available at RTU Petniecibas programma 2016.-2020. gadam.pdf (Latvian only)) set the following goals of the faculty (FEEE):

1. Increasing the international visibility of research;
2. Increasing the impact of innovation and research on the development of relevant fields of science;
3. Increasing the economic and public importance of research;
4. Developing research infrastructure.

The vision of the RTU FEEE is to become Latvia's leading, internationally recognised study, science and innovation institution in the energy, electrical engineering and environmental protection sectors by 2020.

FEEE has identified four main strategic areas based on long-term research objectives:

- to increase the **international visibility of research** and to increase the quality of drafted publications by improving the environment that promotes innovative thinking;
- **to reduce the fragmentation of the research directions of institutes** and to encourage inter-institutional cooperation and cooperation within RTU research platforms;
- **to increase the economic and public importance of research** by participating in the EU research and innovation programme Horizon 2020 and in other international support programmes;

- **to develop research infrastructure** through the creation of new laboratories and more efficient use of *UseScience*, including not only equipment, but also services and competencies that FEEE can provide.

The these objectives of studies and research are aimed at promoting successful research, its link it to academic studies and integration into them, and helping early-stage researchers to successfully enter the profession.

The interdisciplinary role of research is ensured by engaging in the work of RTU Research Platforms which aim to provide inter-faculty, interdisciplinary research in areas of importance to the national economy and society. Research platforms are a cooperation coordination mechanism whose task is to analyse the needs of companies and various public institutions in order to define prospective research directions in line with RTU competencies, to organize relevant internal project competitions, applications for international projects, cooperation with companies and public institutions. RTU IESE together with other FEEE institutes, participates in the RTU research platform "Energy and Environment" coordinated by RTU FEEE.

The link of scientific research to the study process is ensured using potential knowledge transfer principles and continuous improvement of competences, which manifest in integration of research results in study courses and study process, involvement of students in research, familiarising of students with latest research results, enabling them to conduct research work independently or in cooperation (team work). The link of science and research to the study process is ensured also by involving visiting lecturers in lectures and practical classes, active participation of students in international conferences and seminars, preparation of international scientific publications and participation in international cooperation research projects, thus developing their research skills during all studies, at the same time fostering that students become young scientists. During studies RTU IESE encourages Bachelor, master and doctoral students to get actively involved in research, to foster interaction with research staff and get to actively involved in scientific research activities. Students of the study direction "Environmental protection" actively participate in the development of spin-offs (e.g. the students of the Master programme M. Karols), where researchers ad graduates continue to successfully develop scientifically and economically successful results affecting the economy, society and culture. Such activities increase the sustainability of study programmes by encouraging students to work in science, to select future doctoral studies as well as doctoral students, to continue their scientific activities after obtaining a doctoral degree at IESE and in others scientific institutions. On integration of the results of scientific research in the study process see Paragraph 4.5 on the involvement of students in scientific research.

A Scientific Committee was created within RTU FEEE, which meets on a regular basis to foster the development of science at the faculty, including contributes to integration of scientific research results in study courses, thus ensuring a continuous increase in study courses with updated research results. The efficiency of the link between scientific research and the study process is characterised by the results of RTU FEEE scientific activity and the SWOT analysis:

Internal strengths of RTU FEEE:

- Renewed study and research infrastructure;
- The quality of RTU studies and science is secured by professional and loyal academic staff, who is rich in experience;
- A successful process of renewal of academic staff due to the growing number of doctoral graduates in recent years;
- Good scientific performance indicators (number and citation rate of publications, international projects, contract work, etc.) at national and international level, despite small (international level) public financial support for science;

- Active international cooperation in the field of study and scientific research;
- Development of new research directions promoting the opening and improvement of new study programmes;
- Improving the quality of the end of studies by involving students in the development of scientific projects;
- Implementation of several study programmes in English.

External opportunities of RTU FEEE:

- High demand for energy, electrical engineering and environmental engineering specialists in Latvia and abroad;
- Global development of scientific research in the fields of energy, electrical engineering and the environment;
- Updating of the topics of graduation papers in cooperation with international projects and industry companies, including innovation companies;
- Raising additional funding and extending international cooperation by participating in national and European programmes and projects (National Research Programmes, projects funded by LCS, Horizon 2020, etc.);
- Cooperation with industry companies in the implementation of market-oriented research;
- Availability of infrastructure for national research centres for the development of scientific research activities, including graduation papers and doctoral theses;
- Enrolment of more international students into study programs.

The efficiency of the link between scientific research and the study process is confirmed by the fulfilment of the targets and outcome indicators set by RTU IESE and their growing dynamics. Thus, for instance, an increase in the number of reports of students has been observed at the international scientific conference CONECT organised by RTU IESE every year since 2014 (21 in 2014, but 60 reports in 2020), elements of research were included in about 47% of courses in study programmes in 2013 and in about 84% of courses in 2020. Close cooperation with industry, businesses, associations (active membership of teaching staff in associations) and other stakeholders in the sector, and therefore the implementation of applied scientific projects, increases the possibilities of integrating the most appropriate scientific solutions into the study process.

Some of the most important research results, which are integrated into academic studies and are intended to be achieved and integrated in the future in the study process (for more information on scientific projects see section 4.3):

- The objective of the European Social Fund project “Attraction of human resources for the development of an integrated renewable energy generation system” (2013-2015) was to establish a new Baltic-level scientific group in the environmental science sector, which operates in the field of development and analysis of innovative integrated energy production from non-renewable sources, involving in the group young scientists and doctoral candidates. As part of the project, a scientific monograph “Renewable electricity storage” was developed. The monograph is devoted to exploring the problems of irregular and recurring renewable electricity storage. The main focus is on exploring and analysing the possibility of implementation of the technological solution idea “Electricity for the production of biomethane”. The monograph is widely used in the study courses “Renewable Energy” (4 CP), “Biotechnologies” (4 CP), etc. of the study direction “Environmental protection”.
- During the implementation of the Erasmus+ project “CABARET” (2016-2019) stable international and regional cooperation was established between higher education institutions in Asia and Europe to establish a sustainable early warning system and promote the capacity

to counter disasters in coastal communities. “CABARET” enabled individuals and organisations to acquire the skills needed to continue existing research and to be able to manage research processes in partner countries’ institutions aimed at reducing the effects of disasters, and to ensure the sustainability of the results obtained, to integrate these acquired skills into the content of study courses of study programmes of universities.

- In 2020, within the scientific project “CO2 Deal: Effective Valorisation of CO2 for Decarbonised Regional Development” un “Panacea: “Public health and environmental pollution prevention through circular economy approaches in health care waste management”, which received funding within the call for Fundamental and Applied Research Projects, it is planned to develop modules of study courses on (1) CO2 valorisation possibilities, limiting factors, evaluation methods and (2) the possibilities for valorisation of waste in healthcare institutions. The developed study course modules are planned to be included in the study programme of Riga Technical University “Environmental Engineering” and in the lifelong learning study course “Environmental Engineering” (2CP) implemented by RTU IESE.

4.3. Description and assessment of the international cooperation in the field of scientific research and/or artistic creation by specifying any joint projects, researches, etc. Specify those study programmes, which benefit from this cooperation. Specify the future plans for the development of international cooperation in the field of scientific research and/or artistic creation.

Undeniable ensuring of sustainability of balanced development of scientific research of RTU IESE is cooperation and strong cooperation partners in Latvia, other European Union Member States, Scandinavian countries, Russia, Kazakhstan, Uzbekistan, Ukraine, Moldova, the United States, Canada, Taiwan, India and other countries. RTU IESE participates in joint Baltic Sea Region, Horizon 2020 and Nordic Energy Research programmes and projects whose results have contributed to the development of environmental science and engineering sciences and resolution of practical challenges for industry companies. It is the scientific research capacity and achievements of RTU IESE that are the main prerequisites for the successful improvement of study programmes of the study direction “Environmental protection” and for the development of science-based study programmes. Obviously, doctoral programmes (“Environmental Science” and “Environmental Engineering” study programme) contribute to and at the same time gain from the implementation of institutional activities based on scientific progress.

The most important forms of implementation of scientific and research works are conducting research ordered by the state, participation in international projects, scientific publications, participation and reporting at international and local conferences. Taking into account that research in the field of environmental protection, in essence, mainly is applied and interdisciplinary research, part of research of the direction also belongs to this group.

An impressive increase in the attraction of scientific research projects is observed in the study direction “Environmental protection”: the number of projects has tripled in the period from 2013 to 2020. Furthermore, the amount of funds raised by the projects implemented by RTU IESE has quadrupled from 2013 to 2020.

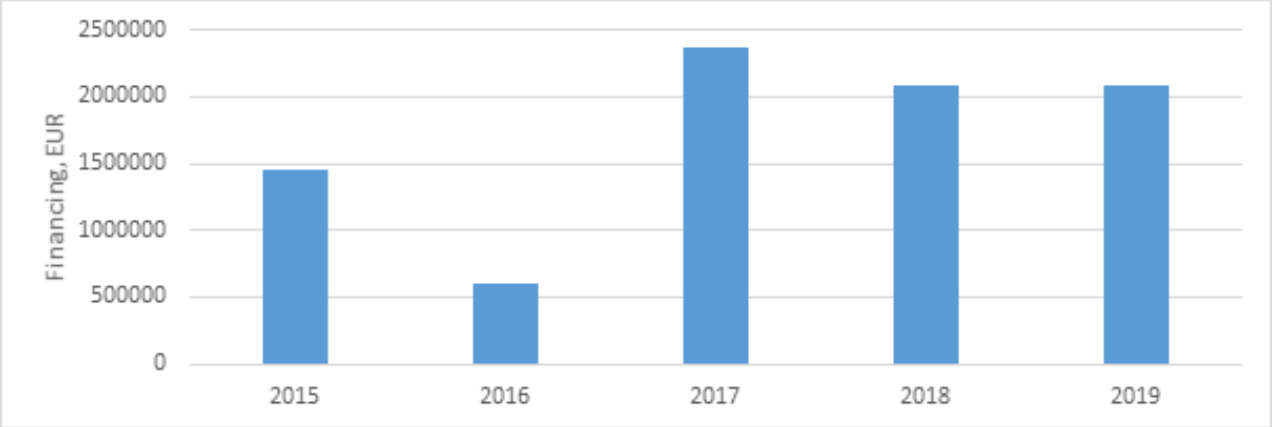

Figure: *Budget of scientific research project portfolio implemented by RTU IESE from 2015-2020.*

The most important projects within the study direction "Environmental protection" in the reporting period (2013 – now) are listed below.

Internationally funded projects, where RTU IESE has the role of the leading coordinator

RTU IESE is the first institute at RTU, which obtained Horizon 2020 projects (***SUNSHINE*** AND ***ACCELERATE SUNSHINE***), where it plays the role of the leading partner. This is a significant proof of RTU IESE's scientific capacity and scientific leadership in the area not only at university level, but also internationally.

- **Energy efficiency in renovated apartment buildings SUNSHINE** (2015 – 2019/2020) *"SUNSHINE" is the first HORIZON 2020 project in which a Riga Technical University institution is taking a role of coordinator. In this project, IESE scientists implement ideas about the role of the Energy Service Companies (ESCOs) in the household sector. The main objective of the project is to create and find a stable place for ESCO in energy efficiency improvement measures in order to fulfil the tasks of the EU Energy Efficiency Directive. The ESCO operation in apartment buildings, where each apartment has its own owner, is associated with high level risks, difficulties in attracting finance and the necessity to solve legal problems by developing specific energy performance contracting. The tasks of the "SUNSHINE" project are connected with the creation of new ESCO by involving municipality heating supply companies.*

  Project is funded by: Horizon 2020

  Budget: EUR 183 553.00

  Project Manager: RTU IESE professor Dr.sc.ing. Marika Rošā, RTU IESEI professor Dr.sc.ing. Claudio Rochas

  Partners: Building and Energy Conservation Bureau, SIA "Salaspils siltums", SIA "RENESCO", SIA "Ekodoma", SIA "eco.NRG", Funding for Future B.V. (The Netherlands and Latvia)

- **Accelerate SUNShINE: "Save your building by saving energy. Begin to move more quickly"** (2017 - 2020) *Project Accelerate SUNShINE is further development of the project "SUNShINE" to renovate public and residential buildings in Latvian municipalities, to mobilize all stakeholders, using a longterm energy efficiency agreement and reaching 50–60 % energy savings of the renovated buildings.*

  Project Managers: RTU IESE professor Dr.sc.ing. Marika Rošā, RTU IESE professor Dr.sc.ing. Claudio Rochas

  Project is funded by: Horizon 2020

Budget: EUR 198 106.25

Partners: Ādaži Municipality Council, Bauska Municipality Council, Jūrmala Municipality Council, Tukums Municipality Council, Building and Energy Conservation Bureau, SIA "Ekodoma" Funding for Future B.V. (The Netherlands and Latvia)

Internationally funded projects, whether RTU IESE has the role of a partner

To constantly prove own research capacity at the international scientific research stage (by participation in scientific projects, publications, participation in conferences, etc.), RTU IESE actively participated in the implementation of international projects initiated by foreign scientific research organisations.

- **Production of second generation biofuels from biowaste and algae "BioWALK4Biofuels"** (01.04.2010 - 31.03.2015.) *The project is dedicated to the innovative, economically efficient and sustainable development of a system in order to produce second generation biofuel using macroalgae as a catalyst. This solution can reduce eutrophication and the amount of greenhouse gas emissions, as well as promote energy independence at national and regional level. The main aims and objectives of the project are:*

  - development of the sustainable extraction of biogas for the production of second generation biofuel;

  - determination of the most appropriate species of algae for the production of biogas;

  - establishment of a pilot biogas station for the production of biogas from biowaste using macroalgae as a catalyst;

  - improvement of biogas to transport fuel quality.

  Through the participation of Latvian, Italian and Danish partners, the evaluation of the available macroalgae in the Mediterranean Sea, the North Sea and the Baltic Sea for the production of biofuel was carried out. Based on the implemented pilot studies, IESE has conducted a sustainability assessment of the product on system and the alternative use of biogas: life cycle assessment, life cycle cost analysis and social life cycle analysis.

  Project coordinator from RTU IESE: RTU IESEI professor, Dr.sc.ing. Francesco Romagnoli

  Project is funded by : the EU 7th Framework Programme

  Budget: EUR 175000.00

  Partners: Sapienza University of Rome (Italy), CoNISMa (Italy), Ecoil (Italy), Danish Technological Institute (Denmark), National Environmental Research Institute (Denmark), Hashemite University (Jordan), Central Salt and Chemicals Research Institute (India), AquAgri Processing (India), NGVA Europe (Belgium)

- **Disaster resilience academic network "ANDROID"** (2011-2014) *The aim of the project is to promote cooperation and innovation in the field of higher education in order to increase society's resilience to disasters that are caused by climate change and by environmental and human induced hazards. Within the project, the best disaster management mechanisms are analyzed. These mechanisms can provide preparedness to disaster induced changes and the ability to adapt to these changes by minimally infl uencing the economic, political, social and environmental processes in society. The scientists of the IESE have developed a quantitative and qualitative set of indicators that can accelerate the evaluation of disaster risk probability and inflicted consequences in municipalities and, as a result, choosing the most appropriate action program. The action program is based on the analysis of environmental, climatic,*

social, economic and technological factors.

Project coordinator from RTU IESE: RTU IESE professor, Dr.sc.ing. Francesco Romagnoli, RTU IESE professor, Dr.sc.ing. Claudio Rochas

Project is funded by: Lifelong Learning programme

Partners: Salfordas Universitāte (United Kingdom), NISDR, the United Nations Human Settlements Programme (UNHABITAT), Asian Disaster Preparedness Centre (ADPC), Federation of Sri Lankan Local Government Authorities (Sri Lanka)

- **Technological solutions for the development of the Nordic power system TOP-NEST** (2011-2015) *The main aim of the project TOP-NEST is to provide real and eff ective management solutions for transition to a sustainable Nordic energy and transport system by 2050 and to improve Nordic industry competitiveness in the international clean technology market. Within the project, the IESE focuses on the planning of clean transport system development and comprehensive technological, economic, environmental, social and political factor analysis in the transport sector by 2030. In the framework of the project several scientific publications were produced, for instance, about barriers and opportunities in the transport sector in Europe, use of renewable energy in transport, analysis of policy instruments in the Baltic States and the possibility to use from household waste derived biomethane in the transport system in Latvia. In order to determine factors that infl uence transition to a low emission transport system (the utilization of green fuel and the development of innovative transport infrastructure in Latvia) and to off er solutions for the development of sustainable transport system, IESE scientists have developed a system dynamic model. The model includes various political, economic and technological scenario analysis and depicts the effi ciency of their introduction.*

  Project is funded by: Nordic Energy Research

  Budget: 720000 NOK (around 71365.90 EUR)

  Project coordinator from RTU IESE: RTU IESEI professor, Dr.sc.ing. Marika Rošā

  Partners: Nordic Instiute in Innovation, Research and Education (Norway), Lund University (Sweden), Technical University of Denmark (Denmark), Technical Research Centre of Finland (Finland)

- **Development of the Nordic energy sector until 2050 NORSTRAT** (2012-2015) *Nordic countries are preparing to produce, transmit and use green electricity. The "NORSTRAT" project is focused on finding a solution to problems that are associated with the transmission of renewable electricity. The main scenario is directed towards 100 % use of renewable energy resources in 2050 in the Nordic and the Baltic countries. The scenarios analyze both investments in the creation of new connections and the integration of the Baltic countries in the collective renewable electricity market. The IESE, together with the Stockholm Environment Institute, analyzed Estonian, Latvian and Lithuanian opportuniϴ es of electricity transmission system from both views development of new connections and from the view of electricity consumer.*

  Project is funded by: Nordic Energy Research

  Budget: 600000 NOK (around 61 180.79 EUR)

  Project coordinator from RTU IESE: Professor, Dr.hab.sc.ing. Dagnija Blumberga

  Partners: SINTEF (Norway), Stockholm Environment Institute (Sweden adn Estonia), Technical

University of Denmark (Denmark).

- **Project for the development of a Waste to Energy cluster COOLSWEEP** (2013-2015) *The project is aimed at the development of a cluster, where waste management companies, heating supply companies and technology manufacturers and installers are united. The cluster was developed on the basis of an already existing company "CLEANTECH-Latvia" - as a Waste to Energy department. 15 participants had applied for this project and their aim was to implement the targets of the cluster, which include: development of new ideas, submission of international cooperation projects, research of the experience of similar clusters in Austria, Italy, Spain, Denmark and Norway. The task of the IESE scientists was to develop a cluster for the sustainable use of energy resources. The project will result in the development of a new project application on the potential use of a refuse derived fuel.*

  Project is dunded by: EU 7th Framework Programme

  Budget: EUR 114 300.00

  Project coordinator from RTU IESE: Professor, Dr.sc.ing. Francesco Romagnoli

  Partners:

  - *From Latvia: SIA "ZAAO", SIA "Getliņi EKO"*
  - *From other countries: OREEC (Norway), Aclima (Spain), CLEAN (Denmark), FORA (Denmark), ECO WORLD STYRIA (Austria), Lombardy Energy Cluster (Italy), Montanuniversität Leoben (Austria).*

- **Involvement of Human Resources for Development of Integrated Renewable Energy Resources Energy Production System** (2013-2015) *The aim of this project is to develop innovative and alternative renewable electricity production and storage system for the Baltic countries in order to provide production of electricity that is based on local resources and conservation of biological diversity. The proposed solution includes these technological modules:*

  - *module of generated electricity from irregular renewable resources (wind and solar);*
  - *electrolysis module;*
  - *methanation module;*
  - *biogas production module;*
  - *methane storage and usage module.*

  Suitability of the proposed innovation of the integrated energy system was experimentally analysed. The assessment of environmental, economic and political aspects related to the integrated system was performed through the system dynamic modelling, life cycle assessment, life cycle cost assessment and social life cycle assessment methods.

  Project is funded by: the European Social Fund

  Budget: EUR 495 599.06

  Project coordinator from RTU IESE: Professor, Dr.sc.ing. Jūlija Gušča

  Partners: University of Latvia, Riga Technical university

- **Energy efficiency improvement in historic buildings** (2010-2013) *The IESE has participated in the Baltic Sea Region programme's project "Co2 olBricks". This was the first project in Latvia that launched improvement of energy efficiency in historic buildings and included the analysis of the obtained results. The IESE has evaluated previous projects and, together with the Riga City Council, implemented a pilot project in the Spīķeri quarter,*

Maskavas iela 8 in Rīga. Three innovative thermal insulation materials like aerogel, vacuum insulation panels and polyisocyanurate were used for the insulation of the historic building. At the end of the project, heat loss monitoring and data analysis were carried out.

Project is funded by: Baltic Sea Region

Project coordinator from RTU IESE: professor, Dr.sc.ing. Andra Blumberga

Partners:

- *From Latvia: Riga City Council*
- *From other countries: Aalborg University (Denmark), KU Leuven (Belgium), Dresden University of Technology (Germany), Marche Polytechnic University (Italy), SP Technical Research Institute (Sweden), Technical University of Denmark (Denmark), INTRO FLEX ApS (Denmark), Erik Møller Architects (Denmark), University of Applied Sciences Western Switzerland (Switzerland).*

- **Development of a training course and study program module „Socio-economic aspects of the climate technology for bioeconomy sector BIOECONOMY** (2015-2016) *A training course and a study program "Socio-economic aspects of the climate technology of bioeconomy sector" will be developed by the IESE scientists in the framework of the project "Bioeconomy". Whereas a bioeconomy model, based on sustainable use of bioresources, will be developed within the project "Bioclimate".*

  Project is funded by: the European Economic Area Financial Mechanism

  Budget: 193 141.00 EUR

  Project Manager: Dagnija Blumberga

  Partner: University of Bergen (Norway)

- **Development of bioeconomical model for sustainable use of biological resources in order to reduce climate changes and improve adaptation capacity BIOCLIMATE** (2015-2016) *The aim of the project is to create an analytical tool - a system dynamics model for modelling and analysing the transition possibilities of the Latvian economy to bioeconomy with high added value in the medium and long term, by simulating the impact of national socio-economic development and climate change and assessing the necessary policy instruments. The model will allow for the detailed forecasting of GHG emissions in close connection with the international emissions inventory. Within the framework of the project, it will be analysed how to use the biological resources available in the country (flora and fauna that grows and rebuilds at the scale of a person's life-cycle), increasing their added value in order to ensure sustainable and gradual improvement of the Latvian economy, while at the same time arranging the environment in which it is ready to live the nation of Latvia.*

  Project is financed by: the European Economic Area Financial Mechanism

  Budget: 189 725.00 EUR

  Project Manager: RTU IESE professor, Dr.sc.ing. Andra Blumberga

  Partner: University of Bergen (Norway)

- **Syngas production from biomass and use in a syngas burner** (2015-2016) *In collaboration with SIA "Balteneko", a project by European Economic Area Financial Mechanism is being implemented in order to create a syngas production technology as well as organize effi cient combustion process of syngas burner. Syngas producϴ on technology consists of a woodchip drying plant, biomass gasifi er, syngas cooling and purifi caϴ on*

technology. Research on parameter change and the creation of the optimization model is being carried out. The results to be achieved by the end of the project are scientific and practical experience in the creation of gasifi cation technology system, experimental planning and evaluation of the operational parameters. This is a signifi cant move towards the application of innovative and effi cient gasification technologies in Latvia for further development.

Project is funded by: the European Economic Area Financial Mechanism

Budget: EUR 47 553.80

Project coordinator from RTU IESE: professor, Dr.hab.sc. ing. Dagnija Blumberga

Partners: SIA "Balteneko", SIA "MRK Serviss"

- **RIBuild: Energy Efficiency Improvement in Historic Buildings** (2015-2020) *Based on experience of the Co2 olBricks project, the scientists of the Aalborg University and the IESE, as well as representatives from five other countries, implement the project RIBuild within the HORIZON 2020 programme. During the five project implementation years, the historic building wall materials, opportunities of thermal insulation and building reconstruction in Europe will be identified, as well as the experience of reducing energy consumption in historic buildings will be summarized. The aim of the RIBuild project is to develop guidelines for the insulation of historic buildings from the inside, as well as to model solutions of saving historic buildings, evaluate energy savings and environmental impact while preserving the historic and cultural value of the building.*

  Project is funded by: Horizon 2020

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Andra Blumberga

  Budget: EUR 346 375.00

  Partners:

  - *From Latvia: Riga City Council*
  - *From other countries: Aalborg University (Denmark), KU Leuven (Belgium), Dresden University of Technology (Germany), Marche Polytechnic University (Italy), SP Technical Research Institute (Sweden), Technical University of Denmark (Denmark), INTRO FLEX ApS (Denmark), Erik Møller Architects (Denmark), University of Applied Sciences Western Switzerland (Switzerland)*

- **Natural Thermo Packaging** (2017-2020)

  1st cycle: 19.07.2017. - 18.01.2018.

  2nd cycle: 19.01.2018. - 31.03.2020.

  Within this project, IESE scientists develop natural thermo packaging that could be an ecological and sustainable product with minimal impact on the environment.

  Project is funded by: ERAF, LIAA

  Project coordinator from RTU IESE: professor, Dr.hab.sc. ing. Dagnija Blumberga, docent, Dr.sc.ing. Indra Muižniece, Terēza Bezručko,

  Budget: EUR 25 000.00

- **IFUS: Individual Heat Supply with Integrated Fog Unit System** (2017-2020) *The aim of the project is to develop a new flue gas treatment system solution for low-capacity biomass*

combustion systems to reduce emissions by 80% and increase energy efficiency by 20% compared with traditional solutions.

Project is funded by: European Regional Development Fund (ERDF)

Project coordinator from RTU IESE: professor, Dr.hab.sc. ing. Dagnija Blumberga, M.sc.Antra Kalnbaļķīte

Budget: EUR 595 843.79

- **Flexibility for Variable Renewable Energy Integration – Flex4RES** (2016-2019) *The primary objective of the Flex4RES project is to identify and assess regulatory and technical pathways towards coherent Nordic energy systems in 2050 based on strong interactions between different energy markets that ensure resilience, sustainability and efficiency*

  Project is funded by: Nordic Energy Research

  Project coordinator from RTU IESE:professor, Dr.hab.sc. ing. Dagnija Blumberga, Docent, Dr.sc.ing. Jeļena Ziemele

  Budget: EUR 103 000.00

  Partners: Technical University of Denmark (Denmark), Norwegian University of Life Science (Norway), The Swedish Royal Institute of Technology (Sweden), Aalto University (Finland), Stockholm School of Economics (Sweden), Norwegian Centre for Research Quality and Policy Impact Studies (Norway)

- **LowTEMP: Low Temperature District Heating for the Baltic Sea Region** (2017-2020) *LowTEMP project is related to the implementation of low temperature district heating systems in the Baltic Sea Region countries. District heating systems are widespread around the Baltic Sea Region but those are often outdated and do not meet energy efficiency requirements. The project brings together partners from nine Baltic Sea Region countries, which represent local, regional and national authorities, district heating suppliers, energy agencies, research institutions and associations.*

  Project is funded by: Interreg Baltic Sea Region 2014-2020

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Francesco Romagnoli

  Budget: 250 000.00 EUR

  Partners:

  - *From Latvia: Riga Technical University, Vidzeme Planning Region, Gulbene City Council*
  - *From other countries: Institute of Fluid Flow Machinery, Polish Academy of Sciences (Poland), District Heating Enterprise Ltd. – OPEC Gdynia (Poland), Brandenburg University of Technology (BTU) Cottbus – Senftenberg (Germany), ZEBAU – Centre for Energy, Construction, Architecture and the Environment GmbH (Germany), Energy Efficiency Association for Heating, Cooling and CHP (Germany), Holbaek Municipality (Denmark), Gate 21 (Denmark), Lejre Municipality (Denmark), Sustainable Business Hub (Sweden), City of Malmö (Sweden), Thermopolis Ltd. (Finland), District Heating Kurikka (Finland), Tartu Regional Energy Agency (Estonia), Klaipeda University (Lithuania), Public Institution Housing Energy Efficiency Agency (Lithuania), ANO Energy Efficiency Centre (Russia)*

- **ActNow: Action for Energy Efficiency in Baltic Cities** (2017-2020) *The ActNow project is related to increase energy efficiency in buildings by developing coherent energy*

management system for energy consumption smart metering and analysis thereby increasing the capacity of local government employees in energy management and investment planning. The sustainability of project ideas in Latvia will be ensured by the cooperation of IESE with employees of the Vidzeme Planning Region.

Project is funded by: Interreg Baltijas jūras reģiona programma 2014-2020

Project coordinator: professor, Dr. sc. ing. Francesco Romagnoli

Budget: 254 772.00 EUR

Partners:

- *From Latvia: Riga Technical University, Gulbene City Council*
- *From other countries: Magistrate of the City of Bremerhaven (Germany), Leuphana University Lüneburg (Germany), Renewable Energies Agency (Germany), Europe University Flensburg (Germany), Energy agency for South East Sweden (Sweden), Trolleybus Communication Enterprise Ltd. (Poland), Municipality of Gdynia (Poand), The Szewalski Institute of Fluid-Flow Machinery Polish Academy of Sciences (Poland), Centria University of Applied Sciences Ltd. (Finland), Association of Ylivieska Region (Finland), ProjectZero (Denmark), Silute District Municipality Administration (Lithuania), CivittaUAB (Lithuania), Elva Municipality (Estonia), South-Estonian Centre of Renewable Energy (Estonia), Immanuel Kant University Kaliningrad (Russia)*

- **TEST-4-SME: Laboratory Network for Testing of Environmental Products** (2017-2020) *The Project will initiate an innovation support network in the Baltic Sea Region for electronics SMEs. The support network will provide testing and consultation for electronics SMEs on how to demonstrate conformity with international standards during early product development.*

  Project is funded by: Interreg Baltijas jūras reģiona programma 2014-2020

  Project coordinator from RTU IESE:: professor, Dr. sc. ing. Jūlija Gušča

  Budget: 285 000,00 EUR

  Partners:

  - *From Latvia: The University of Latvia, Ventspils University of Applied Sciences*
  - *From other countries: Tartu Observatory (Estonia), University of Tartu (Estonia), Applied Research Institute for Prospective Technologies (Lithuania), Centria University of Applied Sciences (Finland), Hochschule Wismar (Germany), University of Applied Sciences: Technology, Business and Design (Germany), JSC Modern E-Technologies (Lithuania)*

- **CABARET: Capacity Building in Asia for Resilience Education** (2016-2019) *The aim of the project during its action is to build capacity for international and regional cooperation between Higher Education Institutes (HEIs) in Asia and Europe. The cooperation among Asian HEIs themselves will also be developed, to improve multi-hazard early warning systems and increase disaster resilience among coastal communities. CABARET project concentrates on a region not sufficiently addressed by projects already being funded under previous schemes. CABARET project will empower individuals and organisations with the skills, competencies and credentials needed to continue to pursue research, and to lead research at institutions in partner countries, aimed at reducing the impact of disasters. The main activities of the project, including training, workshops, dissemination events and management meetings are clustered around six meetings of projects partners, which will take place in Asia and Europe.*

Project is funded by: Erasmus+

Project coordinator from RTU IESE: Dr. sc. ing. Francesco Romagnoli

Budget: EUR 30 615.00

Partners: University of Huddersfield (United Kingdom), University of Central Lancashire (United Kingdom), University of Cantabria (Spain), University of Mining and Geology (Bulgaria), University of Malta (Malta), University of Moratuwa (Sri Lanka), University of Peradeniya (Sri Lanka), Bandung Technical Institute (Indonesia), Andalas University (Indonesia), Maldives National University (Maldives), De La Salle University (Philippines), Ateneo de Manila University (Philippines), Mandalay Technological University (Myanmar), University of Yangon (Myanmar)

- **BIOCM: Bio-Empowered Oxidative Coupling of Methane Process** (2017-2020) *The Oxidative Coupling of Methane (OCM) allows the conversion of the methane contained in natural gas into ethylene, which is a main building block for the chemical and plastic industries. Biogas is a potential methane source and its use as a renewable energetic fuel has been spreading rapidly. The main objective of the BIOCM project is to design and provide a robust proof of concept for an OCM process which efficiently converts biogas into ethylene. Novel processes for the treatment of residual waste water in anaerobic sequencing batch reactors with immobilized biomass are to be developed aimed at achieving environmental compliance of the effluents and biogas production. The biogas is then to be converted into ethylene via OCM and the reaction exothermicity can be used to drive the reform of the unconverted methane for energy and material integration and to produce a wider product range within a biorefinery concept. A life cycle analysis of the production chain is to be carried out to ensure the sustainability of the proposed process structures.*

  Project is funded by: ERANet-LAC (Network of the European Union, Latin America and the Caribbean Countries on Joint Innovation and Research Activities)

  Project coordinator from RTU IESE: profesore, Dr. sc. ing. Jūlija Gušča

  Budget: 66 600.00 EUR

  Partners: Technische Universität Berlin (Germany), Instituto Mauá de Technologia (Brasil), Universidad Nacional de Colombia (Columbia)

- **Improving production efficiency in the fish processing companies** (2018-2021) *The aim of the project "Improving production efficiency in the fish processing companies" is to introduce significantly improved production methods in order to increase production efficiency and reduce the consumption of energy, water and resources in fish processing. The planned innovation of the project is the introduction of production methods that would increase the production efficiency, reduce the consumption of energy, water and resources in the processing of fish, and find solutions for the further utilization of fish processing waste.*

  Project is funded by: European Maritime and Fisheries Fund (EMFF)

  Project coordinator from RTU IESE: professor, Dr. hab. sc. ing. Dagnija Blumberga

  Budget: 289 423.08 EUR

  Partners: The Union of Latvian Fish Processing Industry (ULFPI)

- **Climate investment capacity (CIC): climate finance dynamics & structure for financing the 2030 targets** (2018-2020) *The project aims to create a European framework to support the transition to a climate-friendly economy in the European Union. As a result, the*

skills of public sector participants and public financial support scheme managers will be strengthened to deal with investment challenges in meeting the energy, climate and energy goals of Germany, Latvia and the Czech Republic by 2030.

Project is funded by: The European Climate Initiative (EUKI)

Project coordinator from RTU IESE: asoc. professor, Dr. sc. ing. Agris Kamenders

Budget: 60 960 EUR

Partners: Institute for Climate Protection, Energy and Mobility (Germany), Czech Technical University in Prague (Czech Republic)

- **ICCEE – Improving Cold Chain Energy Efficiency** (2019-2022) *The ICCEE (Improving Cold Chain Energy Efficiency) project will facilitate Small and Medium Enterprises (SMEs) in the cold chains of the food and beverage sector to undertake energy efficiency measures (EEMs) after carrying out supply chain energy audits. The focus on the cold chains of the sector is due to the significant energy requirements (refrigerated transport, processing and storage) with large potentials for savings. The implementation of the holistic approach, shifting from the single company perspective to the chain assessment, lead to increased opportunities for EEMs. To enable the update of EEMs, ICCEE will a) implement and apply an analytical energy efficiency tool to support and facilitate decisionmaking at different company organisational levels and b) launch a capacity building program towards staff and relevant stakeholders and a community dedicated to support a change in energy culture of the sector. The feasibility of EEMs will be evaluated by considering economic, environmental and social impacts encompassing their entire life cycle and the entire supply chain. Non-energy benefits and behavioural aspects will also be addressed and recommendations on financing schemes for SMEs will be assessed. The first part of the trainings will reach 300 companies through 20 national workshops thanks to the collaboration of associations in the consortium. 32 companies will be trained for the use of the tool in 4 EU workshops. At a final step, ICCEE will launch e-learning courses, which will be available also beyond the project's lifetime reaching at least additional 64 companies. ICCEE will introduce primary energy savings (118 GWh/year), increase invested capital in sustainable energy (64 million €), and reduce GHG emissions (40,376 tonCO_2/year). Capacity building activities allow to increase stakeholders' knowledge and enhance their energy culture (2000 people). Outcomes from ICCEE will also support policymakers in defining tailored policies for the sector.*

  Project is funded by: Horizon 2020

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Francesco Romagnoli

  Budget: 63 000 EUR

  Sadarbības partneri: Universita Degli di Brescia (Italy), Institute for European Energy and Climate Policy (Netherlands), Federazione Italiana per L'uso Razionale Dell'Enegia (Italy), Adelphi Research Gemeinnutzige GMBH (Germany), Associat Technique Energie Environnement (France), Fraunhofer Gesellschaft zur Foerderung der Angewandten Forschung E.V. (Germany), Escan SL (Spain), Spread European Safety GEIE (Italy), European Cold Storage and Logistics Association (Belgium), Anaptyxiaki Epimelitiriou Korinthias (Greece), Universitaet Stuttgart (Germany), Federatia Patronala Romana Din Industria Alimentara - Romalimenta (Rumania).

- **Supercritical Omega-3 oil from production by-products**

  1st cycle: 01.2018 – 10.2018,

2nd cycle: 10.2018-04.2021

The goal of the project is to obtain single-cell oil from by-products. As a result of the implementation of the project, a technology will be developed that is a set of facilities for pre-treatment of industrial waste, cultivation of microorganisms in a substrate (substrate - treated waste), biomass treatment of microorganisms, single-cell oil (product) extraction from biomass (supercritical CO2 extraction) and product quality control.

Project is funded by: European Regional Development Fund, RTU co - financing

Project coordinator from RTU IESE: docent, PhD Krišs Spalviņš

Budget: 27 777 EUR (1st cycle) + 274 500.00 EUR (2nd cycle)

- **Advancing Sustainable Circular Bioeconomy in Central and Eastern European countries: BIOEASTsUP** (2019-2022) *The overall objective of BIOEASTsUP project is to support the BIOEAST initiative in the implementation of its Vision for 2030 and Action Plan for transition of 11 Central and Eastern European (CEE) to bioeconomy. This will be done by engaging the relevant stakeholders, accenting sustainable circular bioeconomy on the CEE governments' agenda improving macro-regional cooperation formats with downstream and upstream linkages of agri-food sector, and supporting national bioeconomy strategies development. The project will advance the BIOEAST initiative to become a catalyst for a research and innovation, rural development and other policies towards bioeconomy development in the CEE by creation of favourable inter-sectoral framework for sustainable deployment of biomass potential.*

  Project is funded by: Horizon 2020

  Project manager: Dr.hab.sc.ing. Dagnija Blumberga

  Budget: 104 937.50 EUR

  Partners:

  - *From Latvia: Latvia University of Life Sciences and Technologies*
  - *From other countries: Instytut Uprawy Nawożenia i Gleboznawstwa — Państwowy Instytut Badawczy (Poland), Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej — Państwowy Instytut Badawczy (Poland), Ministerstwo Rolnictwa i Rozwoju Wsi (Polija), Ministry of Agriculture (Hungary), Zemědělský výzkum, spol. s r.o. (Czech Republic), Agrárgazdasági Kutató Intézet (Hungary), Agricultural Academy (Bulgaria), Estonian University of Life Sciences (Estonia), Vytauto Didziojo universitetas (Lithuania), Ministerstvo pôdohospodárstva a rozvoja vidieka Slovenskej republiky (Slovakia), Univerza v Ljubljani (Slovenia), Ministrstvo za kmetijstvo in okolje (Slovenia), Energetski institut Hrvoje Požar (Croatia), Luonnonvarakeskus (Finland), Fachagentur Nachwachsende Rohstoffe e. V. (Germany), Institute of Agricultural Economics (Rumania), European Rural Development Network (Poland), Europa Media Szolgaltato non Profitkozhasznu Kft. (Hungary), Quadro Synergy Ltd. (Bulgaria).*

- **Utilization of biodegradable by-products into Protein Rich Extract For Either Ruminants or fish - Single Cell Protein (PREFER-VSP)** (01.04.2020.-30.09.2020.) *The aim of the project is to develop a technology that would allow the cultivation of protein-producing microorganisms using cheap and underused biodegradable agricultural residues, production by-products and invasive plants as feed material in the Latvian economy. Cultivation of these micro-organisms would yield protein-rich microbial biomass, called single-cell proteins (SCP), which can be used as a major source of protein in farm and*

aquaculture animal feed. Combining the latest innovations in bioreactor design, hydrolysis of biodegradable materials and selection of microorganisms – the project plans to develop a technological solution that would ensure the production of SCP, which would be cheaper than the current feed, would have a higher total protein content, all essential amino acids. The solution would provide farms and aquaculture with high-quality feed containing all the essential amino acids, thus producing high-nutrition products from these animals that would be healthier for human consumption. The technology would not create competition over existing agricultural land, the process would be significantly faster and more environmentally friendly than existing alternatives. Reducing the need for agricultural raw materials will reduce the negative impact on nature and species diversity. The process would ensure environmentally friendly disposal of biodegradable production residues and by-products, as well as from by-products available in Latvia, could produce products with higher added value than the currently used solutions (biogas, heating, fertilizer).

Project is funded by: European Regional Development Fund (ERDF)

Project manager: Dr.sc.ing. Jeļena Pubule

Budget: 25 000.00 EUR

- **Developing an indoor air purification biofilter facility for energy efficiency dilemma in buildings – BIACRED** (29.01.2018. - 28.07.2018.) *The aim of this project is to create a prototype of a biofilter unit that will reduce the concentration of CO2 and volatile organic compounds (VOCs) in the air by using the biomimicry principle - the ability of plants to absorb and release CO2.*

  Project is funded by: European Regional Development Fund

  Project manager: Dr.sc.ing. Andra Blumberga

  Budget: 27 777.00 EUR

- **Renovation Impact on Climate Change and Energy Efficiency** (01.05.2015 - 30.04.2016.) *The purpose of the study "Renovation Impact on Climate Change and Energy Efficiency" is to develop specific recommendations and provide evidence to policy-makers, local authorities and project developers, in order to achieve an active comprehensive renovation of multi-apartment residential buildings in Latvia. The research has resulted in proposals based on the conclusions obtained and covering both the creation of preconditions for self-organization of the inhabitants (for example, the support of the municipality for the formation of apartment owners' associations, the development of documentation for renewal, etc.) and a more standardized approach to the process of restoration (e.g., the minimum set of building restoration measures , register of builders, various financial instruments (grants, ESCO, etc.)*

  Project is funded by: European Economic Area and Norwegian Financial Instrument

  Project manager: Dr.sc.ing. Dagnija Blumberga

  Budget: 3 500.00 EUR

- **Development cooperation project for promotion of sustainable environmental engineering education between Urgench State University and Riga Technical University** (25.07.2014 - 31.12.2014) *Immediate results of the project are related to intangible benefits – training of Bachelor and Master students of Urgench State University on alternative energy sources and energy efficiency to promote sustainable engineering science.*

The project is financed by: Ministry of Foreign Affairs

Project manager: Dr.hab.sc.ing. Dagnija Blumberga

Cooperation partners: Urgench State University

Project budget: 24,985.00 EUR

- **Nordic Energy Research project „TOPNEST”** (2012-2015) *The main aim of the project TOP-NEST is to provide real and effective management solutions for transition to a sustainable Nordic energy and transport system by 2050 and to improve Nordic industry competitiveness in the international clean technology market. Within the project, the IESE focuses on the planning of clean transport system development and comprehensive technological, economic, environmental, social and political factor analysis in the transport sector by 2030. In the framework of the project several scientific publications were produced, for instance, about barriers and opportunities in the transport sector in Europe, use of renewable energy in transport, analysis of policy instruments in the Baltic States and the possibility to use from household waste derived biomethane in the transport system in Latvia. In order to determine factors that influence transition to a low emission transport system (the utilization of green fuel and the development of innovative transport infrastructure in Latvia) and to offer solutions for the development of sustainable transport system, IESE scientists have developed a system dynamic model. The model includes various political, economic and technological scenario analysis and depicts the efficiency of their introduction.*

  Project is funded by: Nordic Energy Research

  Project manager: Dr.sc.ing. Marika Rošā

  Partners: Nordic Institure for Studies in Innovation, Research and Education – NIFU (Norway), Lund University (Sweden), The Technical University of Denmark (Denmark), The Technical Research Centre of Finland (Finland)

  Budget: 67 819.08 EUR

- **Energy efficient and ecological housing (EcoHousing)** (01.05.2011.- 30.12.2013) *A market survey was carried out in Finland, Estonia and Latvia in relation to what type of boilers and stoves are currently available on the market for small buildings. Research was carried out on the energy efficiency and safety of the use of the newest wood boilers and combined (solar and pellet) boilers in the case of heating of small buildings. The results were presented at a seminar in Austria in the framework of the World Sustainable Energy Days in March 2013 and published in the TTS Booklet, in the RTU series of publications and on the website of the project. A series of seminars on the latest developments in the biomass and hybrid boiler technology “Energy Efficient and Ecological Housing” informed the public.*

  Project is funded by: Central Baltic INTERREG IVA Programme 2007-2013

  Project manager: Dr.sc.ing. Francesco Romagnoli

  Partners: TTS Institute (Work Efficiency Institute) (Finland), Tallinn University of Technology (Estonia), Tallinn University, Institute of Informatics (Estonia), Estonian University of Life Sciences (Estonia), Baltic Environmental Forum (Latvia)

  Budget: 150 184.08 EUR

- **Smart building EnVElope with solaR Energy STorage (EVEREST)** (2019-2021) *The aim of this interdisciplinary study is to develop an innovative smart facade structure capable of ensuring solar energy storage that meets both criteria of an active facade system – it is*

capable of altering properties and serves as an energy converter (by transforming solar energy into heat). The proposed facade solution is intended for use in both new and reconstructed buildings, which aim to have nearly zero-energy levels, thereby supporting local and global climate objectives. The main function of the facade module is to reduce heating and cooling loads and to cover some of the energy needed for heating with the solar energy stored in the module.

Project is funded by: Latvia's state budget Fundamental and Applied Research Program

Project manager: Dr.sc.ing. Ruta Vanaga

Budget: 300 000 EUR

- **Bridging the carbon neutrality gap in energy communities: social sciences and humanities meet energy studies (BRIDGE)** (2021-2023) *The project proposal is to develop a policy simulation instrument for policy makers to assess the introduction of alternative business models, the creation of energy communities, taking into account the various psychological and social aspects of behaviour in small-scale cooperative energy systems. System dynamics models help to solve complex problems for complex systems. Research of the dynamic decision-making processes of one and multiple players games developed in the project will reflect compromises for community-wide renewable energy systems and energy efficiency measures and will demonstrate how to maximise RES production and reduce energy consumption by involving consumers and modelling these opportunities at the same time. The developed model will help to bridge the carbon neutrality gap through a socio-technological transition in energy.*

  Project is funded by: Latvia's state budget Fundamental and Applied Research Program

  Project manager: professor Dr.sc.ing. Andra Blumberga

  Budget: 300 000 EUR

- **Effective Valorisation of CO2 for Decarbonised Regional Developmen (CO2 Deal)** (2021-2023) *The general objective of the project "Integrated decarbonisation solutions for the efficient valorisation of CO2 in regions (CO2 Deal)" is to develop a roadmap for decision-makers on efficient CO2 valorisation in Latvian regions in a way that is environmentally friendly, flexible and business-based, respecting the principles of a low-carbon circular economy. The selected CO2 valorisation processes will be analysed against their environmental, social, economic and climate viability. On the other hand, the main sectors to be studied are energy, industry, agriculture, land use and forestry, as well as waste management.*

  Project is funded by: Latvia's state budget Fundamental and Applied Research Program

  Project manager: Dr.sc.ing. Jūlija Gušča

  Budget: 300 000 EUR

- **Public health and environmental pollution prevention through circular economy approaches in health care waste management (Panacea)** (2021-2023) *The general objective of the project "Prevention of public health and environmental pollution through a circular economy approach to health care waste management (Panacea)" is to develop a roadmap for decision-makers and health care waste management companies on how to valorise the disinfected health care waste in an efficient, environmentally safe, sustainable and cost-effective way to valuable resources, taking into account the principles of the circular economy. The project is based on a sequential poly-modelling approach which combines*

methods such as 1) analysis of existing studies, 2) indicator analysis method, 3) multiple-criteria decision analysis (MCDA), 4) life cycle assessment (LCA), 5) social life cycle assessment (S-LCA), 6) economic analysis (cost-benefit method) method, life cycle cost analysis (LCCA) and 7) experimental testing.

Project is funded by: Latvia's state budget Fundamental and Applied Research Program

Project manager: Dr.sc.ing. Silvija Nora Kalniņš

Budget: 300 000 EUR

Projects financed by the National Research Programme

- **National Research Programme's project LATENERGI** (2014-2018) *In the framework of the National Research Programme's project "LATENERGI", a subproject "Environment and Energy" is under implementation by the IESE and involves a wide range of activities: analysis of environmentally friendly national energy policy implementation by evaluating and developing innovative solutions to increase the proportion of the use of renewable resources; solutions for implementation of 4th generation district heating technologies; mitigation of climate change impacts and solutions to climate change adaption in the energy field. The activities of the IESE within the project include mapping of green technologies, introduction of energy management in all sectors, evaluation of resilience in the energy infrastructural objects. The IESE's activities are closely connected with heating supply companies, the Ministry of Agriculture, the Ministry of Economics, the Ministry of Environmental Protection and Regional Development, private company AS "Latvenergo", University of Latvia and various nongovernmental organisations like Latvian Association of Heat Enterprises, Latvian Renewable Energy Federation, Latvian Biogas Association, etc.*

  Project is funded by: National Research Programm

  Budget: 562 500.00 EUR

  Project coordinator from RTU IESE: professor, Dr. hab. sc. ing. Dagnija Blumberga, M.sc.Antra Kalnbaļķīte

  Partners: Riga Technical Univerity, The University of Latvia, Latvia University of Life Sciences and Technologies, Institute of Physical Energetics

- **Blind spots in the energy transition policy** (2018-2020) *Objective of the project: To develop a methodology for analysing the impacts of energy and climate policy instruments through an indication of previously unanticipated problems and developing and testing a dynamic policy efficiency model for assessing the impact of policy instruments and forecasting future projects in order to avoid economic losses in the economy and society.*

  Project coordinator from RTU IESE: professor, Dr. hab. sc. ing. Dagnija Blumberga

  Project is funded by: Latvia's state budget Fundamental and Applied Research Program

  Budget: 199 000 EUR

- **Bioresources value model (BMV)** (2018-2021) *The goal of the project's "Bioresources value model" is to develop a methodology with a transdisciplinary approach to assessing the bioeconomy and modelling the value of bioresources in order to find ways to increase the value of use of agricultural, forestry and fishery biological resources and promote the development of these economic and scientific sectors.*

  Project coordinator from RTU IESE: asoc. professor, Dr. sc. ing. Anna Kubule

Project is funded by: Latvia's state budget Fundamental and Applied Research Program

Budget: 285 000 EUR

- **Integrated CO2 biofilter and microalgae biomass production technology for biogas plants using novel Stacked Modular Open Raceway Pond approach - SMARB (2018-2021)** *The overall objective is to develop a new hybrid microalgae cultivation technology for 3rd generation biomass production with high productivity that can be directly integrated in agricultural biogas plants, thus mitigating food-energy dilemma. Moreover, the proposed technology can solve parts of the main environmental drawbacks from the anaerobic digestion related to the management and disposal of the digested biomass (digestate) and effective reuse of CO2 through the microalgae biomass production. By combining current state of the art photo-bioreactor technologies with best open raceway pond (ORWP) practice and furthermore improving ORWP combined (natural and artificial) lighting conditions, media volume mixing technologies, CO2 injection technologies, and systems general geometrical design – we aim to: improve CO2 absorptions efficiency by at least 30%, improve microalgae growth rates by 50%, increase overall biomass yield about two times, reduce the required ORWP area of land by 40% and ensure stable production all year round despite changing seasons.*

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Francesco Romagnoli

  Project is funded by: Latvia's state budget Fundamental and Applied Research Project LZP-2018/1-0426

  Budget: 255 085 EUR

- **Improvement of building energy efficiency technologies** 2018-2021) *The project will develop new technological solutions for improving energy efficiency of existing buildings engineering systems (heating, hot water, ventilation and air conditioning), identify the potential of renewable energy use in buildings, improve building envelope, develop policy recommendations for nearly zero energy buildings.*

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Andra Blumberga

  Partners:

  - *From Latvia: Riga Technical University*
  - *From other countries: Institute for Climate Protection, Energy and Mobility (Germany), Czech Technical University in Prague (Czech Republic)*

  Project is funded by: National Research Program "Energy"

  Budget: 354 000 EUR

- **Energy and climate modelling towards net zero emissions** (2018-2021) *The project will introduce the most up-to-date system of modelling instruments and tools, taking into account not only techno-economic approach, emphasizing detailed technological and economic variables, and system interactions, also over decades, in a formalised quantitative framework, but also socio-technical aspects (institutions, actors, values, technology innovation, etc.) and their interaction over longer time periods (decades) at multiple levels and scales.*

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Andra Blumberga

  Project is funded by: National Research Program "Energy"

Budget: 558 000 EUR

- **The pathway to energy efficient future for Latvia** (2018-2021) *Energy sector is one of the cornerstones of sustainable development of the Latvian economy and the improvement of energy efficiency has been defined as one of the main national economy development directions. The project aims to determine energy efficiency potential and benchmarks in specific sectors of the economy provide science-based policy recommendations for end user efficiency measures to acquire the identified potential and assess their impact.*

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Marika Rošā

  Project is funded by: National Research Program "Energy"

  Budget: 354 000 EUR

- **Latvijas siltumapgādes un dzesēšanas sistēmu attīstība** (2018-2021) *Aim of the project*: *Determination of the energy efficiency potential of heat supply and cooling in Latvia and development of recommendations by 2030 with a perspective up to 2050. Assessment of the development potential of district heating and assessment of the heat market regulation regime. Policy recommendations for improving the efficiency of heat supply and cooling in Latvia, including efficient use of heat waste in industry.*

  Project coordinator from RTU IESE: professor, Dr.hab. sc. ing. Dagnija Blumberga

  Project is funded by: National Research Program "Energy"

  Budget: 354 000 EUR

- **Assessment and analysis of energy efficiency policy** (2018-2021) *The project will assess past and current energy efficiency policy interventions in Latvia compared to energy efficiency goals, propose improvements and new policy interventions, assess existing energy efficiency monitoring and energy saving verification system, and develop proposals and recommendations for the verification system improvement.*

  Project coordinator from RTU IESE: professor, Dr. sc. ing. Andra Blumberga; professor, Dr.sc.ing. Gatis Bažbauers

  Project is funded by: National Research Program "Energy"

  Budget: 354 000 EUR

- **4muLATe Sustainable and renewable transport policy formulation in Latvia (**2018-2021) *The aim of the project "Sustainable and renewable transport policy formulation in Latvia" is to find the best solution for increasing the share of renewable energy in the transport sector, taking into account economic, environmental and social aspects. This will be done in close cooperation with industry to reinforce the practical application of scientific approaches. The most significant results of the project include a new computer simulation model, policy recommendations, renewable energy strategy for the transport sector, public information.*

  Project coordinator from RTU IESE: asoc.professor Dr.sc.ing. Aiga Barisa

  Project is funded by: National Research Program "Energy"

  Budget: 350 000 EUR

  More information at http://www.4mulate.rtu.lv/

- **Assessment of Latvia's renewable energy supply-demand economic potential and**

policy recommendations (2018-2021) *The project will gather information on innovative energy technologies and processes, assess existing and prospective policies and their impact on renewable and local energy resource integration in energy system, assess the renewable and local energy resource utilization potential in power supply, heat supply and transport sectors, develop proposals and recommendations for energy and transport sector development, by utilizing renewable and local energy resources. The project will promote the development of sustainable, modern, and competitive energy sector in Latvia that is in the best interests of society, by providing scientifically sound knowledge on cost efficient extraction and use of local and renewable energy resources.*

Project coordinator from RTU IESE: professor, Dr. sc. ing. Andra Blumberga

Project is funded by: National Research Program "Energy"

Budget: 600 000 EUR

More information at www.lataer.rtu.lv

Contract work

- **Possibilities of producing modern biofuels in Latvia and prospects for electric vehicle technologies (2019-2020)** *The objective of the study is to evaluate technologies for the production of modern biofuels and their production opportunities in Latvia from the biomass of forestry residues and non-food pulp residues, as well as to assess the development of electricity-powered electric vehicle technologies and forecast the prospects for modern biofuels and electric vehicles in the transport sector. The study consists of completing 6 main work tasks. The study analyses policy planning documents, strategies and regulatory enactments that define and regulate the energy structure of the transport sector and its changes in replacing oil-processing products with renewable resources.*

  The project is financed by: AS "Latvijas Valsts Meži"

  Cooperation partners: Four RTU scientific institutes: RTU IESE, RTU Institute of Industrial Electronics and Electrical Engineering, RTU Institute of Applied Chemistry, RTU Institute of Heat, Gas and Water Technology.

- **Forecast of GHG emissions in non-ETS sector in Latvia** (06.2014 -27.07.2014) *The Ministry of Environmental Protection and Regional Development has contracted the IESE to defi ne the policy instruments necessary for fulfilment of the European Union's targeted limits on greenhouse gas (GHG) emissions in the non-ETS sector in 2020 and 2030. The IESE scientits have developed a system dynamic model that analyses each non-ETS sector individually and also jointly. The non-ETS sectors include agriculture, part of the energy sector, transport, industry and waste. The results of the system dynamic model show that the most problematic sector for fulfi lment of the GHG emission reductions is agriculture, where large amounts, approximately 95 % of potentially useful land need to be utilized for such or other purposes. Therefore there will be an increase in greenhouse gas (N2O) emissions that are associated with land improvement and fertilization. The results of the system dynamic model also show that a huge decrease in greenhouse gas emissions will be possible in the transport sector, if the corresponding regulations are developed and implemented. Whereas, the reduction of the CO2 emissions in the energy sector is limited due to already achieved results.*

  Funded by: Latvian Environmental Protection Fund

  Partners: Ministry of Environmental Protection and Regional Development

- **Cleaner production. Industrial symbiosis** (2013-2015) *Implementation of the cleaner production in Latvian companies is associated with the research and improvement of efficiency of the technological processes. It includes the idea about the rational use of resources through implementaϴon of the technological and energy management measures.*

  Funded by: SIA "Bio-Venta"SIA "Graanul Invest"SIA "Valmiermuižas alus", AS "Valmieras stikla šķiedra" and other production companies.

- **Sustainable cooperation with AS "Latvenergo"** *Sustainable cooperation with AS "Latvenergo" can be grouped in three main directions:*

  1. *The introduction of smart metering in households.*
  2. *Establishment of the initial energy review for the AS "Latvenergo" energy end user.*
  3. *Analysis of system dynamic model for the implementation of the EU Energy Efficiency Directive in the evaluation of policy instruments.*

  Funded by: AS "Latvenergo"

- **Feasibility analysis of fourth generation heating supply system** *The heating company AS "RĪGAS SILTUMS" contracted the IESE for several scientific studies in order to understand what is necessary for transition to third generation heating systems and for the use of low temperature heat transfer agents.*

  Funded by: JSC "RĪGAS SILTUMS"

- **Training course "District Heating"** *IESE organizes training courses for employees who work with district heating systems. The main topics in the programmes are: analysis of the current situation in Latvia and globally, fourth generation district heating systems, boiler house technologies, alternative energy resources for heat production, Latvian legislation in the energy sector and tariff methodology. Seminars also cover topics related to energy users, economic aspects, environmental aspects and energy efficiency improvements in power supply units, heating networks and apartment buildings. Within the training course there are three practical works that include visits to sites. The final seminar of the training course provides answers to the question "How will Latvia be able to get along without fossil energy resources in 2050". The training course runs from October to May and it consists of 9 seminars and 3 practical works. Participants who have attended the whole course will receive a certificate of training for 7.5 ECT*

  Funded by: SIA "Jūrmalas siltums"

- **Forecast of GHG emissions in non-ETS sector in Latvia** (06.2014 -27.07.2014) *The Ministry of Environmental Protection and Regional Development has contracted the IESE to defi ne the policy instruments necessary for fulfilment of the European Union's targeted limits on greenhouse gas (GHG) emissions in the non-ETS sector in 2020 and 2030. The IESE scientits have developed a system dynamic model that analyses each non-ETS sector individually and also jointly. The non-ETS sectors include agriculture, part of the energy sector, transport, industry and waste. The results of the system dynamic model show that the most problematic sector for fulfi lment of the GHG emission reductions is agriculture, where large amounts, approximately 95 % of potentially useful land need to be utilized for such or other purposes. Therefore there will be an increase in greenhouse gas (N2O) emissions that are associated with land improvement and fertilization. The results of the system dynamic model also show that a huge decrease in greenhouse gas emissions will be possible in the transport sector, if the corresponding regulations are developed and implemented. Whereas, the reduction of the CO2 emissions in the energy sector is limited due to already achieved*

results.

Funded by: Latvian Environmental Protection Fund

Proeject manager: Dr.hab.sc.ing. Dagnija Blumberga

Partners: Ministry of Environmental Protection and Regional Development

Budget: 24 929.00 EUR

For more information about the projects see: https://videszinatne.rtu.lv/en/science/project-and-research/active/ and https://videszinatne.rtu.lv/en/science/project-and-research/realized/

International cooperation in scientific research at RTU IESE is developed not only through projects, but also through joint drafting of scientific publications. The main cooperation partners of RTU IESE, based on jointly created publication, were scientists from Kazakhstan, Lithuania, Italy, Germany, Sweden and Norway, as well as companies (for example, AS "Latvenergo").

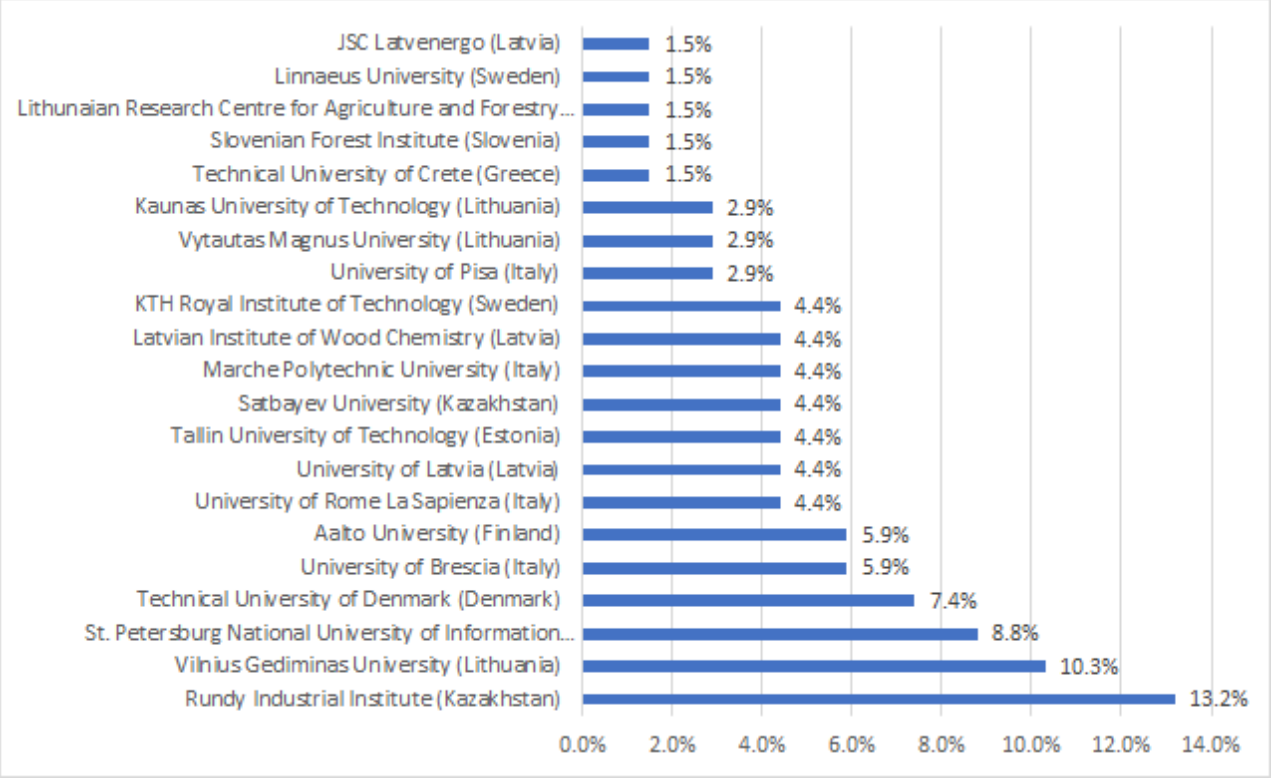

Figure: *Main cooperation partners of RTU IESE in drafting of publications (in 2015-2020).*

The results of scientific research are used in the development and renewal of study courses. Study courses are reviewed at least annually and are regularly supplemented with latest research results. Activities of RTU IESE academic and scientific staff in scientific research projects plays a big role in this process. Teaching staff responsible for study courses includes the results obtained from scientific projects in lectures and practical classes. This makes it possible to ensure that the science process is integrated into the study process.

The research projects currently being carried out are the most direct way of promoting international cooperation in the field of scientific research. Existing cooperation promotes the development of new scientific ideas and strengthens the capacity to prepare project applications. In the future, RTU VASSI plans to actively participate in the preparation of scientific project applications both as a project partner and a project leader. The main partners in scientific cooperation will continue to be well-known scientific institutions in Europe specializing in research on similar scientific topics.

4.4. Specify the way how the higher education institution/ college promotes the involvement of the teaching staff in scientific research and/or artistic creation. Provide the description and assessment of the activities carried out by the academic staff in the field of scientific research and/or artistic creation relevant to the study direction by providing examples and the summary of the quantitative data on the activities in the field of scientific research and/or artistic creation relevant to the study direction over the reporting period, for instance, the publications, participation in conferences, activities in the field of artistic creation, participation in projects by the academic staff members, etc., by listing the aforementioned according to the relevance.

The RTU staff development strategy is based on diverse improvement of teaching staff, which includes involvement in scientific research and artistic creation.

RTU academic staff is actively involved in research work in addition to study work (see in point no 4.1.).

The RTU staff development strategy is based on diverse improvement of teaching staff, which includes involvement in scientific research and artistic creation. As it has already been mentioned in Paragraph 3.5, RTU IESE has been implementing the academic staff improvement strategy which provides for annual evaluation of performance of teaching staff and coordination of development recommendations. The implementation of the plan has significantly improved scientific activity indicators.

Scientific research activities of academic staff are related to scientific research within the framework of various international and Latvian projects, as well as scientific research contract work. Overall, academic staff and researchers of the direction “Environmental protection” prepared 475 publications, which are available in internationally quoted databases, from 2013 to 2020. 383 of scientific publications in journals and conference proceedings are available in databases Thomson Reuters Web of Science and SCOPUS and 236 of them are cited publications, which are indexed in these (SCOPUS and Web of Science) databases.

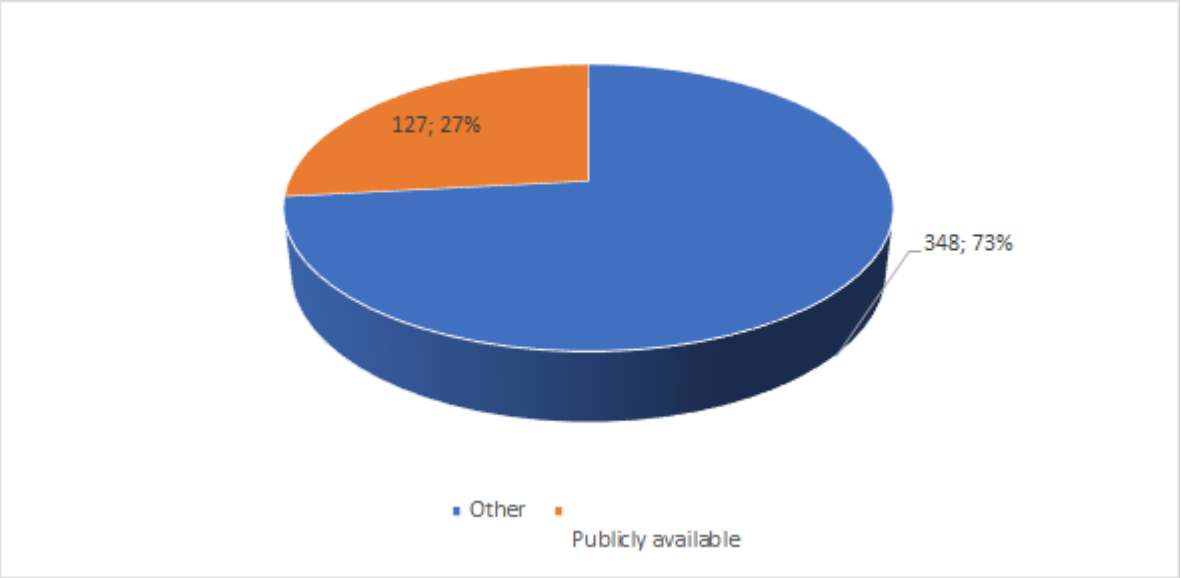

Figure: *Breakdown of SCOPUS-indexed publications by the type of their availability (Open Access or other) (by years, from 2013 to 2020).*

As it has already been mentioned, along with academic workload elected academic staff also performs scientific work, which is part of research workload. The results of scientific research work of RTU IESE are evaluated as excellent: in the last 3 years RTU FEEE and directly RTU IESE are in the leasing positions at RTU by scientific achievements, i.e. number of published and cited publications, number and budget of international scientific projects, number of defended doctoral theses.

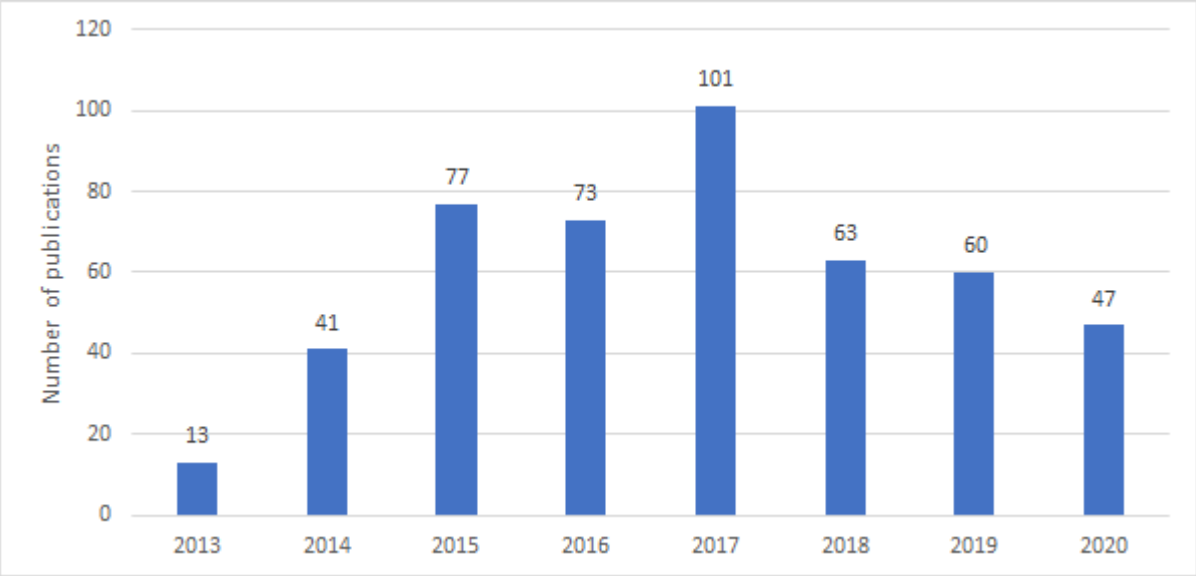

Figure: *Dynamics of SCOPUS-indexed publications of RTU IESE in the reporting period; data on 2020 are incomplete (by years, from 2013 to 2020).*

Overall, 475 scientific publications (59 publications per year on average) have been indexed un the RTU IESE SCOPUS database during the reporting period. The number of publications and their scientific quality – measured in terms of the citation of publications and the impact of the journals of the articles accepted for publication – has increased significantly over the years and continues to grow. The increase in the number and quality of publications is explained by a number of factors:

- Focusing of the **financing model of RTU** (e.g. in the context of scientific performance funding) and the action police on high scientific achievements. In order to ensure the excellence of the university, both in the study process and in the scientific process, the RTU strategy and strategic objectives are refocused on scientific excellence, which clearly contributes to the excellence of the studies. The annual activity plans of faculties, which are supervised by RTU management, are one of examples of how this strategy is implemented in practice.
- ***RTU IESE's strategic approach to scientific excellence, including the science-based study process*** (participation of students in "CONECT" conferences, participation in business games with industry experts, scientific brainstorms between students and teaching staff on the novelty, topicality of graduation papers and doctoral theses, etc.). And consequently, there is also an increasing number of international scientific research projects.
- Establishment and capacity building of a strong scientific research project development and implementation team at RTU IESE. RTU IESE has established a powerful scientific research and development and implementation team consisting of both scientific staff (professors, researchers, etc.) and students (doctoral students, Master students), financial specialists, public relations professionals, etc. Together with each project programme call, joint brainstorms are organised to agree on scientific projects to apply for, to determine responsible personnel and deadlines. On average, 4-5 meetings are held during the project application development phase.

- ***Additional performance requirements for RTU IESE doctoral students in publication drafting requirements***. At the end of each academic year (May-June), the Science Committees of faculties carry out attestation of doctoral students. The period of the attestation meeting is determined by the vice-dean for research of each faculty in scientific work individually. During the attestation meeting in which all doctoral students of the faculty participate, the performance of the doctoral student's work plan is evaluated, taking into account the minimum requirements specified in the Doctoral Regulations for the preparation of publications and drafting of a doctoral thesis. RTU IESE has set higher requirements for their doctoral students in terms of the number of scientific publications than those set by RTU.

Professors, associate professors, leading researchers, as well as researchers, who are doctoral students, have the biggest number of publications. This is related both to the requirements for the fulfilment of criteria in the process of electing and re-electing professors and associate professors (publications, monographs, the number of patents and the number of projects attracted and the amount of funding, the number of supervised doctoral theses, etc.) and the active involvement of these categories in the implementation of research projects.

More than half of the total number of SCOPUS-indexed publications are articles in full-text conference proceedings. The three most popular types of publications (full-text conference proceedings, collections of abstracts of articles and publications in scientific journals) constitute 461 publications or 97% of the total number of publications. This is an indication of active participation of teaching staff in scientific conferences and to a large extent evidences of compliance of academic activities of teaching staff with current trends in the represented field.

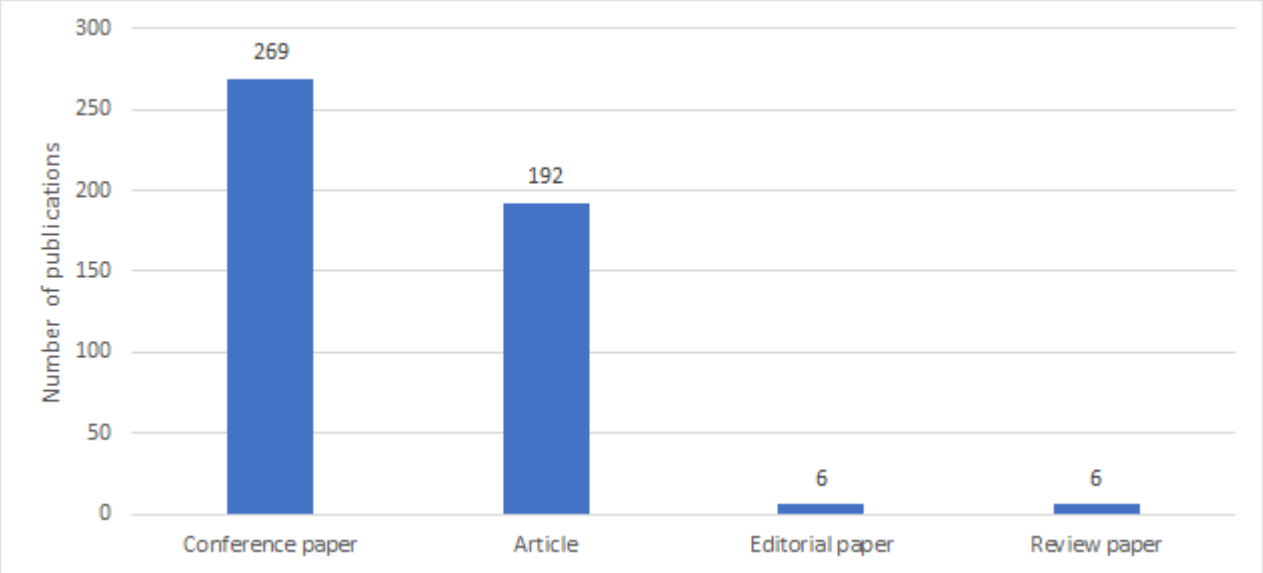

Figure: *Breakdown of SCOPUS-indexed publications by type of publication; data on 2020 are incomplete (by years from 2013 to 2020).*

The created publications (SCOPUS indexed) have been quoted in different sources 3018 times, which is an evidence of high added value, feedback and significant contribution to the scientific environment.

Almost all the publications are indexed in a scientific database. Most of publications can be found in the SCOPUS database (475 publications) and WoS (334 publications). The specified data are on 2020 are as at 1 November 2020 and do not include 46 publications.

In order to promote scientific excellence of RTU FEEE academic staff and participation of students from all levels of studies in the international scientific environment increasing the quality and

number of scientific publications, in April 2016 RTU FEEE, as the only RTU faculty, initiated **the competition "Best scientific publication".** FEEE academic staff and students of all levels can participate in the competition. By date 15 of each month, authors submit reports on the publications published in *Web of Science* or *Scopus* databases in the previous month to the FEEE vice-dean for research. For a scientific publication to qualify for the award of the best publication of the month and/or year, the scientific publication should meet the following conditions: (1) The publication is indexed in the Web of Science or Scopus database. (2) The publication *has been published* or is in the status of *Article in Press* (it should be available in Web of Science or Scopus databases). (3) The authors of the publication must represent one or more RTU FEEE institutes in the publication. (4) The authors of the publication representing the RTU FEEE should be the first to third author/s of the publication. Criterion for the evaluation of the best scientific publication of the month – the SNIP factor of the edition of scientific publication, which is published in the publication (Source Normalized Impact per Paper). The applicant with the highest SNIP value receives the nomination of the scientific publication of the month. The criteria for evaluating the best scientific publication of the year include: 70% of the overall assessment is the number of citations of a scientific publication in the reporting year and in the previous year, with the exception of the self-citation by the represented author/s within RTU, and 30% of the overall assessment consists of the SNIP factor of the edition of scientific publication, which is published in the publication (Source Normalized Impact per Paper) for the last available time period. An applicant with the highest overall score receives the nomination of the scientific publication of the year and receives an award of EUR 1000,00 from the budget of RTU FEEE. RTU IESE actively participated in this competition and in all the years since the year of initiation of the competition publication of RTU IESE academic staff have been recognised as the best scientific publication of RTU IESE (see Figure).

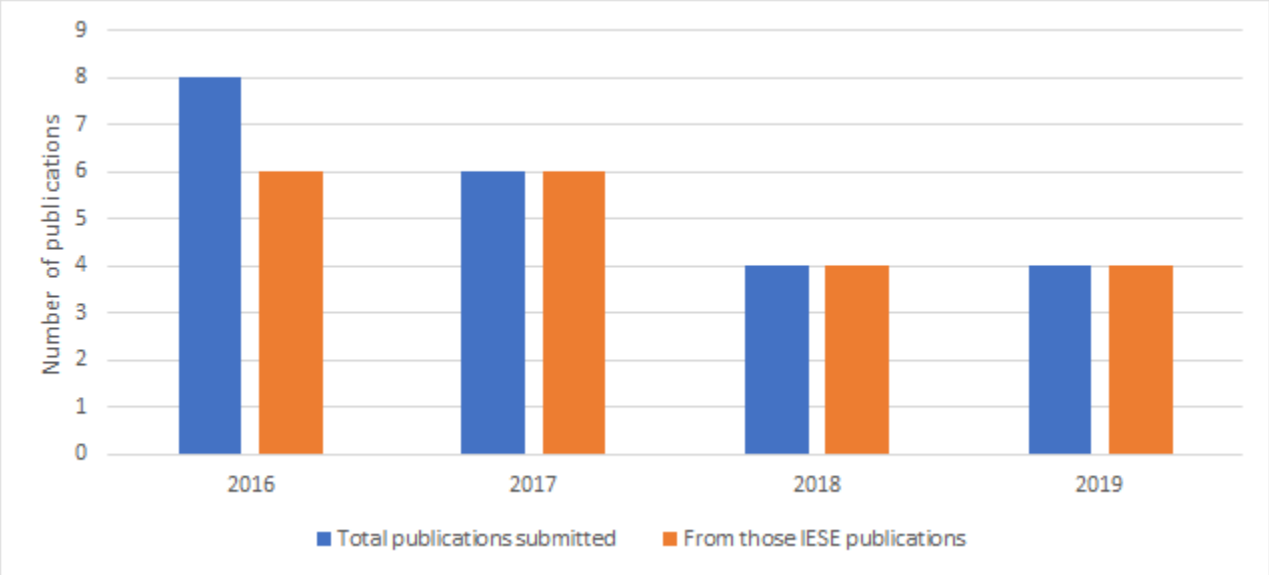

Figure: *Report on progress of the competition "Best scientific publication of RTU IESE in 2016-2019.*

In the reporting period, **16 monographs** have been issued on the topic of the study direction "Environmental protection" and RTU IESE teaching staff also participated in drafting of collective international monographs – 4 monographs, which are available in the RTU library, RTU IESE library. In order to promote the development of scientific language, monographs on environmental protection, which are quite few, are mainly published in Latvian (15 monographs in 2013-2020). However, books in English are also published (for example, scientific monograph *Barisa, A., Rošā, M. Modelling of Road Transport Policies in Latvia. Riga: RTU Press, 2017. 198 p. ISBN 978-9934-10-994-2.* The monographs published in the reporting period include:

In 2013

- *Blumberga, D., Veidenbergs, I., Gedrovičs, M., Žandeckis, A., Žogla, G., Kamenders, A., Kirsanovs, V., Beloborodko, A., Cinis, A., Kļaviņa, K., Dzikēvičs, M. Laboratorijas darbu krājums vides inženierzinātņu studentiem. Rīga: RTU Izdevniecība, 2013. 101 lpp. ISBN 9789934104442. (in Latvian)*
- *Dāce, E., Pakere, I., Blumberga, D. Analysis of Sustainability Aspects of the Packaging Deposit-Refund System in Latvia. No: Sustainable Development and Planning VI: WIT Transactions on Ecology and the Environment. Vol.173. C.Brebbia red. New Forest: 2013. 729.-740.lpp. ISBN 978-1-84564-714-8. e-ISBN 978-1-84564-715-5. Pieejams: doi:10.2495/SDP130611 (in English)*

In 2015

- *Blumberga, D., Veidenbergs, I., Valtere, S., Gedrovičs, M., Bažbauers, G., Blumberga, A., Žandeckis, A., Žogla, G., Kalniņš, S., Burmistre, I., Beloborodko, A., Kirsanovs, V., Timma, L., Muižniece, I., Kļaviņa, K., Lauka, D. Laboratorijas darbu krājums vides inženierzinātņu studentiem. 2.daļa. Rīga: RTU Izdevniecība, 2015. 118 lpp. ISBN 978-9934-10-595-1. (in Latvian)*
- *Blumberga, A., Blumberga, D., Dzene, I., Gušča, J., Romagnoli, F., Vīgants, E., Veidenbergs, I. Atjaunojamās elektroenerģijas akumulācija. Rīga: RTU Izdevniecība, 2015. 238 lpp. ISBN 978-9934-10-748-1. (in Latvian)*
- *Kuplais, Ģ., Blumberga, D., Dāce, E. System Analysis for Integration of Landfill Energy Production in Regional Energy Supply. No: Waste to Energy. S.Syngellakis red. Southampton: WIT Press, 2015. 231.-240.lpp. ISBN 978-1-78466-060-4. e-ISBN 978-1-78466-061-1. (in English)*
- *Pubule, J., Rošā, M., Blumberga, D. The Development of EIA Screening for the Anaerobic Digestion of Biowaste Projects in Latvia. In: Biomass to Biofuels. Southampton: WIT press, 2015, pp.157-167. ISBN 978-1-78466-034-5. e-ISBN 978-1-78466-036-9. Available from: doi:10.2495/978-1-78466-034-5/015 (in English)*

In 2016

- *Blumberga, D., Gedrovičs, M., Kirsanovs, V., Timma, L., Kļaviņa, K., Kubule, A., Kļaviņš, J., Muižniece, I., Kauls, O., Barisa, A., Bāliņa, K., Lauka, D., Ziemele, J., Kārkliņa, I. Laboratorijas darbu krājums vides inženierzinātņu studentiem. 3.daļa. Rīga: RTU Izdevniecība, 2016. 92 lpp. ISBN 978-9934-10-747-4. (in Latvian)*
- *Blumberga, D., Barisa, A., Kubule, A., Kļaviņa, K., Lauka, D., Muižniece, I., Blumberga, A., Timma, L. Biotehonomika. Rīga: RTU Izdevniecība, 2016. 338 lpp. ISBN 978-9934-10-789-4. (in Latvian)*
- *Blumberga, D., Veidenbergs, I., Blumberga, A., Dāce, E., Gušča, J., Rošā, M., Romagnoli, F., Pubule, J., Barisa, A., Timma, L., Bāliņa, K., Kļaviņa, K., Kubule, A., Lauka, D., Muižniece, I., Kalnbaļķīte, A., Kārkliņa, I., Prodaņuks, T. Biotehonomika: metodiskais materiāls. Rīga: Rīgas Tehniskās universitātes Vides aizsardzības un siltuma sistēmu institūts, 2016. 84 lpp. (in Latvian)*
- *Blumberga, A., Bažbauers, G., Davidsens, P., Blumberga, D., Grāvelsiņš, A., Prodaņuks, T. Sistēmdinamika biotehonomikas modelēšanai. Rīga: RTU Izdevniecība, 2016. 332 lpp. ISBN 978-9934-10-801-3. Pieejams: doi:10.7250/9789934108013 (in Latvian)*
- *Blumberga, D., Briede, A., Brizga, J., Dimante, D., Kalvāne, G., Kļaviņš, M., Melecis, V., Pruse, I., Vincēviča-Gaile, Z., Zaļoksnis, J., Crump, J., Asdal, K., Westerveld, L., Halvorsen, M. Klimats un ilgtspējīga attīstība. Rīga: LU Akadēmiskais apgāds, 2016. 384 lpp. ISBN 978-9934-18-136-8. (in Latvian)*

In 2017

- *Blumberga, A., Blumberga, D., Biseniece, E., Kamenders, A., Kašs, K., Vanaga, R., Žogla, G. Ēku energoefektivitāte: vakar, šodien un rīt. Rīga: RTU Izdevniecība, 2017. 352 lpp. ISBN 978-9934-10938-6. (in Latvian)*
- *Barisa, A., Rošā, M. Modelling of Road Transport Policies in Latvia. Riga: RTU Press, 2017. 198 lpp. ISBN 978-9934-10-994-2. (in English)*
- *Žogla, L., Rošā, M., Kubule, A., Vīgants, H., Blumberga, D., Veidenbergs, I. Rūpniecības energopolitikas analīze. Rīga: RTU Izdevniecība, 2017. 144 lpp. ISBN 978-9934-22-020-3. (in Latvian)*

In 2018

- *Barisa, A., Blumberga, A., Blumberga, D., Grāvelsiņš, A., Gušča, J., Lauka, D., Kārkliņa, I., Muižniece, I., Pakere, I., Priedniece, V., Romagnoli, F., Rošā, M., Seļivanovs, J., Soloha, R., Veidenbergs, I., Vīgants, E., Vīgants, Ģ., Ziemele, J. Energosistēmu analīze un modelēšana. Rīga: RTU Izdevniecība, 2018. 144 lpp. ISBN 978-9934-22-037-1. (in Latvian)*
- *Barisa, A., Blumberga, A., Grāvelsiņš, A., Rochas, C., Blumberga, D., Dāce, E., Vīgants, E., Romagnoli, F., Galindoms, G., Vīgants, Ģ., Veidenbergs, I., Ziemele, J., Rošā, M., Sarmiņš, R., Kalniņš, S., Prodaņuks, T., Kirsanovs, V. Ilgtspējīgi energoavoti. Rīga: RTU Izdevniecība, 2018. 146 lpp. ISBN 978-9934-22-017-3. (in Latvian)*

In 2019

- *Bažbauers, G., Blumberga, D., Njakou-Djomo, S., Dzene, I., Gušča, J., Kazulis, V., Kļaviņa, K., Kuzņecova, T., Ķeirāne, E., Lauka, D., Muižniece, I., Pastare, L., Piļicka, I., Pubule, J., Rēpele, M., Romagnoli, F. Klimata tehnoloģiju ekodizaina risinājumi. Rīga: RTU Izdevniecība, 2019. 156 lpp. ISBN 978-9934-22-104-0. (in Latvian)*
- *Sarma, U., Karnītis, Ģ., Karnītis, E., Bažbauers, G. Toward Solutions for Energy Efficiency: Modeling of District Heating Costs. No: Energy Transformation Towards Sustainability. M.Tvaronavičienė, B.Ślusarczyk red. Amsterdam: Elsevier, 2019. 219.-237.lpp. ISBN 978-0-12-817688-7. Pieejams: doi:10.1016/B978-0-12-817688-7.00011-2 (in English)*

In 2020

- *Kamenders, A., Barisa, A., Blumberga, A., Rochas, C., Blumberga, D., Pakere, I., Dzene, I., Burmistre, I., Muižniece, I., Veidenbergs, I., Ziemele, J., Kļavenieks, K., Kašs, K., Žihare, L., Sniega, L., Žogla, L., Rošā, M., Kalniņš, S. Energoplānošanas attīstības tendences Latvijas pašvaldībās. Rīga: RTU Izdevniecība, 2020. 172 lpp. ISBN 978-9934-22-062-3. (in Latvian)*
- *Āboltiņš, R., Bariss, U., Blumberga, A., Blumberga, D., Cilinskis, E., Feofilovs, M., Grāvelsiņš, A., Kuzņecova, T., Lupkina, L., Muižniece, I., Rochas, C., Romagnoli, F. Klimata inženierija un politika. Rīga: RTU Izdevniecība, 2020. 204 lpp. ISBN 978-9934-22-102-6. (in Latvian)*

The prepared monographs are used in the study process for the creation of content of study courses, thus ensuring integration of scientific activity in the study process.

35 doctoral theses were defended in the reporting period from year of studies 2013/2014 to year of studies 2019/2020 in the study direction “Environmental protection” in the RTU Doctoral Council “Environmental Science and Heat Energy” (previously RTU Doctoral Council P-19 “Environmental Science”) (see also part II of the description of the doctoral study programme “Environmental Engineering”).

Every year RTU IESE organises the international scientific conference “CONECT”. The conference of environmental and climate technologies “CONECT” is organised as a regular scientific forum in the middle of May in Riga. The main objective is to acquaint scientists with achievements in the fields of

energy systems and environmental engineering and to provide scientists, especially doctoral students, with the opportunity to publish their research results. The conference includes topics such as innovative technologies, renewable energy sources, pollution prevention, energy policy, circular economy, system dynamics, improvement of energy efficiency and other.

The "CONECT" conference has been held annually since 2008 and is organised by the RTU Institute of Energy Systems and Environment. The conference has always been organised physically until now, but in 2020, due to the COVID-19 pandemic, the conference was held online on the Zoom platform. This year, as usual, the conference lasted three days: for two days scientists presented their latest research at plenary sessions, panel sessions and poster sessions, and on the third day, the conference concluded with a discussion on various scenarios for the development of COVID-19, restart and future development. Every year, the two best articles receive awards, one of which is always a student article.

CONECT brings together scientists and researchers from different countries. The conference includes representatives from all continents of the world, the figure shows both the total number of participants and the number of countries represented over the past five years.

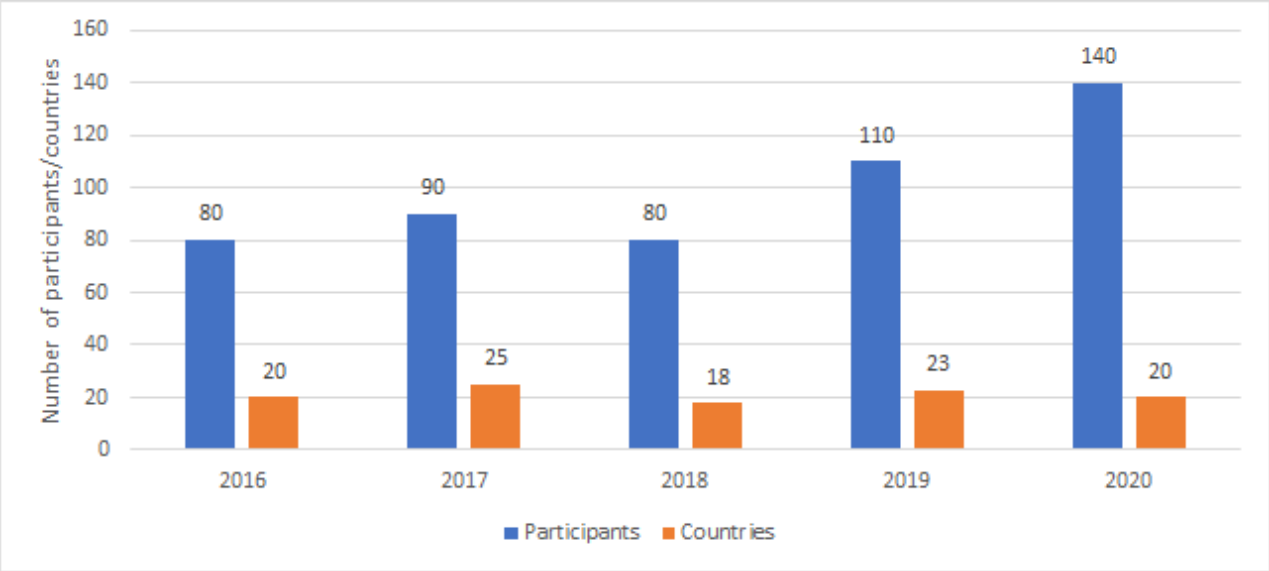

Figure: *Number of participants and represented countries of the CONECT conference.*

Conference articles are published in the *Open Access* journal and indexed in the *Scopus* and *Web of Science* databases. Part of the articles are selected and recommended for submission of an extended publication to other journals, which are also indexed in the Scopus database. In 2015-2018, CONECT articles as a special edition were published in the *Elsevier* journal "Energy Procedia". Since 2019, CONECT articles have been published in the journal "Environmental and Climate Technologies" special edition, as well as scientific journals are involved every year, for example, this was *Elsevier* journal "Journal of Environmental Management" in 2019.

The next CONECT conference will be held on 12-14 May 2021. The submission of articles is open until 15 February 2021. More information on the international conference "CONECT" is available on https://conect.rtu.lv/.

Research and articles of researchers, academic staff and doctoral students of the study direction are published in different scientific editions in Latvia and abroad.

Since 2011, RTU IESE has been issuing the international scientific journal "Environmental and Climate Technologies". This is international *Open Access* scientific journal issued by Riga Technical University and manages RTU Institute of Energy Systems and Environment. The journal ensures international publicity of original research and innovation work. Topics of the journal, which cover

all aspects of environmental science:

- Renewable energy sources,
- Cleaner production,
- Eco-design,
- Life cycle analysis,
- Reduction of greenhouse gases and climate technologies,
- Waste management,
- Environmental monitoring and assessment, etc.

Since 2012, the journal has been included in the SCOPUS database, and since 2016 – in the Web of Science Metrics. 245 articles were issued from 2012 to 2020. The dynamics of the number of articles is ascending: starting from 15 articles in 2012 to 73 articles in 2020. The growing dynamics is explained by the performed journal popularisation activities and by its growing international visibility among environmental protection scientists.

Articles in the journal "Environmental and Climate Technologies" (ECT) are published all year round (Open Volume) and special editions with CONECT conference articles have been issued in the last two years. The journal is published on the De Gruyter Open (earlier Versita) Sciendo platform. Since 2012, the journal has been indexed in Scopus and Web of Science databases. The current SNIP of the journal is 1.541 based on the SCOPUS Journal Metrics.

It is important for an international journal to ensure representation of different countries and, based on Scopus guidelines, most of foreign authors and only 29% are articles of Latvian scientists (see Figure "Authors of ECT journal, average indicator, 2016-2020").

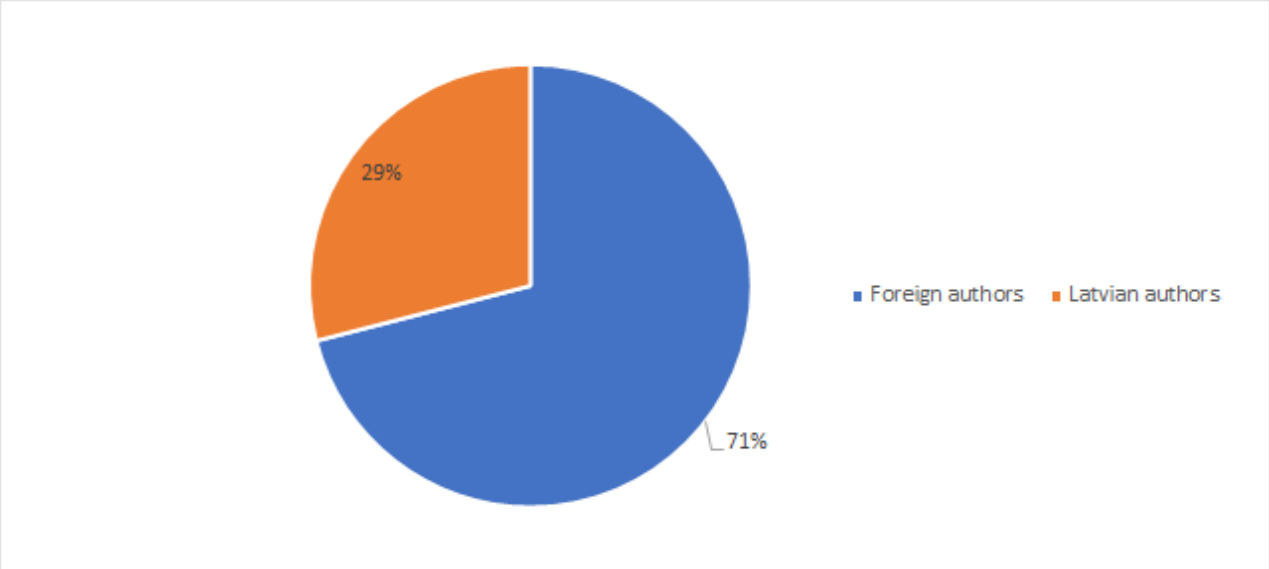

Figure: *Authors of ECT journal, average indicator for published articles in 2016-2020.*

The ECT journal published articles of authors from Latvia, Lithuania, Estonia, Finland, Denmark, the United Kingdom, Italy, Spain, Greece, Germany, Russia, Poland, Ukraine, Australia, Jordan, South Africa and other countries.

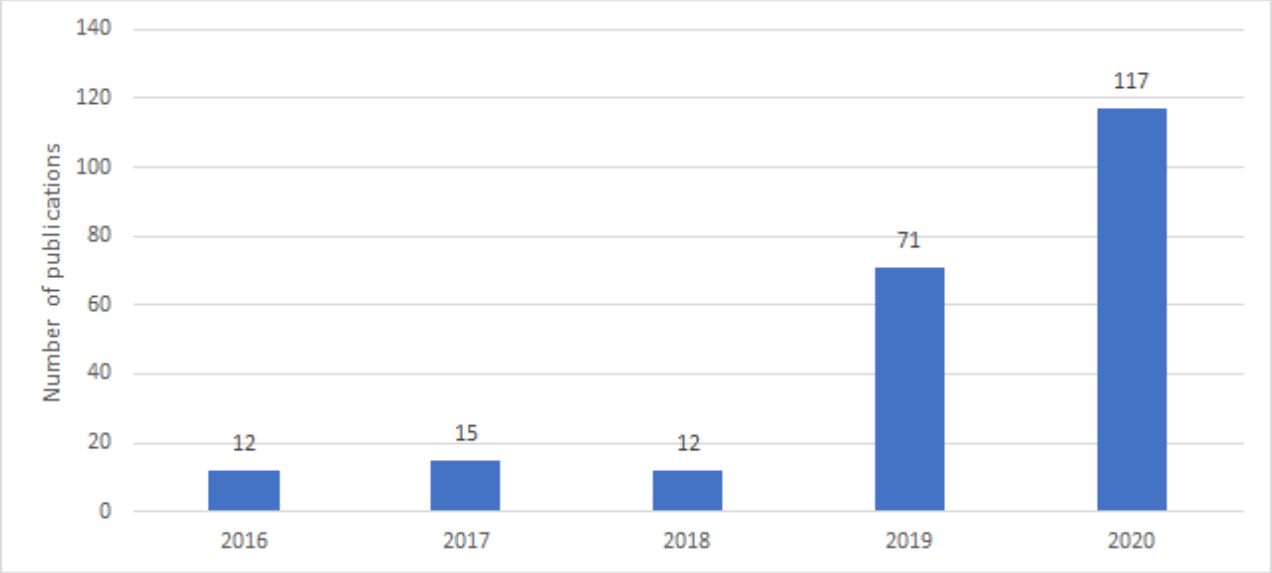

Figure: *Articles published in the ECT journal, including articles of students, 2016-2020. (* In 2019 – including the CONECT special edition; **In 2020 – including the CONECT special edition)*

The figure shows that the number of published articles has increased in recent years, it should be taken into account that articles of the CONECT special edition of 2019 and 2020 are also included.

The editorial board of the journal carefully evaluates the submitted articles and an average of 30-50% of them are rejected as not meeting the requirements or journal topics. The editorial board of the ECT journal includes professors from different Latvian universities and a significant number of foreign experts are involved (see Figure).

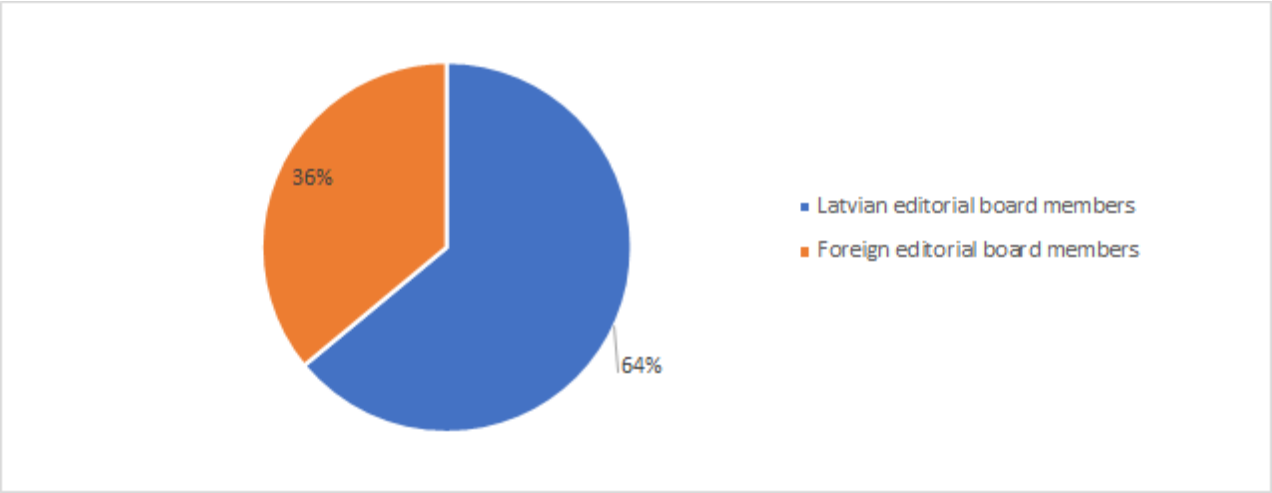

Figure: *Editorial board of the ECT journal.*

Editions of the journal are available here: https://content.sciendo.com/view/journals/rtuect/rtuect-overview.xml. The platform https://ect-journals.rtu.lv/ is used for submission of articles.

It should be noted that in June 2020, the international university ranking U-Multirank recognised RTU as one of 25 leading world universities in terms of the share of *Open Access Publications*. This means that a considerable number of publications of RTU researchers can be found in open access scientific journals making research results available to all interested persons. U-Multirank consists of five parts – teaching and learning, research, knowledge transfer or valorisation, international orientation or regional engagement, and universities are evaluates by several criteria in each of these parts. This year, higher education institutions are evaluated by the share of open access

publications for the first time. The performance of higher education institutions is evaluated on a scale from A – highest assessment, to E. RTU is the only Latvian higher education institution, which received A level assessment in 11 criteria, for example, share of open access publications, graduates employment, number of spin-offs created, external research income, Bachelor and Master students graduating on time, Bachelor programmes in English, companies created by graduates, Bachelor programmes in English, international publications at RTU received appreciation in seven criteria. The results of RTU have improved in six assessment criteria compared to 2019.

See below organisation of conferences, seminars and forums important within the study direction "Environmental protection" and participation in them:

2016/2017

RTU IESE participated:

1. *Conference "Smart Energy Systems and 4th Generation District Heating", 26.-28.09.2016., Denmark, Aalborg;*
2. *Conference "Interplay of Tradition and Innovation for flourishing of bioeconomic: Nordic and Baltic call for educational research and sustainability in Higher Education", 04.-05.10.2016., Latvia, Daugavpils;*
3. *Local Renewables Conference 2016 "Energisting the smart city and region", 26.-28.10.2016., Germany, Freiburg;*
4. *Conference "Global change in marine environment: ocean acidification and warming", 27.-28.11.2016., Estonia, Tallin;*
5. *SET Plan 2016 – Central European Energy Conference X, 30.11.-02.12.2017., Bratislava, Slovakia;*
6. *Conference "Fourth International Conference on Inter Disciplinary Research in Engineering and Technology 2017", 08.-10.02.2017., India, Deli;*
7. *Bioeconomy forum "Towards a sustainable and Innovative Bioeconomy", 01.03.2017., Riga, Latvia;*
8. *Conference „Vides zinātne un izglītība Latvijā un Eiropā", 24.03.2017., Riga, Latvia;*
9. *Baltic Gas Conference 2017, 11.04.2017., Riga, Latvia;*
10. *Conference "85th Meeting of EURO Working Group on MCDA", 20.-22.04.2017., Italy, Padua;*
11. *Participation at "Latgales simtgades kongress"05.-06.05.2017, Latvia, Rezekne;*
12. *Conference CONECT 2017, 10.-12.05.2017., Riga, Latvia;*
13. *Participation ar bioeconomy forum "Forest-based Bioeconomy and Climate Change Mitigation", 05.-06.06.2017., Finland, Helsinki;*
14. *Conference "The 35th International Conference of the System Dynamics Society", 16.-20.07.2017., USA, Boston;*
15. *Conference "Latvijas Universitāte komercializē: Veiksmes stāsti", 02.08.2017., Riga, Latvia;*
16. *Conference "Receipt for the 9th International Conference on Applied Energy 2017 (ICAE2017)", 21.-24.08.2017., United Kingdom, Cardiff;*
17. *Participation in the seminar about energy efficiency in historical buildings, 04.-05.10.2016, Belgium, Brussels;*
18. *Participation in a seminar on heat insulation of historical buildings, 13.-15.12.2016, Denmark, Copenhagen;*
19. *Seminar "Bioenergy and ecosystems services for low-carbon development in the Baltic Sea Region", Vilnius Gediminas Technical University. 05.-07.12.2017, Lithuania, Vilnius;*
20. *Cycle of seminars on the introduction of ESCO schemes for improvement of energy performance of buildings, 05.-08.12.2017, Switzerland, Zurich and United Kingdom, London;*
21. *Seminar "Energy efficiency in the financial market". 17.-20.01.2017, Belgium, Brussels;*
22. *Seminar on RES modelling solutions in Nordic countries, Technical University of Denmark.*

13.-14.03.2017, Denmark, Copenhagen;

23. *Seminar on integrated RES market in Nordic countries. 27.-28.08.2017, Norway, Oslo;*
24. *Seminar on resilience of infrastructure in climate adaptation conditions. 25.-31.03.2017, Sri Lanka, Colombo;*
25. *Seminar on assessment of historical building materials. 14.-17.06.2017, Sweden, Göteborg;*
26. *Seminar on the development of environmental engineering study programmes, Anna University and Hindustan University. 02.-07.10.2016, India, Chennai;*
27. *Seminar on the use of structural physics laboratories for energy performance of buildings, Dresden University of Technology (Technische Universitat Dresden), 06.-10.11.2016, Germany, Dresden;*
28. *Reading of lectures within the cycle of discussion of the Vidzeme Planning Region "Development of products in cooperation with researchers and scientists". 25.08.2017, Latvia, Valmiera;*
29. *International scientific conference "CONECT 2016", Riga, 12-14 October 2016*
30. *International scientific conference "CONECT 2017", Riga, 10-12 May 2017*

Scientific conferences organised by RTU IESE

1. *International scientific conference "CONECT 2016", Riga, 12-14 October 2016*
2. *Conference "Environmental science and education in Latvia and Europe". Latvia, Riga, 24 March 2017.*
3. *International scientific conference "CONECT 2017", Riga, 10-12 May 2017*

Seminars organised by RTU IESE

1. *Seminar "Heat supply in Latvia and the world today. Is there a future for district heating in Latvia. Fourth generation heat supply systems, 19.10.2016;*
2. *Expert seminar "Forest biomass – new products and technologies" in cooperation with the company "Latvijas Valsts Meži". 26.10.2016;*
3. *Expert seminar "Determining the commercialisation potential of innovative products from forest biomass through a multiple-criteria analysis method" in cooperation with the company "Latvijas Valsts Meži". 30.10.2016;*
4. *Seminar "How to evaluate the use of energy sources in heat supply: from fossil fuel to biofuel. Why is Solar heat energy (or maybe also electricity) the future?", 02.11.2016;*
5. *Seminar "How to evaluate biomass and biogas production technologies: from wood to syngas and biogas. Which technologies are perspective today and which will pass the test of time?", 23.11.2016.*
6. *Seminar "Heat supply systems today and tomorrow. Site inspection - agricultural company Tērvete", 30.11.2016;*
7. *Seminar "Energy news. Latvian law in energy sector. How are tariffs are made. Level marks", 14.12.2016;*
8. *Seminar "Energy efficiency in the energy source and heating networks. Boiler house technologies", 11.01.2017;*
9. *Seminar for pupils from International School of Riga on solar energy usage opportunities, 17.-18.01.2017, Riga, Latvia;*
10. *Seminar "Forest resources for the energy sector. Swedish experience" 24.01.2017. Visiting lecturers from Sweden;*
11. *Seminar "Heat supply systems energy user. Improving energy efficiency in multiapartment buildings", 01.02.2017;*

12. *Seminar for pupils on the use of renewable energy sources, 13-14.02.2017, Riga, Latvia;*
13. *Seminar for pupils on efficient use of resources, 23.02.2017, Riga, Latvia;*
14. *Seminar "Heat generation: choice of technologies. Flue gas deep cooling, 01.03.2017;*
15. *Seminar "Economic aspects of energy technology. Environmental aspects. Flue gas scrubbing and measurements", 12.04.2017;*
16. *Seminar "Why and how can Latvia do without fossil energy sources in 2050", 09.05.2017.*

Participation of RTU IESE in seminars

1. *Participation of D.Blumberga in the seminar on economic development opportunities organised by IDAL, 08,09.2016, Riga, Latvia;*
2. *Participation in seminar "European Partnership for Sustainable Economic Growth and Employment!", 08.-10.11.2016, Germany, Potsdam;*
3. *Presentation of the final report of the study "Forest biomass – new products and technologies", 11.01.2017, Riga, Latvia;*
4. *Seminar organised by the Elektrum centre "Energy efficiency in ventilation systems", 25.01.2017;*
5. *Participation of D.Blumberga in the seminar "Sustainable and efficient solutions in heating and wate use" organised by the Elektrum Energy Efficiency Centre with a presentation "Reducing heat losses and efficient use of heat energy", 22.02.2017, Jurmala, Latvia;*
6. *Participation of J.Gušča as an experts in a seminar on environmental impact assessment at different stages of life cycle of products and services, 22.02.2017, Riga, Latvia;*
7. *Discussion of experts on the Energy Efficiency Directives "Energy efficiency: top new European Union laws!", 27.01.2017, Riga, Latvia;*
8. *Participation of D.Blumberga in the bioeconomics forum "Towards a Sustainable and Innovative Bioeconomy" with a presentation "Forest-based Bioeconomy: research in RTU", Riga, Latvia, 09.03.2017;*
9. *Seminar organised by the Ministry of Agriculture, 15.03.2017, Riga, Latvia;*
10. *Discussion "Climate changes?", 16.03.2017, Riga, Latvia;*
11. *Participation of I. Muižniece in the seminar organised by the Vidzeme Planning Region "Development of products in cooperation with researchers and scientists", 25.08.2017, Valmiera, Latvia.*
12. *Latgale Centennial Congress (5–6 May 2017, Rezekne).*

Patent applications

1. *D. Blumberga, V. Kirsanovs, C. Rochas, I. Veidenbergs, E. Vīgants, Ģ. Vīgants "Gasification unit", P-16-95, 09.12.2016.*
2. *D.Blumberga, D.Lauka, J.Gušča, I.Veidenbergs "Biomethane production unit", No. 15164, 20.08.2017.*
3. *D.Lauka, D.Blumberga, I.Muižniece "Material for stimulation of fermentation in biogas production process", No. 15161, 20.03.2017.*
4. *I.Muižniece, D.Blumberga, D.Lauka, A.Blumberga "Granulated woodchip heat insulation material", No.15124, 20.01.2017.*

2017/2018

Personnel of RTU IESE participated in the following conferences:

1. *Conference "Symposium on medicinal plants in the context of globally sustainable land use and bioeconomy", 11-14.09.2017, Wismar, Germany;*
2. *Conference "3rd International Conference on Smart Energy Systems and 4th Generation District Heating", 12-13.09.2017, Copenhagen, Denmark;*
3. *Conference "Energy 2017", 13.09.2017, Riga, Latvia;*
4. *Conference "58th RTU International Scientific Conference- Bioenergy Technology", 16.10.2017, Riga, Latvia;*
5. *SIMWOOD project final conference "Solutions for Wood Mobilisation in Europe", 12-13.10.2017, Paris, France;*
6. *Conference "Annual High-Level Experts Conference 2017", 17-18.10.2017, Brussels, Belgium;*
7. *International conference "Clean Energy for Smart City", 20.10.2017, Riga, Latvia;*
8. *International conference "Lab Space Design", 26.10.2017, St Petersburg, Russia;*
9. *Conference "Baltic Pathway Towards Low Carbon and Climate Resilient Development", 30-31.10.2017, Riga, Latvia;*
10. *International conference "HOW TO: engage in innovations", 23.01.2018, Riga, Latvia;*
11. *Conference "Science meets industry", 24.01.2018, Riga, Latvia;*
12. *Scientific practical conference "Forest science – its diversity", 22.02.2018, Jelgava, Latvia;*
13. *Conference "Energy efficiency 2018", 28.03.2018, Riga, Latvia;*
14. *Conference "Importance of education in sustainable development goals in Latvia", 18.04.2018, Riga, Latvia;*
15. *Conference "For greener business in Europe", 20.04.2018, Riga, Latvia;*
16. *Conference "Biosystems Engineering 2018", 10.05.2018, Tartu, Estonia;*
17. *Conference "26th European Biomass Conference & Exhibition" 14-18.05.2018, Copenhagen, Denmark;*
18. *International conference "CUE2018-Applied Energy Symposium and Forum 2018: Low carbon cities and urban energy systems", 03-09.06.2018, Shanghai, China;*
19. *International scientific conference "CONECT 2018", Riga, 16-12 May 2018.*

Scientific conferences organised

1. *International scientific conference "CONECT 2018", Riga, 16-12 May 2018.*

Organised seminars

1. *Discussion – role play "Solutions to problems of collection of used tyres". 23.11.2017;*
2. *Seminar/discussions "Possibilities of developing Latvian national economy using local bioresources for production of high added value products";*
3. *Discussion "Women in engineering sciences in Latvia". 10.04.2018;*
4. *Discussion forum "Why is Latvia a green country?". 18.06.2018;*
5. *Seminar/discussions "Possibilities of developing Latvian national economy using local bioresources for production of high added value products". 16.01.2018.*

In the year of studies 2017/2018 RTU IESE participated in the following seminars:

1. *Participation of Agris Kamanders, Dagnija Blumberga, Gatis Žogla, Jūlija Gušča in the seminar "Developing a system for certification of energy performance of buildings", 14.11.2017, Riga, Latvia;*
2. *Participation of Aiga Barisa in the discussion "Biomethane production potential in Latvia",*

24.10.2017, Riga, Latvia;

3. *Participation of Gatis Bažbauers in Science Rocks discussion "Eco-design", 31.01.2018, Riga, Latvia;*
4. *Participation of Dzintars Jaunzems in the national level round table discussion on financing of energy efficiency in Latvia, 26.04.2018, Riga, Latvia;*
5. *Participation of Dagnija Blumberga "IDAL: LV100 business forum "Discover new opportunities. Discover Latvia"", 20.06.2018, Riga, Latvia;*
6. *Participation of Dagnija Blumberga, Gatis Bažbauers, Lauma Žihare, Armands Grāvelsiņš in the seminar/discussion "Possibilities of developing Latvian national economy using local bioresources for production of high added value products", 16.01.2018, Riga, Latvia;*
7. *Participation of Dzintars Jaunzems in the seminar "CEE ENERGY TRANSITION "Low carbon energy transition? Together it is possible" 19-20.10.2017, Prague, Czech Republic;*
8. *Participation of Dagnija Blumberga, Vladimirs Kirsanovs in the seminar "Energy efficiency in agriculture", 24.10.2017, Aizkraukle, Latvia;*
9. *Participation of Miķelis Dzikēvičs in the seminar "CE mark – pre-condition for trading goods on the EU market", 26.10.2017, Riga, Latvia;*
10. *Participation of Andra Blumberga in the seminar "Energy efficient construction and reconstruction of buildings. German quality in Latvia. Good practice projects", 26.10.2017, Riga, Latvia;*
11. *Participation of Francesco Romagnoli, Zane Indzere, Antra Kalnbaļķīte in the seminar "SEMINAR: "Aspects of risk perception and social resilience: the case of LIFE PRIMES project"", 15.11.2017, Riga, Latvia;*
12. *Participation of Dagnija Blumberga in the seminar "Seminar "Women in the Nordic Energy Sector: state of affairs, actions and future perspectives"", 21-22.11.2017, Stockholm, Sweden;*
13. *Participation of Jeļena Pubule in the seminar on Horizon 2020 priority "Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy", 23.11.2017, Riga, Latvia;*
14. *Participation of Andra Blumberga, Ritvars Freimanis in the seminar at the Elektrum Energy Efficiency Centre "Energy efficiency", 24.01.2018, Jurmala, Latvia;*
15. *Participation of Lauma Žihare, Indra Muižniece in the seminar "First meeting of Latvian experts related to the field of bioeconomy", 30.01.2018, Riga, Latvia;*
16. *Participation of Dagnija Blumberga, Jūlija Gušča, Indra Muižniece, Lauma Žihare, Antra Kalnbaļķīte, Zane Indzere, Ritvars Freimanis in the seminar "Social business and social innovation in the fields of sustainable development and technologies", 08.02.2018, Riga, Latvia;*
17. *Participation of Dagnija Blumberga, Krišs Spalviņš in the networking seminar for forestry and timber industry researchers and businessmen "Forest and trees – how to get more from them?", 28.02.2018, Riga, Latvia;*
18. *Participation of Jūlija Gušča in the seminar "LIFE programme INFO DAY", 01.03.2018, Riga, Latvia;*
19. *Participation of Jūlija Gušča in the seminar "Is RTU study process of high quality?", 02.03.2018, Riga, Latvia;*
20. *Participation of Andra Blumberga in the seminar at the Elektrum Energy Efficiency Centre "Renewable energy sources and trends in the world", 21.03.2017, Jurmala, Latvia;*
21. *Participation of Francesco Romagnoli in the seminar "LCA modelling on bioenergy systems: overview, methodological approaches and case studies", 21-22.03.2018, Perugia, Italy;*
22. *Participation of Maksims Feofilovs in the 1st seminar of the cycle of training of the Salaspils strategic work group, 27.03.2018, Salaspils, Latvia;*
23. *Participation of Sanita Sereda, Raimonda Soloha in the seminar "General requirements to*

competences of testing and calibration laboratories LVS EN ISO/IEC 17025:2017", 18.04.2018, Riga, Latvia;

24. *Participation of Lauma Žihare, Jeļena Ziemele in the seminar Breakfast of RTU Research Platform "Nanogenerators for conversion of mechanical energy in electrical energy", 23.05.2018, Riga, Latvia;*
25. *Participation of Jeļena Ziemele in the seminar "Nordic Green to Scale results and recommendations for Latvia"; 30.05.2018, Riga, Latvia;*
26. *Participation of Aiga Barisa in the seminar on potential project applicants in the second project competition of fundamental and applied research of 2018, 25.07.2018;*
27. *Participation of Miķelis Dzikēvičs in the seminar – Training of RTU employees on IT security when processing personal data, 28.05.2018, Riga, Latvia;*
28. *Participation of Miķelis Dzikēvičs in the seminar – Prevention of the conflict of interest and professional ethics of public officials, 11.04.2018, Riga, Latvia.*

2018/2019

The staff of RTU IESE participated in the following scientific conferences:

1. *Dagnija Blumberga, Francesco Romagnoli participated in the "The 10th International Conference on Applied Energy (ICAE2018)", 22-25.08.2018, Hong Kong, China;*
2. *Miķelis Dzikēvičs participated in the conference "5G TECHRITORY", 27-28.09.2018, Radison Blu, Riga, Latvia;*
3. *Francesco Romagnoli, Aiga Barisa, Vladimirs Kirsanovs participated in the "Baltic Sea Conference "Energy Efficient Cities" How to set the ball rolling?", 17-18.10.2018, Gdynia, Poland;*
4. *Lauma Žihare participated in "Bioeconomy in the forefront of national policies BIOEAST conference", 8.11.2018, Budapest, Hungary;*
5. *Gatis Bažbauers participated in the conference ""National Energy and Climate Plan 2021–2030" – energy development and climate change mitigation", 26.11.2018, ALTUM Conference Hall, Riga, Latvia;*
6. *Krišs Spalviņš, Indra Muižniece, Dagnija Blumberga participated in the conference "Innovation in fishery and Latvian fishery development trends", 30.11.2018, Riga, Latvia;*
7. *Marika Rošā, Francesco Romagnoli participated in the conference "Energy management in local governments: achievements and future prospects", 07.03.2019, RTU Scientific Library, Riga, Latvia;*
8. *Lauma Žihare, Krišs Spalviņš, Indra Muižniece participated in the conference "Biosystems Engineering 2019", 8-10.05.2019, Tartu, Estonia;*
9. *Dagnija Blumberga participated in the conference "Energy efficiency for sustainable future", 05.06.2019, People Work, Riga, Latvia.*

Scientific conferences organised by RTU IESE with participation of academic staff:

1. "*The Conference of Environmental and Climate Technologies CONECT 2019", 15-17.05.2019, FEEE, Āzenes iela 12/1, Riga, Latvia.*

Participation of RTU IESE in seminars in the year of studies 2018/2019:

1. *Miķelis Dzikēvičs participated in seminar "Research data management", 02.11.2018, RTU Faculty of Architecture, Riga, Latvia;*

2. *Francesco Romagnoli, Dagnija Blumberga, Vladimirs Kirsanovs, Ieva Pakere participated in the seminar "Low temperature district heating system opportunities in Latvia", 06.11.2018, Vecgulbenes Muiža, Gulbene, Latvia;*
3. *Dagnija Blumberga participated in the networking seminar for energy, industrial electronics and electrical engineering researchers and businessmen "Light up energy for business", 05.11.2018, SEB Bank Innovation Centre, Riga, Latvia;*
4. *Armands Grāvelsiņš participated in the seminar "Quality criteria for energy efficiency projects and their financing", 27.03.2019, Hotel Bergs, Riga, Latvia;*
5. *Dagnija Blumberga, Andra Blumberga, Miķelis Dzikēvičs, Vladimirs Kirsanovs participated in the seminar "Why does solar energy have future in Latvia" 29.03.2019, EE Centre Elektrum, Jurmala, Latvia;*
6. *Dagnija Blumberga, Vladimirs Kirsanovs, Einārs Cilinskis participated in the seminar "Climate Change. Circular Economy and Energy", 02.07.2019., Āzenes iela 12/1, Riga, Latvia.*

2019/2020

The academic staff of RTU IESE participated in the following scientific conferences:

1. *Participation of Baiba Ieviņa and Francesco Romagnoli in the conference "Algae biomass for a sustainable future" 03-05.09.2019, Sweden, Umeå;*
2. *Participation of Andra Blumberga and Dagnija Blumberga in the conference "Smart Energy Systems and 4th Generation District Heating 2019", 09-11.09.2019, Denmark, Copenhagen;*
3. *Participation of Francesco Romagnoli, Ieva Pakere and Vladimirs Kirsanovs in the conference "The Future of Thermal Grids", 24.09.2019, Sweden, Malmö;*
4. *Participation of Francesco Romagnoli and Vladimirs Kirsanovs in the conference "100 % Climate Neutrality Conference 2019", 30.09-02.10.2019, Denmark, Sønderborg;*
5. *Participation of Alīna Safronova and Vladimirs Kirsanovs in the conference "European Transport Conference 2019 (ETC)", 09-11.10.2019, Ireland, Dublin;*
6. *Participation of Dagnija Blumberga in the 13th SET-Plan Conference: 'R&I in the energy sector to enhance European industrial leadership', 13-15.11.2019, Helsinki, Finland;*
7. *Participation of Dagnija Blumberga, Gatis Bažbauers, Andra Blumberga, Agris Kamenders un Dzintars Jaunzems in the conference "Is it the time for transformation in the Latvian energy sector?", 27.11.2019, RTU Scientific Library, Riga, Latvia.*

Scientific conferences organised by RTU IESE:

1. Scientific conference CONECT 2020, 13-15.05.2020, Zoom platform.

In the year of studies 2019/2020 RTU IESE academic staff participated in the following seminars:

1. *Agate Veipa, Antra Kalnbaļķīte, Dace Lauka, Edgars Vīgants, Elvis Berjoza, Miķelis Dzikēvičs, Zane Indzere, Ivars Veidenbergs, Armands Grāvelsiņš, Jeļena Pubule, Anna Kubule, Ruta Vanaga, Vivita Priedniece participated in the Seminar-discussion "Analysis of the policy and restrictions of use of renewable energy sources and local sources in energy supply and transport sector", 10.10.2019, Āzenes iela 12/1-116, Riga, Latvia;*
2. *Reinis Āboltiņš, Vladimirs Kirsanovs, Dagnija Blumberga, Dzintars Jaunzems participated in the Seminar-discussion "Development of the biogas industry for the needs of transport energy", 17.10.2019, Āzenes iela 12/1-116, Riga, Latvia;*
3. *Alise Ozarska, Antra Kalnbaļķīte, Dace Lauka, Edgars Vīgants, Līga Sniega, Miķelis Dzikēvičs, Reinis Āboltiņš, Elvis Kalniņš, Ivars Veidenbergs, Dzintars Jaunzems, Armands Grāvelsiņš,*

Anna Kubule participated in the Seminar-discussion "Development of Latvian heat supply and cold supply in the context of the EU Directive", 24.10.2019, Āzenes iela 12/1-116, Riga, Latvia;

4. *Agris Kamenders, Antra Kalnbaļķīte, Edgars Vīgants, Reinis Āboltiņš, Vladimirs Kirsanovs, Ritvars Freimanis, Dzintars Jaunzems, Francesco Romagnoli, Miķelis Dzikēvičs, Ivars Veidenbergs, Armands Grāvelsiņš, Ruta Vanaga, Dace Lauka, Dagnija Blumberga, Gatis Bažbauers, Andra Blumberga participated in the Seminar-discussion "Energy balance modelling towards carbon neutrality", 31.10.2019, Āzenes iela 12/1-116, Riga, Latvia;*
5. *Armands Grāvelsiņš participated in the training seminar "Area of clean technologies – possibility for sustainable business and society?", 07.11.2019, LU Microsoft Innovation Centre, Kalpaka bulvāris 4, Floor 2;*
6. *Edgars Vīgants, Gatis Bažbauers participated in the seminar "Clean energy package and national energy and climate plans – prospects of renewable energy sources in Latvia", 03.12.2019, Saeima Baltic Hall, Jēkaba iela 6/8, Riga;*
7. *Dagnija Blumberga, Vladimirs Kirsanovs participated in the Seminar "Energy management in Vidzeme" (within "Vidzeme Innovation Week"), 02.2020, Smiltene Cultural Centre, Smiltene;*
8. *Agris Kamenders, Edgars Vīgants, Dzintars Jaunzems and Juris Antužs participated in the seminar "Investments in climate and energy projects 2030", 05.03.2020, RTU Scientific Library, Paula Valdena iela 5, Riga;*
9. *Jeļena Pubule, Alise Ozarska participated in the seminar "Introduction to Research Data Management, Open Research and Data Managements Plans", 04.02.2020, Āzenes iela 12, Riga;*
10. *Indra Muižniece, Antra Kalnbaļķīte, Dagnija Blumberga, Lauma Žihare, Ilze Vamža participated in the LCS FARP seminar "Seminar of the sector of agricultural, forestry and veterinary sciences", 28.04.2020, Zoom platform.*

4.5. Specify how the involvement of the students in scientific research and/or artistic creation activities is promoted. Provide the assessment and description of the involvement of the students of all-level study programmes in the relevant study direction in scientific research and/or artistic creation activities by giving examples of the opportunities offered to and used by the students.

Following the recommendations of the European Union Higher Education Academy, the European Higher Education Area and UNESCO on the establishment of a science-based study process, RTU and RTU IESE have developed and put in place mechanisms for the involvement of all study levels and programmes in research activities based on (*) the integration of problem-solving approaches into higher education, i.e. the exchange or dissemination of knowledge and experience, (*) the integration of research in all study levels and (*) valorisation of created innovations.

Among the most important activities of the study direction, the following can be mentioned:

- Support funds for conducting scientific projects (Master studies, doctoral studies).
- Involvement of students in the implementation of scientific projects.
- Student employment in the university's scientific laboratories.
- Availability of research infrastructure, including hardware and databases.
- Participation of students in international conferences and the university's annual scientific technical conference.
- Summer schools on research methods and methodology.

- Students have access to different tutorials and mentoring.

At RTU level doctoral grants are provided to Doctoral students on a competitive basis. International calls are made to attract to post-doctoral projects. In addition, the internal Research Excellence Grant for young scientists was established in 2018 as a new initiative, providing 270 000 EUR for 3-year period based on international competition (conditions are similar to EC ERC grant with international call and evaluation performed by external, i.e., foreign well-recognized researchers). The grant allows young and talented researchers to establish their own research groups and make research career at RTU.

Internal project calls provide additional funding for publishing articles in SCOPUS/WoS indexed editions, and internal projects within six research platforms – "Energy and Environment", "Cities and Development", "Information and Communication Technologies", "Transport", "Materials, Processes and Technologies", "Security and Defence" (for more information of research platforms see section 4.1) – stimulate involvement of Doctoral and Master students in multi-disciplinary and inter-faculty research projects in cooperation with the industry. RTU's internal project calls within the six research platforms, which are organized every year, have criteria regarding the involvement of students in the project, giving an additional score if students at the Bachelor, Master or Doctoral level are involved in the project.

The Research Support Fund (10% of the research base funding is allocated to this fund) provides support to Doctoral students (attending conferences, publishing papers and thesis, etc.). Employment of Doctoral students and post-doctoral researchers at RTU went up from 0 FTE in the period of 2013-2016 to 88 FTE (Doctoral students) and 97 FTE (Post-doctoral researchers) in 2018.

Doctoral students play a special role. The purpose of doctoral grants is to support research related to doctoral theses and to contribute to the defence of the doctoral thesis in the 4^{th} year after starting doctoral studies. The amount per grant is EUR 10,000. The grant is used for doctoral student's wage as a scientific assistant and/or researcher, as well as for covering of costs related to purchasing of materials necessary for research, publicity and competence improvement. 4 grants were granted for the doctoral study programme "Environmental Science" in 2019, and 9 grants in 2020.

17 post-doctoral 3-year long projects with total funding of 2.28 million EUR were launched in 2017. The funding covered salaries, costs of materials and mobility, as well as support for further development of research skills. About EUR 134,000 were granted to one project. 16 post-doctoral 3-year long projects with total funding of 2.14 million EUR were launched in 2018. 12 3-year long projects with total funding of 3.7 million EUR were launched in 2019. 18 post-doctoral 3-year long projects with total funding of 2.4 million EUR were launched in 2020. In 2021, at least 10 another post-doctoral projects are planned to be launched. The post-doctoral projects allow attracting new researchers to RTU from abroad and other Latvian research institutions, and providing academic career opportunities to Doctoral students who graduate from RTU.

The Design Factory (DF) of Riga Technical University (see additional information about the DF below) organizes the study course "Vertically Integrated Project" (VIP), during which interdisciplinary student teams develop a challenging long-term research project under the guidance of experienced researchers. The course is implemented in cooperation with researchers from the Georgia Institute of Technology (the USA). Within the course, cross-disciplinary student teams are assembled, bringing together students from at least three different study programmes, and ranging from first-year Bachelor students to Doctoral students, as well as involving pupils from the Engineering High School (EHS) of RTU (see additional information about the EHS below). During the course, students participate in research work under supervision of RTU researchers, working together with students of other study programmes and gaining experience in research as well as in

team and project work. At the end of the course, each team presents its progress and demonstrates the results obtained. For example, during spring semester of 2019, the call for VIP courses was announced for three topics:

- sensor systems and networks (group leader Prof. Jurģis Poriņš);
- wastewater treatment (group leader Prof. Tālis Juhna);
- energy efficient houses (group leader Leading Researcher Jānis Zaķis).

In 2018 and 2019, two students of the study direction "Environmental protection" participated in VIP activities: international student N. A. Patel (Master's study programme "Environmental Science") and A. A. Stīpniece (Bachelor's study programme "Environmental Science").

The Engineering High School of Riga Technical University is the first general secondary education establishment in Latvia that has been founded within the framework of a university. It is the place where the most talented Latvian pupils can acquire the study courses in exact and natural sciences at an advanced level to get prepared for the engineering studies. At the EHS, special attention is paid to the integration of engineering studies and scientific research activities into the study process.

A success story is the establishment of RTU Design Factory Labs (http://rtudf.rtu.lv) for design and prototyping. Idea of having the Lab at RTU was inspired by a positive example of Aalto University in Finland. Its task is to provide expertise and shared infrastructure for developing prototypes of new products and technologies, based on ideas of students and researchers. RTU Design Factory also works with industry, start-ups and spin-offs and has established a very good reputation. We could observe that it considerably improved the involvement of students at all study levels in research and innovation activities and promoted cooperation of RTU with industry.

To develop students innovative thinking, creativity and entrepreneurship, RTU implements a project "Innovation grants for students" (project No. 1.1.1.3/18/A/001 "RTU innovation grants for students" co-financed by ERDF). Students of all levels are offered to involve in different activities and to improve their business skills, to cooperate with the industry, to develop early science-intensive business ideas, to get a scholarship and a support grant. The "RTU Innovation Grants for Students" is a platform for students, industry and scientists, which promotes mutual cooperation, development and artistic creation (see Fig. Innovative thinking and business skills development process). Students of the study direction "Environmental protection" also actively use the opportunity to participate in this project (for additional information see sections of the report on the involvement of students of Bachelor's and Master's study programmes in scientific research).

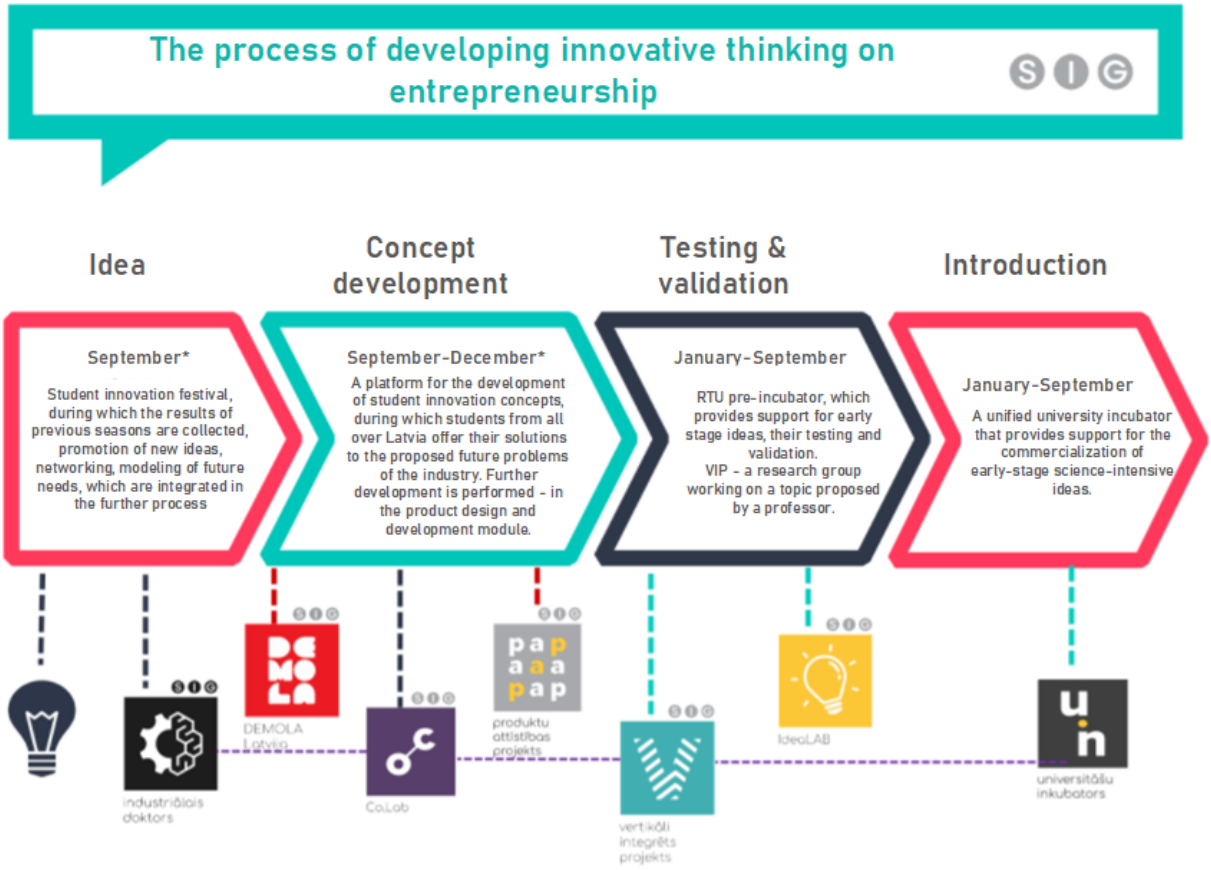

Figure: *Innovative thinking and business skills development process.*

Eight activities are implemented in the programme "RTU Innovation Grants for Students":

- "DEMOLA Latvia"- concepts for innovative use solutions for ideas/challenges defined by companies are developed by uniting students from different universities, academic and scientific staff and industry companies. Interdisciplinary and intercultural student teams, which involve young specialists in different areas, are created for problem solving in order to develop the ability to cooperate with industry representatives already during studies. Searching for new solutions promotes design thinking, provides intercultural experience and understanding of industry development and development and introduction of new concepts. The cooperation platform "DEMOLA Latvia" is implemented according to the example of the successful International Open Innovation Cooperation Platform "DEMOLA Network".
- Ideation activities – promote generation of new business ideas, team building, networking and development of new products. The process is based on generation of ideas, the development of a quick (in conditions of time and space restrictions) solution and the receipt of expert evaluation. For example, a Hackathon, which lasts 24-48 hours, and aims to create new teams and create new technological solutions. Initially, each person having a business idea presents it to the other participants. The participants then choose, on which idea they will work for the next 48 hours and make a real prototype of the product from scratch. The hackathon is a place when representatives of different levels and occupations meet.
- Product development project (PDP) – a training module, where student teams create prototypes by systematising and deepening knowledge in development of new products, technology transfer, innovation and commercialisation of their results. The task of the activity is to develop the competence of students in the development of new products and technology transfer, to multiply business skills and their use in practice, at the same time promoting the development of general innovation and planning skills, as well as to raise awareness of modern business models.

- A vertically integrated project (VIP) unites students from different sectors allowing them to develop a large-scale design and research project, at the same time strengthening and expanding scientific activities of teaching staff. The purpose of the activity is to create an opportunity for students from different study programmes and levels to cooperate a longterm research project – Master and doctoral students supervise the work of Bachelor students in a design and research project that may be part of the Master's or doctor's research work.
- RTU IDEALAB – the pre-incubator provides support to new or existing business ideas of RTU students promoting the initiation of new business activities providing support to students for the development and initial testing of a business idea. On student or a team, in which at least one representative is a student of RTU, may submit their ideas for the pre-incubator. "RTU IdeaLAB" is implemented at two levels. First, there is training of all applicants focusing on validation and testing of the idea, improvement of team work, identification of the common goal.
- COMMERCIALISATION TRAININGS FOR SCIENTISTS LAB – the objective of the activity is to develop and promote closer cooperation between the research and commercial sectors, involving business leaders in the research process of young scientists – doctoral students, in parallel ensuring an evaluation of the commercial nature of the research and promoting business skills and innovative thinking of the young scientist.
- INDUSTRIAL DOCTOR – development of a doctoral thesis research in line with interests and needs of a company. In the preparation of doctoral students scientific methods are usually based on problems created in the academic environment, therefore there is no clear link with the industry and its needs. The objective of this activity is to provide financial support to young scientists who write a doctoral thesis on a topic useful for the development of the company and whose scientific developments are necessary for the development of the company concerned. The university, in cooperation with the company, prepares a doctor of science with specialisation initiated by the company. The doctoral student works at university, but is actively involved in R&D activities of the company. The selected topic is based on scientific excellence of the university and the strategic vision of the company in technological development.
- University incubator – promotes the development of science-intensive business ideas of students and creation of new high value added companies. Student teams get support in the development of initial testing of a scientifically intensive business idea preparing it for the next phase of development of the idea – attraction of private or public investment. The incubator provides teams with expert consultations (for testing the viability of the business idea, preparation of a business plan, market research, organisation of working groups, technological expertise of a business idea and building of a team of developers of the idea), equipped workplaces, trainings, services of external experts, technological expertise and support funding for the development of the business idea.

In all study programmes students are actively involved in practical transfer of business ideas.

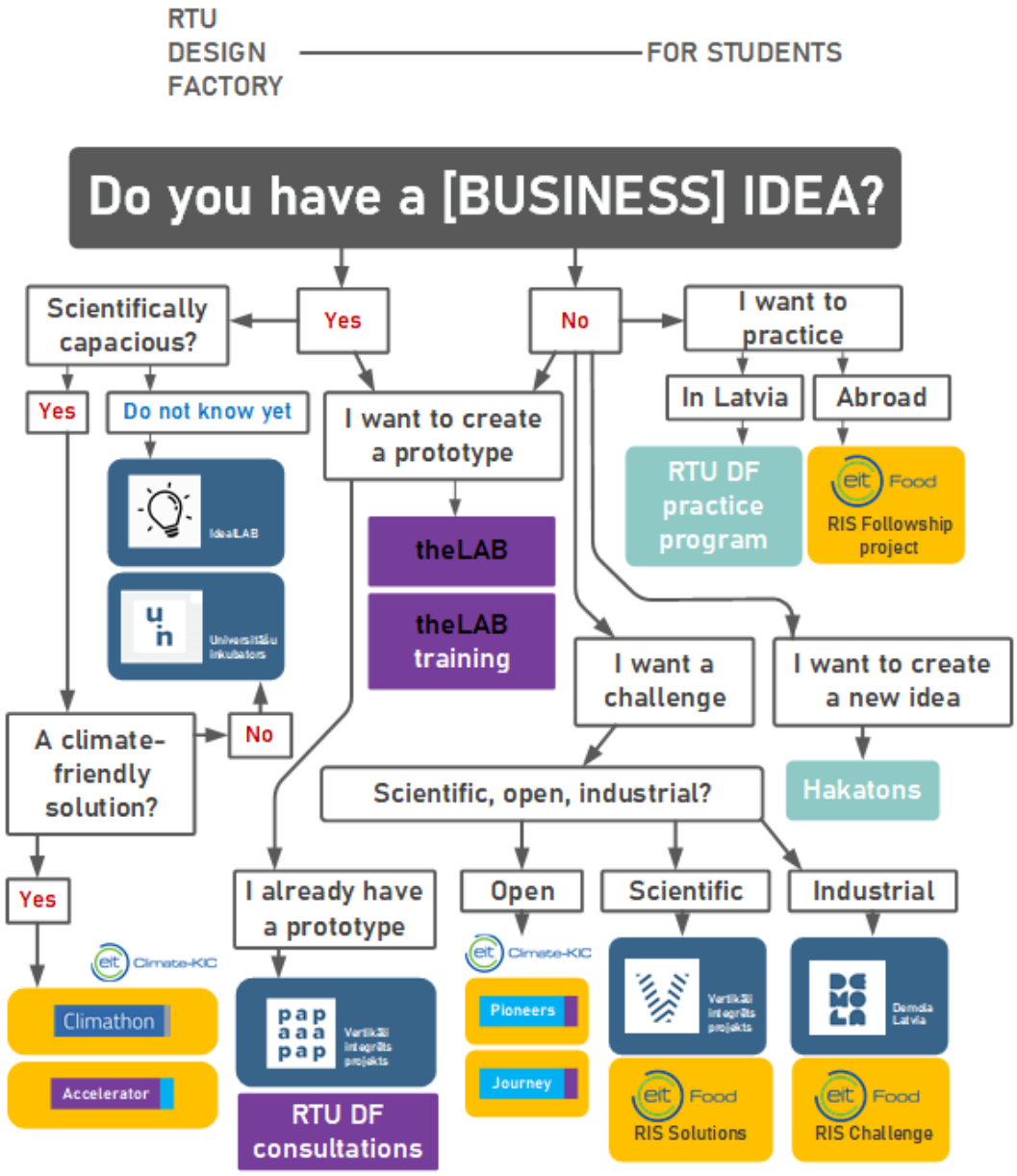

Figure: *Activities offered by the RTU Design Factory to support students*

In 2019, 8 students from different programmes of RTU study direction ‘Environmental protection” got involved in activities of RTU innovation grants for students (see Fig.), using the opportunity to improve their business skills and developing their business ideas.

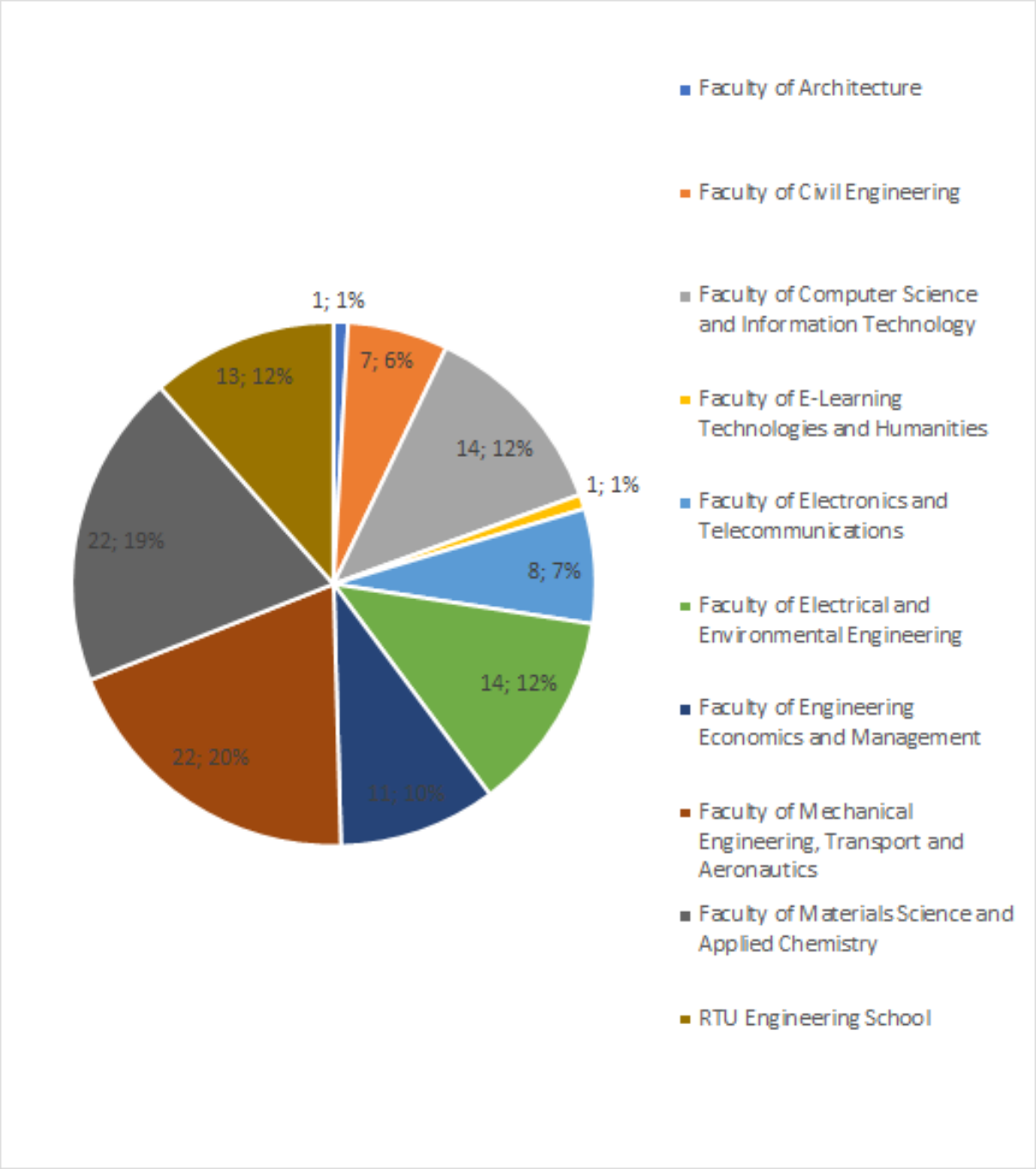

Figure: *The number of students enrolled in 2019 in activities of RTU Innovation Grants for Students*

RTU also has a support mechanism for the involvement of Master and Bachelor students in scientific research work.

- The purpose of the competition **RTU grants for Master students** is to increase the number of highly qualified Master students at RTU, who are able to write internationally citable scientific publications and continue with doctoral studies, thus strengthening the development and capacity of RTU scientific staff. The purpose of the competition meets the RTU strategy – to foster employment of graduates at RTU after graduation, an increase in the number of internationally recognised scientific publications, developed of high-quality scientific research, which is integrated in the study process. Any successful master student, who has been elected in a position of a scientific assistant at RTU, can participate in the competition. The funding of the competition, for example, in 2019-2020 amounted to EUR 95,000, the maximum amount per project was EUR 6000 and the project implementation period was up to 12 months. Project applications are evaluated in accordance with

administrative, quality and capacity evaluation criteria. Capacity and quality evaluation criteria include: compliance of the summary of the Master's thesis with the project objective, number of publications and type of publications prepared during the implementation of the project, current scientific qualification of the project applicant – international publications published and participation in international conferences. The result of the project is a Master student employed in scientific work, 1 full-text publication submitted and accepted for publication, a scientific article in a journal, or a full-text publication in conference proceedings, promoted skills of a scientific assistant in science and research work, promoted continuation of Master student's studies in an RTU doctoral study programme.

- The purpose of **RTU doctoral grants** is to support research related to doctoral theses and to contribute to the defence of the doctoral thesis in the 4th year after starting doctoral studies. Grants are awarded based on a competition to successful doctoral students of the years 1, 2, 3 and 4. The amount per grant is EUR 10,000. The grant is used for doctoral student's wage covering at least 800 working hours in a position of a scientific assistant and/or researcher. The competition criteria include: Number of *SCOPUS* and *Web of Science* indexed publications, number of published scientific books, reviewed conference abstracts, pedagogical work at RTU. The figure below provides a summary of RTU FEEE doctoral grants and performance of doctoral students of the study direction "Environmental protection" in them.

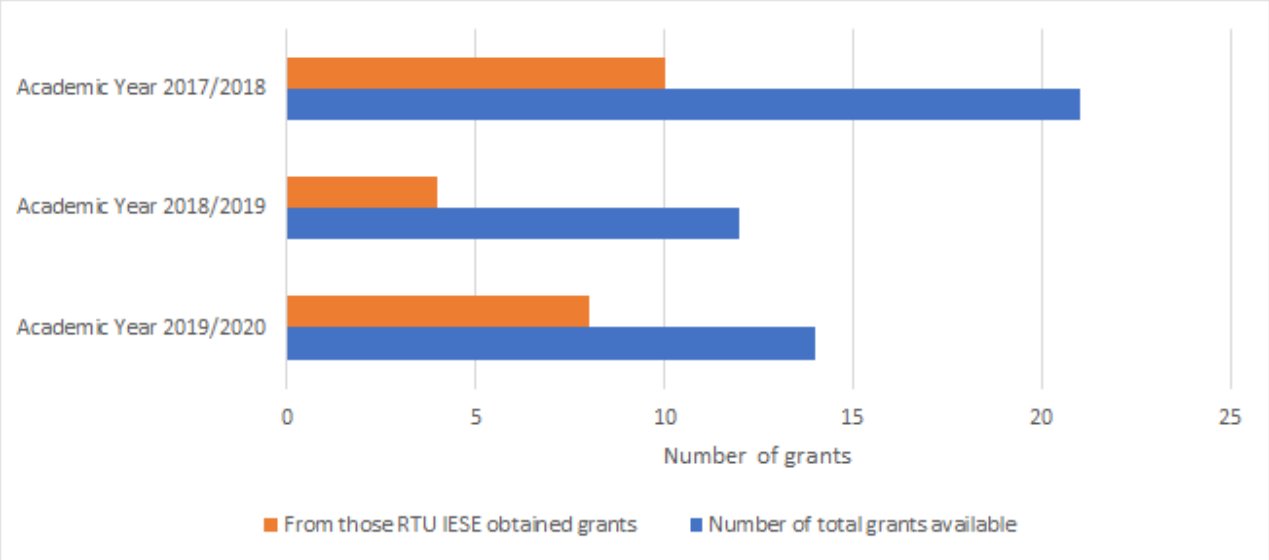

Figure: *Summary of the breakdown of doctoral grants at RTU FEEE (2016-2020).*

Taking into account that scientific research oriented study approach is ensured at all levels of study programmes (Bachelor, Master and doctoral). students of study programmes of the study direction "Environmental protection" conduct important fundamental and scientific research during their studies, the results of which have a serious impact on the development of the sector. This is ensured in three ways:

- Scientific research activity **at the level of study courses**. Topics of specialised courses are supplemented with the practical example of scientific research projects implemented by RTU IESE. For example, the study course "Bioeconomics" of the Bachelor level study programme integrated drafting of bioeconomic regional policy plans as practical work, which closely correlated with the Horizon 2020 BioEastUp project framework implemented by RTU IESE.
- Scientific research activity **at the level of graduation papers**. The topics of students' graduation papers (Bachelor's and Master's theses) are directly linked to the scientific research projects being conducted, thus ensuring adequate level of novelty in graduation papers, including participation in the development of experimental stands. This kind of

approach is very effective as it helps to achieve a high level of scientific excellence of graduation papers (according to data on 2018-2020, on average around 60-65% of all Master -level students draft a scientific publication on their graduation paper or the know-how generated in course papers and publish it in SCOPUS and/or Web of Science indexed journals – see also the *Figure* ***"Share of students at the CONECT conference in 2016-2020 years***)". At the level of doctoral theses, doctoral students are involved in the implementation of a number of thematically related scientific research projects, often acting as one of the leading participants (on average one student of the doctoral study programme of the study direction "Environmental protection" is involved in the implementation of 1-3 projects).

- Students participate in scientific research activities at the **levels of salaried work**. In 2016-2020, 72 students took part as employees of the projects implemented by RTU IESE as project employees (the Figure below shows a breakdown of projects and student engagement in them). Students who have been employed in RTU IESE scientific laboratories in research projects during their free-time (e.g. on holidays) recognised that they also provide additional benefits in the study process, such as an in-depth understanding of the extensive use of theoretical knowledge in practice.

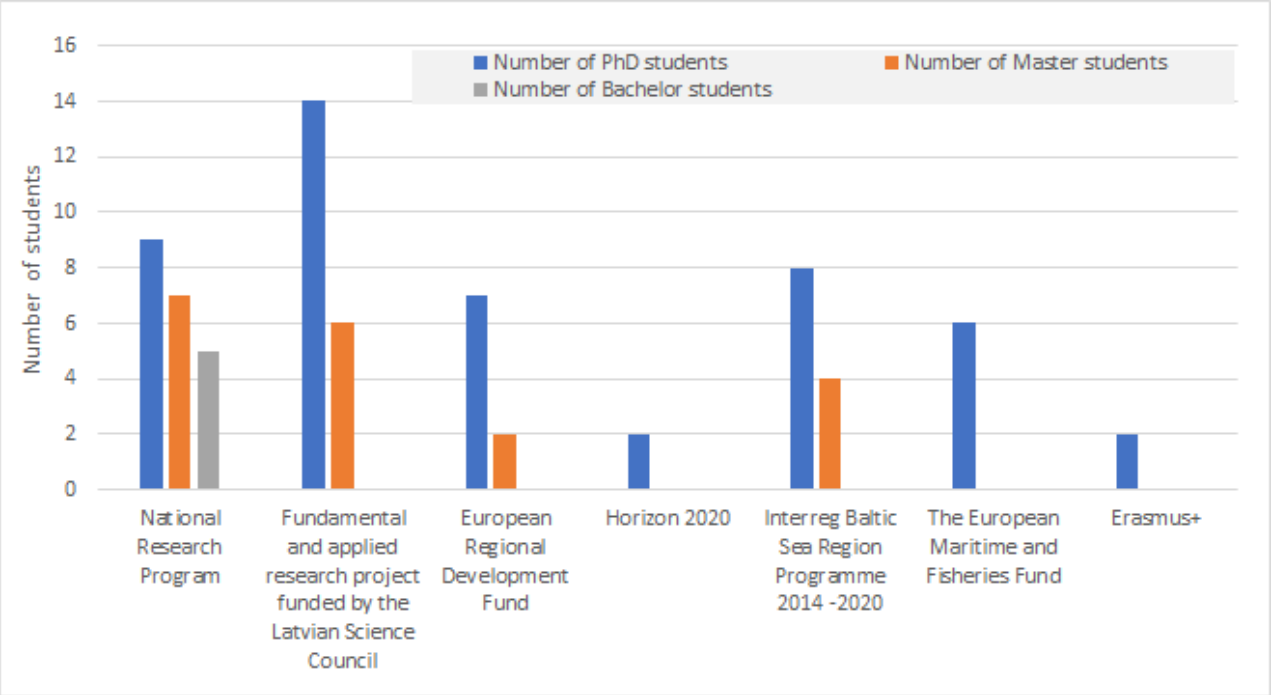

Figure: *Participation of students (by levels of the study programme) in research projects carried out by RTU IESE*

Students can also publish the high-quality results of scientific research work (as part of course papers and graduation papers) in the international journal "Environmental and Climate Technologies" issued by RTU IESE (abbreviated as "ECT"), which is indexed in the SCOPUS and Web of Science databases. The Figure shows the number of publications in "ECT" journals and the number of student articles from all articles published in the "ECT" journal over the past five years.

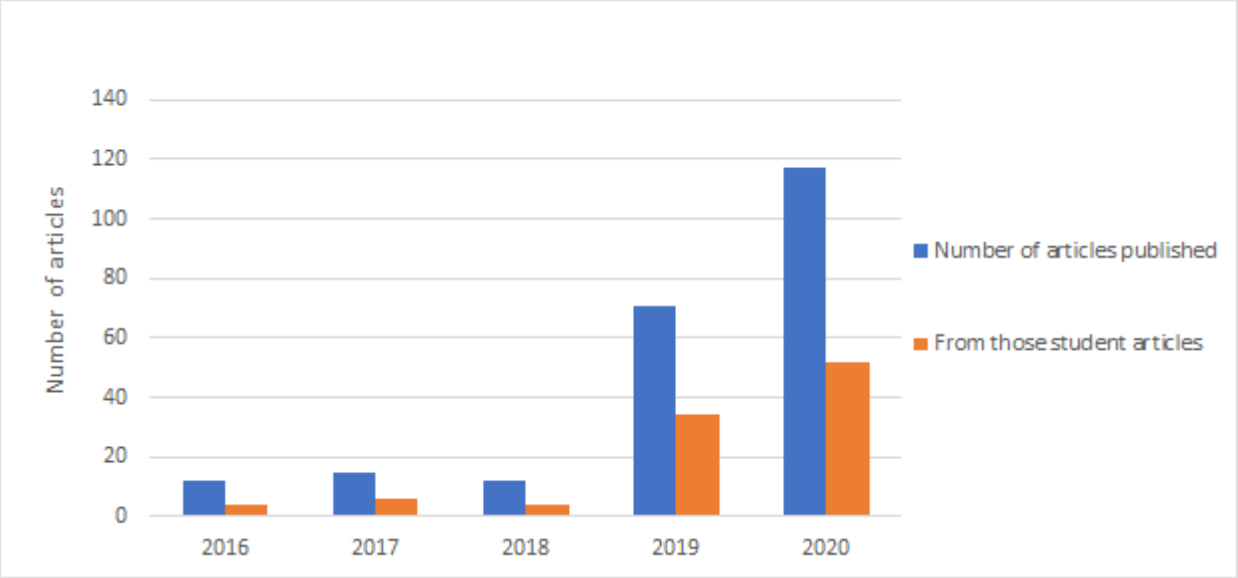

Figure: *Articles published in the ECT journal, including articles of students, 2016-2020. (* In 2019 – including the CONECT special edition; **In 2020 – including the CONECT special edition)*

Scientific activity of students within the study direction "Environmental protection" is developed also through participation in the annual international scientific conference CONECT organised by RTU IESE (for more information on the conference see section 4.4). Every year, the CONECT conference brings together Bachelor, master and doctoral level students from Latvia and foreign countries. Students make up a considerable share of participants of the conference (see Figure "Share of students at the CONECT conference in 2016-2020"). The Figure summarises information on the last five years.

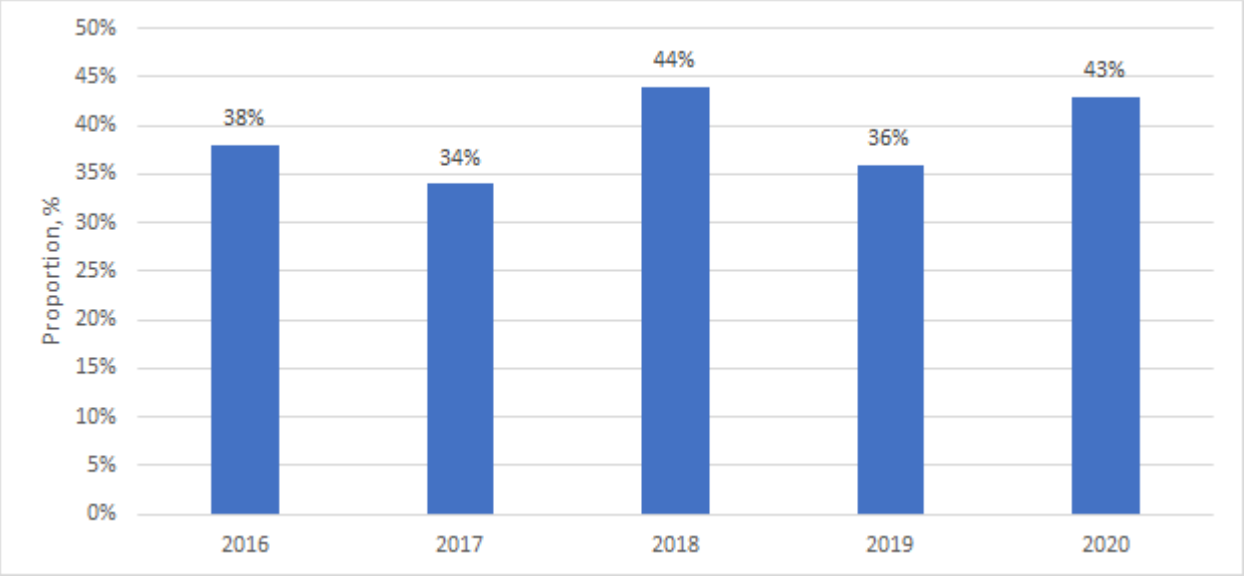

Figure: *Share of students at the CONECT conference in 2016-2020.*

4.6. Provide a brief description and assessment of the forms of innovation (for instance, product, process, marketing, and organisational innovation) generally used in the study direction subject to the assessment, by giving the respective examples and assessing their impact on the study process.

The vision of Riga Technical University until 2025 is to become an internationally competitive, dynamic and modern university of science and technology. In order to implement this setting, the strategy defines four objectives of the University – excellence in science, high quality study process, sustainable valorisation and institutional excellence. Specific result-based targets have been determined for these three objectives to make it possible for the RTU to achieve its vision by 2025.

The RTU is a modern, internationally known university of science and technology, which prepares highly qualified engineering specialists needed for the Latvian economy as a centre of studies, scientific research, lifelong learning and innovation. General modernisation and the takeover of the world's best experience ensure the dynamic and sustainable development of RTU, enabling RTU and its graduates to compete at the international level.

Innovation, valorisation and introduction of innovative methods in the study process is one of strategic priorities of RTU. FEEE innovation activities take place in several directions and at several levels.

- Since 2020, RTU teaching staff have been ensuring the implementation of the study course "Environmental and Climate Roadmap", which provides students with knowledge on innovation in the field of environmental protection and practical skills in evaluating such innovations.
- Students of the study direction (e.g. students in the Master's study programme) are actively involved in the development of innovative ideas, for example, within the EIT Climate-KIC programme. Riga Technical University has been a partner of the European Institute of Innovation & Technology (EIT) Climate Knowledge and Innovation Community since 2016. RTU's participation in EIT Climate-KIC provides opportunities for Latvian students, scientists, start-ups and professionals of different areas to develop entrepreneurial skills while creating solutions to reduce climate change. Thus, RTU strengthens the development of climate-friendly business and green technologies in Latvia. Student start-ups are created on the basis of ideas, which continue to develop in an RTU or Latvian business incubator, patents are also registered.
- Participation of students and teaching staff in hackathons on environmental protection. For example, the idea of modelling tourist flows to preserve environmental values triumphed in the Climathon 2019 organised by RTU in 2019 (the 24-hour Climathon 2019 is an international initiative which takes place in more than 100 cities around the world at the same time creating solutions for climate change caused problems). M. Kacare, a student of the Master's study programme "Environmental science" was also a team member. In 2018, the winner of the Copernicus Hackathon and Climathon Riga 2018, which aimed at seeking a solution for the use of satellite data to manage cities in a smart and climate friendly way, was a team of two students of the RTU Master's study programme "Environmental Science" (M. Karols and G. Gaumigs). The team's idea focuses on temperature at road coverage level, traffic intensity, and monitoring of concentrations of air-polluting gases with the help of sensory data. The idea is currently being developed to a level to ensure international certification of the final product. Meanwhile, in February 2021, a waste management promotion hackathon was organised in cooperation between RTU and RTU IESE's industrial partner SIA "ZAAO".
- Participation of doctoral students and young teaching staff in product commercialisation projects (e.g. participation of RTU IESE doctoral student I. Vamža and young doctoral students K. Spalviņš and I. Muižniece in the commercialisation projects organised by IDAL).
- Integration of new knowledge and experience in study courses.

When RTU IESE scientists and researchers implement research projects (for the list see Paragraph 4.3), they obtain new knowledge from project partners or create new ideas, innovative research

methods as a result of research, which are then integrated in other projects or the study process.

The active scientific activity of the teaching staff of the study direction also makes a contribution to the level of patented inventions:

- *06.2013. - Pellet combustion unit. Patent No.:14670. Authors: D. Blumberga, J. Ziemele, A. Lubiņš, E. Vīgants, A. Zandeckis, G. Vīgants, V. Kirsanovs, I. Veidenbergs. Patent owner – Riga Technical University.*
- *03.2014. – Woodchip heat insulation material. Patent No.: 14792. Authors: I. Muižniece, D. Blumberga. Patent owner – Riga Technical University.*
- *02.2015. – Water wall. Patent No.: 14874. Authors: G. Žogla, A. Blumberga, K. Kašs, D. Blumberga. Patent owner – Riga Technical University.*
- *01.2017. – Granulated woodchip heat insulation material. Patent No.: 15124. Authors: I. Muižniece, D. Blumberga, D. Lauka, A. Blumberga. Patent owner – Riga Technical University.*
- *03.2017. – Material for stimulation of fermentation in biogas production process. Patent No.: 15164. Authors: D. Lauka, D. Blumberga, I. Muižniece. Patent owner – Riga Technical University.*
- *08.2017. – Biomethane production unit. Patent No.: 15164. Authors: D. Blumberga, D. Lauka, J. Gušča, I. Veidenbergs. Patent owner – Riga Technical University.*
- *08.2018 – Gasification unit. Patent No.: P-16-95. Authors: D. Blumberga, V. Kirsanovs, C. Rochas, I. Veidenbergs, E. Vīgants, Ģ. Vīgants. Patent owner – Riga Technical University.*

In general, innovative solutions, international and local experience in the study process are integrated actively and particularly successfully, resulting both in new collaborative projects in the academic and scientific research fields and joint scientific publications.

II - Description of the Study Direction (5. Cooperation and Internationalisation)

5.1. Provide the assessment as to how the cooperation with different institutions from Latvia and abroad (higher education institutions/ colleges, employers, employers' organisations, municipalities, non-governmental organisations, scientific institutes, etc.) within the study direction contributes to the achievement of the aims and learning outcomes of the study direction. Specify the criteria by which the cooperation partners suitable for the study direction and the relevant study programmes are selected and how the cooperation is organised by describing the cooperation with employers. In addition, specify the mechanism for the attraction of the employers.

Cooperation with Latvian higher education institutions

The RTU study direction "Environmental protection" cooperates with several Latvian universities and colleges: University of Latvia (LU), Liepaja University, Latvia University of Life Sciences and Technologies, Rezekne Academy of Technologies, Daugavpils University, Ventspils University of Applied Sciences, Vidzeme University of Applied Sciences.

Within this study direction, there are agreements between RTU and LU, LLU on mutual cooperation in the implementation of the study process, including possibilities to continue studies, and development of science, which provides for cooperation in all the areas, starting from free student

mobility between both universities to the implementation of joint projects in different areas.

Examples of cooperation with Latvian higher education institutions are provided below.

- **Ensuring provision of the study process**. For example, (1) students of study programmes of environmental protection study directions of RTU and University of Latvia (LU) actively use the possibility of mastering part C courses in partner universities. (2) In addition, RTU IESE in cooperation with study programmes "Environmental science" implemented by LU Faculty of Geography and Earth Sciences organise rotation of target-oriented study courses: LU students master thematic blocks on socio-economic aspects of energy supply at RTU (within the study course "Socio-economic aspects of energy supply), while RTU students master a thematic block on ecological cycles at LU (within the study course "Ecology"). There is similar cooperation in doctoral level study courses. (3) There is active attraction of visiting lecturers from Latvia universities within the study direction, while RTU IESE teaching staff read visiting lecturers in other universities. (4) implementation of joint courses. For example, in 2015, there was a joint doctoral school between LU and RTU doctoral programmes "Environmental science".
- **Cooperation at the level of doctoral council**. One of five current members of the RTU Doctoral Council "Environmental engineering and heat energy" currently is a representative outside RTU – professor of the Latvia University of Life Sciences and Technologies, Dr. sc. Ing. Ritvars Sudārs. In the previous Doctoral Council "Environmental Science" (due to the change in the doctoral procedure in the country in 2020, there were changes in the breakdown of Doctoral Councils and therefor also it composition) out of 9 members 4 represented other universities – Dr.sc.ing. Ritvars Sudārs (Latvia University of Life Sciences and Technologies), Dr.geogr. Oļģerts Nikodemus (University of Latvia), Dr.habil.chem. Māris Kļaviņš (University of Latvia), Dr.geogr. Agrita Briede (University of Latvia).
- **Cooperation at the level of Council of Professors**. In the RTU Council of Professor "Environmental engineering and energy" out of 8 council members three represent RTU IESE (chairwoman of the council, professor *sc.ing.* Andra Blumberga, professor *Dr.hab.sc.ing.* Dagnija Blumberga, professor *Dr.sc.ing.* Gatis Bažbauers), one professor of RTU Institute of Industrial Electronics and Electrical Engineering – *Dr. sc. ing.* Oskars Krievs, one professor of RTU Water Systems and Biotechnology Institute – Dr.sc.ing. Tālis Juhna and one industry representative – chairman of the Latvian Association of Waste Management Companies *Dr.sc.ing.* Jānis Vilgerts. Furthermore, two representatives were from other universities – professor of the University of Latvia *Dr. habil.chem.* Māris Kļaviņš and professor of the Rezekne Academy of Technologies *Dr.sc.ing.* Edmunds Teirumnieks. The involvement of members of the Council of professors outside RTU promotes maintenance of the uniform quality level of the professor and associate professor environment in the field of engineering and energy and its improvement.
- **At the level of implementation of joint scientific research and academic projects**.
- **Cooperation of students** within the Association of Latvian Environmental Science Students. The purpose of the association is to represent interests of Latvian environmental science students and society in sustainable development matters in the field of environment. The first step towards the establishment of the youth environmental organisation was made on 28 November 2008, when the first meeting of environmental science students was held, which brought together environmental science/environmental engineering students of six Latvian universities (48 participants). The purpose of the association is to represent interests of Latvian environmental science students and society in sustainable development matters in the field of environment. The tasks of the association are to represent the interests of Latvian environmental science students, to develop environmental science as a science sector in Latvia, to raise the level of knowledge of Latvian society in environmental matters, paying

particular attention to the new generation and to defend human rights principles related to global climate change.

- Cooperation in popularisation of environmental science and education **through activities in environmental science and education organisations.** Cooperation between universities at Latvian level is enhanced by the activities of higher education institutions in the Environment Science and Education Council led by the Director of RTU IESE, professor *hab.sc.ing.* Dagnija Blumberga. The purpose of the Environment Science and Education Council is to develop environmental science and education in Latvia by improving the quality of the research programmes carried out, compliance with European level, promoting cooperation with potential employers and decision-makers. The Environmental Science and Education Council unites representatives of Latvian universities and colleges, in which study programmes related to environmental protection are implemented, i.e. University of Latvia, RTU, Liepaja University, Law on Institutions of Higher Education, Rezekne Academy of Technologies and Daugavpils University.
- **In the organisation of joint academic and scientific research activities**. In order to promote the development of environmental education and science in the field of environmental protection in Latvia, various events (conferences, seminars, discussion forums, etc.) are organised in cooperation with Latvian universities. Thus, for instance, on 18 June 2018, within the IV World Congress of Latvian Scientists, RTU IESE together with implementers of study programmes of the University of Latvia, Tallinn University of Technology, Rezekne Academy of Technologies, Latvia University of Life Sciences and Technologies organised a discussion forum: Why is Latvia a green country?", which apart from professors of these universities was attended by industry experts – *sc.ing.* Jānis Vilgerts, Chairman of the Board of the Latvian Association of Waste Management Companies , *Dr.sc.ing.* Uldis Bariss, AS "Latvenergo, *Dr.sc.ing.* Valdis Vītoliņš, SIA "Jūrmalas siltums" and Saeima deputy Einārs Cilinskis. The event took place in two formats – on-site and in the e-environment – and aroused a discussion on the future of the Latvian environmental protection sector.

Cooperation with foreign higher education institutions

Taking into account integration of Latvia in the European Union and globalisation of business, programmes of the study direction are implemented in Latvian and English. As a result, students better learn international engineering terminology. The FEEE strategy aims to become internationally well-known organisational units, which are open for foreign students, and therefore the following development goals have been set:

- internationalisation of studies, training and research;
- development of international partner relations and cooperation;
- extension of international experience of students;
- effective attraction of foreign students;
- improvement of study quality of international students;
- extension of opportunities of staff and improvement of motivation to get involved and actively participate in the process of internationalisation.

Within the scope of the study direction RTU IESE participates in the organisation of work of several important international organisations and implementation of international projects. Each of the internationalisation aims set by RTU and RTU IESE has detailed sub-aims and tasks to be performed. It should be noted that the number of foreign universities, with which cooperation is established, increases year on year, this enabling students to study and have internship abroad, as well as there is international cooperation of academic staff in research and academic work.

RTU IESE has established a stable cooperation with foreign universities, where cooperation takes place at the level of visiting lectures, traineeships of doctoral students, experience exchange visits, research project application and project implementation levels, participation in doctoral councils, etc.

- **Academic and scientific cooperation in student and academic staff exchange programmes.** *The partner organisations are: Estonian University of Life Sciences (Estonia), University of Padova (Italy), University of Lund (Sweden), Linnaeus University (Sweden), Lappeenranta University of Technology (Finland), University of Tartu (Estonia), West Pomeranian University of Technology (Poland), Estonian University of Life Sciences, Igaunija, VTT Technical Research Centre of Finland, Somija, Kaunas University of Technology (Lithuania), Lviv Polytechnic National University (Ukraine), Tallinn University of Technology (Estonia), Vilnius Gediminas Technical University (Lithuania), Technische Universität Darmstadt (Germany), Institute of Water Problems and Land Reclamation NAAN (Ukraine), Wismar University of Applied Sciences, Technology, Business and Design (Germany), Centria University of Applied Sciences (Finland), Università degli Studi di Perugi (Italy), PETRARCA – European Academy for the Culture of Landsape (Germany), Tashkent State Technical University (Uzbekistan), Rudny Industrial Institute (Kazakhstan), ITMo University (Russia).*
- **In the development of joint study courses.** Such cooperation with the study direction "Environmental protection" is promoted through academic projects (such as ANDROID and CABARET) and participation in COST share management groups. *Partner organisations are: University of Salford (United Kingdom), University of Natural Resources and Applied Life Sciences (Austria), Royal Melbourne Institute of Technology (Australia), Mining and Geology University (Bulgaria), University of Calgary (Canada), United Nations International Strategy for Disaster Reduction (Switzerland), WSL Institute for Snow and Avalanche Research SLF (Switzerland), Swiss Federal Institute of Technology (Switzerland), Global risk forum Davos (Switzerland), Meteorological Service (Cyprus), Frederick University (Cyprus), VSB-technical University of Ostrava (Czech Republic), Czech Technical University (Czech Republic), Karlsruhe Institute of Technology (Germany), FREIE UNIVERSITAT BERLIN (Germany), Institute of Socioeconomic and Cultural International Analysis (Germany), United Nations University (Germany), IT University of Copenhagen (Denmark), Geological Survey of Denmark and Greenland (Denmark), Technical University of Denmark (Denmark), Technical University of Technology (Estonia), Tallinn University of Technology (Estonia), Universitat Politecnica de Catalunya (Spain), Institute of geomatics (Spain), Aalto University (Finland), Grenobe Institute of Technology (Greece), Aristotle University of Thessaloniki (Greece), University of Thessaly (Greece), Croatian Academy of Science and Arts (Croatia), University of Split (Croatia), National University of Ireland (Ireland), University of Iceland (Iceland), Universita` di Ferrara (Itālija), Italian National Agency for New Technologies, Energy and SD (Italy), Politecnico di Milano University (Italy), Universita degli Studi della Tuscia (Italy), Catholic University of Sacred Heart Milan (Italy), University of Moratuwa (Sri Lanka), Vilnius Gediminas Technical University (Lithuania), University of Malta (Malta), DELTARES (Netherlands), Utrecht University (Netherlands), RADBOUD UNIVERSITEIT NIJMEGEN (Netherlands), Norwegian Geotechnical Institute (Norway), Centre for International Climate and Environmental Research (Norway), Adam Mickiewicz University (Poland), Rzeszow University of Technology (Poland), National Laboratory for Civil Engineering (Portugal), University of Coimbra (Portugal), Technical University of Lisbon (Portugal), University of Aveiro (Rumānia), University of Architecture and Urban Planning (Rumānia), Technical University of Civil Engineering of Romania (Rumānia), Mid Sweden University (Sweden), Lund University (Sweden), City of Ljubljana (Slovenia), University of Ljubljana (Slovenia), Firat University (Turkey), Bosphorus University (Turkey), HERIOT-WATT UNIVERSITY (United Kingdom),*

Liverpool John Moores University (United Kingdom), Kingston University (United Kingdom), University of Brightonm (United Kingdom), Oxford Brookes University (United Kingdom), Queen`s University Belfast (United Kingdom), Northumbria University (United Kingdom).

- **Cooperation in the implementation of scientific research projects:** *University of Salford (United Kingdom), University of Natural Resources and Applied Life Sciences (Austria), Royal Melbourne Institute of Technology (Australia), Mining and Geology University (Bulgaria), University of Calgary (Canada), United Nations International Strategy for Disaster Reduction (Switzerland), WSL Institute for Snow and Avalanche Research SLF (Switzerland), Swiss Federal Institute of Technology (Switzerland), Global risk forum Davos (Switzerland), Meteorological Service (Cyprus), Frederick University (Cyprus), VSB-technical University of Ostrava (Czech Republic), Czech Technical University (Czech Republic), Karlsruhe Institute of Technology (Germany), FREIE UNIVERSITAT BERLIN (Germany), Institute of Socioeconomic and Cultural International Analysis (Germany), United Nations University (Germany), IT University of Copenhagen (Denmark), Geological Survey of Denmark and Greenland (Denmark), Technical University of Denmark (Denmark), Technical University of Technology (Estonia), Tallinn University of Technology (Estonia), Universitat Politecnica de Catalunya (Spain), Institute of geomatics (Spain), Aalto University (Finland), Grenobe Institute of Technology (Greece), Aristotle University of Thessaloniki (Greece), University of Thessaly (Greece), Croatian Academy of Science and Arts (Croatia), University of Split (Croatia), National University of Ireland (Ireland), University of Iceland (Iceland), Universita` di Ferrara (Italy), Italian National Agency for New Technologies, Energy and SD (Italy), Politecnico di Milano University (Italy), Universita degli Studi della Tuscia (Italy), Catholic University of Sacred Heart Milan (Italy), University of Moratuwa (Sri Lanka), Vilnius Gediminas Technical University (Lithuania), University of Malta (Malta), DELTARES (Netherlands), Utrecht University (Netherlands), RADBOUD UNIVERSITEIT NIJMEGEN (Netherlands), Norwegian Geotechnical Institute (Norway), Centre for International Climate and Environmental Research (Norway), Adam Mickiewicz University (Poland), Rzeszow University of Technology (Poland), National Laboratory for Civil Engineering (Portugal), University of Coimbra (Portugal), Technical University of Lisbon (Portugal), University of Aveiro (Rumania), University of Architecture and Urban Planning (Rumania), Technical University of Civil Engineering of Romania (Rumania), Mid Sweden University (Sweden), Lund University (Sweden), City of Ljubljana (Slovenia), University of Ljubljana (Slovenia), Firat University (Turkey), Bosphorus University (Turkey), HERIOT-WATT UNIVERSITY (United Kingdom), Liverpool John Moores University (United Kingdom), Kingston University (United Kingdom), University of Brightonm (United Kingdom), Oxford Brookes University (United Kingdom), Queen`s University Belfast (United Kingdom), Northumbria University (United Kingdom), BLT Wieselburg / Federal Institute of Education and Research Francisco Josephinum (Germany), Sapienza University of Rome (Italy), CoNISMa (Italy), Ecoil (Italy), Danish Technological Institute (Denmark), National Environmental Research Institute (Denmark), Hashemite University (Jordan), Central Salt and Chemicals Research Institute (India), AquAgri Processing (India), NGVA Europe (Belgium), Nordic Instiute in Innovation, Research and Education, (Norway), Lund University (Sweden), Technical University of Denmark (Denmark), Technical Research Centre of Finland (Finland), OREEC (Norway), Aclima (Spain), CLEAN (Denmark), FORA (Denmark), ECO WORLD STYRIA (Austria), Lombardy Energy Cluster (Italy), Montanuniversität Leoben (Austria), Aalborg University (Denmark), KU Leuven (Belgium), Dresden University of Technology (Germany), Marche Polytechnic University (Italy), SP Technical Research Institute (Sweden), Technical University of Denmark (Denmark), INTRO FLEX ApS (Denmark), Erik Møller Architects (Denmark), University of Applied Sciences Western Switzerland (Switzerland), Aalborg University (Denmark), KU Leuven (Belgium), Dresden University of Technology (Germany), Marche Polytechnic University (Italy), SP*

Technical Research Institute (Sweden), Technical University of Denmark (Denmark), INTRO FLEX ApS (Denmark), Erik Møller Architects (Denmark), University of Applied Sciences Western Switzerland (Switzerland), Technical University of Denmark (Denmark), Norwegian University of Life Science (Norway), The Swedish Royal Institute of Technology (Sweden), Aalto University (Finland), Stockholm School of Economics (Sweden), Norwegian Centre for Research Quality and Policy Impact Studies (Norway), Institute of Fluid Flow Machinery, Polish Academy of Sciences (Poland), District Heating Enterprise Ltd. – OPEC Gdynia (Poland), Brandenburg University of Technology (BTU) Cottbus – Senftenberg (Germany), ZEBAU – Centre for Energy, Construction, Architecture and the Environment GmbH (Germany), Energy Efficiency Association for Heating, Cooling and CHP (Germany), Holbaek Municipality (Denmark), Gate 21 (Denmark), Lejre Municipality (Denmark), Sustainable Business Hub (Sweden), City of Malmö (Sweden), Thermopolis Ltd. (Finland), District Heating Kurikka (Finland), Tartu Regional Energy Agency (Estonia), Klaipeda University (Lithuania), Public Institution Housing Energy Efficiency Agency (Lithuania), ANO Energy Efficiency Centre (Russia), Magistrate of the City of Bremerhaven (Germany), Leuphana University Lüneburg (Germany), Renewable Energies Agency (Germany), Europe University Flensburg (Germany), Energy agency for South East Sweden (Sweden), Trolleybus Communication Enterprise Ltd. (Poland), Municipality of Gdynia (Poland), The Szewalski Institute of Fluid-Flow Machinery Polish Academy of Sciences (Poland), Centria University of Applied Sciences Ltd. (Finland), Association of Ylivieska Region (Finland), ProjectZero (Denmark), Silute District Municipality Administration (Lithuania), CivittaUAB (Lithuania), Elva Municipality (Estonia), South-Estonian Centre of Renewable Energy (Estonia), Immanuel Kant University Kaliningrad (Russia), Instytut Uprawy Nawożenia i Gleboznawstwa — Państwowy Instytut Badawczy (Poland), Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej — Państwowy Instytut Badawczy (Poland), Ministerstwo Rolnictwa i Rozwoju Wsi (Poland), Ministry of Agriculture (Hungary), Zemědělský výzkum, spol. s r.o. (Czech Republic), Agrárgazdasági Kutató Intézet (Hungary), Agricultural Academy (Bulgaria), Estonian University of Life Sciences (Estonia), Vytautas Magnus University (Lithuania), Ministerstvo pôdohospodárstva a rozvoja vidieka Slovenskej republiky (Slovakia), Univerza v Ljubljani (Slovenia), Ministrstvo za kmetijstvo in okolje (Slovenia), Energetski institut Hrvoje Požar (Croatia), Luonnonvarakeskus (Somija), Fachagentur Nachwachsende Rohstoffe e. V. (Germany), Institute of Agricultural Economics (Rumania), European Rural Development Network (Poland), Europa Media Szolgaltato non Profitkozhasznu Kft. (Hungary), Quadro Synergy Ltd. (Bulgaria).

- **Cooperation at levels of doctoral councils and councils of professors.** In accordance with doctoral regulations, an opinion of an independent reviewer should be provided in the **review of doctoral theses**. RTU IESE actively cooperates with teaching staff of different European and non-European universities as potential reviewers. In the period from 2013 to 2020, teaching staff of the following universities were involved as foreign reviewers within the study programme “Environmental Science”: *Graham Whitelaw (Queen's University, Canada), Hans Bjornsson (Chalmers University of Technology, Sweden), Edita Baltrenaite (Vilnius Gedimina Technical University, Lithuania), Visvaldas Varžinskas (Kaunas University of Technology, Lithuania), Audun Amundsen (University of Bergen, Norway), Gintaras Denafas (Kaunas University of Technology, Lithuania), Žaneta Stasiskiene (Kaunas University of Technology, Lithuania), Irrek Wolfgang (Ruhr West University of Applied Sciences, Germany), Andres Siirde (Tallinn University of Technology, Estonia), Ingo Weidlich (HafenCity University Hamburg, Germany), Timo Laukkanen (Aalto University, Somija), Saulius Vasarevicius (Vilnius Gedimina Technical University, Lithuania), Raimondas Grubliauskas (Vilnius Gedimina Technical University, Lithuania), Vladimirs Biziks (Georg-August-Universität Göttingen, Sweden), Anna Volkova (Tallinn University of Technology, Estonia), Lucia Rocchi (University of Perugia, Italy), Uli Jakob (Stuttgart University of Applied Sciences, Germany), Peter Lund*

(Aalto University, Fniland), Erik O. Ahlgren (Technical University of Denmark, Denmark), Giuseppe Tomasoni (Università degli Studi di Brescia, Italy). It should be noted that the list of reviewers is constantly supplemented through cooperation in scientific projects, drafting of scientific publications, participation in international conferences, etc.

- There is also cooperation in the Master's study programme by implementing cooperation between the RTU study programme "Environmental science" and "Environmental engineering" and "Environmental Engineering" programmes of the Vilnius Gediminas Technical University in acquiring a double diploma (for more information see section 5.4). Within the scope of this cooperation, 23 teaching staff members of the Vilnius Gediminas Technical University were involved in **reviewing of Master graduation papers** in 2013-2020.
- **Cooperation at the level of the Council of Professors** is organised as part of election of professors – an independent international evaluation of the candidate professor by a foreign university professor is organised.

The study direction "Environmental protection" is initially built on the **BALTECH** cooperation base, which was launched in 2000, when RTU in cooperation with the Kaunas University of Technology, Linköping University, Lund University, Royal Institute of Technology and Vilnius Gediminas Technical University created study programmes. Since 1 September 2015, the Riga Technical University has become the presiding university of the BALTECH consortium, one of priority tasks of which is to promote closer cooperation between technical universities of Baltic and Nordic technical universities, thus making the Baltic Sea Region the centre of research and innovation in the European Union. In 2019-2020, changes are planned in the BALTECH consortium as Baltic technology universities join **NORDTEK.** In June 2018, the Riga Technical University organised the annual NORDTEK conference "Changes in globalisation – challenges and opportunities for Nordic-Baltic higher education and research policy". NORDTEK is a consortium of technical universities of five Nordic countries (Sweden, Finland Norway, Iceland and Denmark), whose participants represent 27 universities and together more than 120,000 students, teachers and scientists. The matter of integration of members of BALTECH (Riga Technical University, Vilnius Gediminas University of Technology, Tallinn University of Technology, Kaunas University of Technology) in the NORDTEK consortium was considered at the conference. Within the conference, on 7 June 2018, the agreement on cooperation between NORDTEK and BALTECH technical universities in engineering education was approved at the meeting of NORDTEK rectors providing that: 1) students of universities of the association may study in universities of NORDTEK partners; 2) students may participate in doctoral courses organised by universities of NORDTEK partners; 3) teachers may teach courses, prepared and improve courses in universities of NORDTEK partners. In September 2018, the board of the BALTECH consortium adopted a decision that starting from 1 January 2019 BALTECH gets fully integrated in the Nordic NORDTEK network and, taking into account the transition period, BALTECH terminates its activities in 2020.

Within the completed RTU's cooperation agreements, which includes also cooperation in the study direction "Environmental protection", there is cooperation with more than one hundred foreign higher education institutions (https://www.rtu.lv/en/internationalization/mobility). 115 cooperation agreements with higher education institutions from 22 foreign countries have been concluded (see Annex "List of Corporate agreements"). Students and academic staff of the study direction take advantage of study, teaching and experience exchange opportunities at the higher education institutions of the European Union (EU) member states. More than 100 different cooperation agreements were signed, incl. Erasmus+ mobility, EURAXESS, bilateral cooperation agreements, etc.: https://www.rtu.lv/en/internationalization/mobility

Cooperation with employers, professional organizations

RTU IESE has been cooperating successfully with companies, sectoral associations and public organisations for a long time. Every year, cooperation is expanding, strengthening and new forms of cooperation are emerging, with a growing mutual interest in delivering a successful outcome of cooperation. The main areas of cooperation and activities within the framework of the study directions are:

- ensuring and improving the study process and quality, including improving of curriculum of the programmes and forecasts for the needs of specialists;
- providing professional development of students by offering internship places and jobs;
- managing and reviewing study and graduation papers, offering topics of graduation papers (formulating problems to be solved in companies so that students can develop solutions demanded by the industry);
- ordered research and approbation of the results of scientific studies, company, process improvement and optimisation tasks for students;
- involvement of professionals (company specialists) in the study process;
- organisation and implementation of other, extracurricular, activities outside, including company scholarships and support for students, Career Days (see also Paragraphs 5.3);
- representation of the interests of the university and industry in governmental and international organisations;
- evaluation of new product ideas (for example, Master level study course “Environmental Technologies” and “Innovative Energy Supply Technologies”) (see also Paragraph 4.5).

Cooperation with different professional organisations with the scope of the study direction takes place in organising of joint conferences and seminars, and also as scientific cooperation, consultation on development of the industry and necessary changes and improvements to the education system. As it has already been mentioned in Section 1.4., the management of the study direction is ensured by the Study Direction Committee that includes industry specialists (see Annex "Composition of the study direction committee"). It is another effective form of cooperation with employers. Their point of view is very important in shaping the content of study programmes, as it helps maintain close relation with current trends in the national economy and local government processes. Information on the cooperation agreements concluded is provided in Annex "List of Corporate Agreements".

The most significant cooperation partners in the reporting period (2013-2020) are:

- ***Companies*** *(types of cooperation: in the implementation of the study process – provision of visiting lectures, internship (within the framework of the C study course), resolution of problems related to local government topics within the scope of study courses and drafting of diploma papers; upskilling for company employees; scientific cooperation): SIA “Fortum Jelgava” (Latvia), AS ”BAO” (Latvia), AS „ZAAO” (Latvia), SIA “Klētnieks” (Latvia), SIA „Arate” (Latvia), AS „Komforts Industries”, SIA „Reimanis” (Latvia), SIA „Linstow Center Management” (Latvia), SIA „Ekodoma” (Latvia), SIA „Granulu darbnīca” (Latvia), SIA “Ventspils nekustamie īpašumi” (Latvia), SIA Sperre Baltic (Latvia), A/S PET Baltija (Latvia), SIA Latgran, AS Inspecta Latvia (Latvia), SIA Eiroprojekts (Latvia), SIA “Jūrmalas siltums”, SIA “Salaspils siltums”, SIA “Lautus”, Det Norske Veritas Latvia (Latvia), SIA Efekta (Latvia), SIA “AJ Power” (Latvia), Ventspils digitālais centrs (Latvia), Ventspils Jaunrades nams (Latvia), SIA “Piekrastei.lv” (Latvia), AS “Rīgas kuģu būvētava” (Latvia), AS “Latvijas Zaļais punkts” (Latvia), SIA “Baltic Scientific Instruments” (Latvia), SIA “GRAANUL INVEST” (Latvia), A/S “Lode” (Latvia), SIA “Evopipes” (Latvia), AS “Dzintars” (Latvia), SIA “Madara Cosmetics” (Latvia), “Saarema Landfill” AB (Estonia), “RGS 90 Sverige” AB (Sweden), Sustainable*

Sweden South East (Sweden), "Ea Energy Analyses" (Denmark), "Sustainable Sweden South East" (Sweden), LundaHydro AB (Sweden), Ragnsells (Sweden), University of Tartu (Estonia), JSC Modern E-Technologies (Lithuania), Trolleybus Communication Enterprise Ltd. (Poland), District Heating Enterprise Ltd. – OPEC Gdynia (Poland), Gate 21 (Denmark), Thermopolis Ltd. (Finland), Quadro Synergy Ltd. (Bulgaria), CoNISMa (Italy), Ecoil (Italy), INTRO FLEX ApS (Denmark), Erik Møller Architects (Denmark), CivittaUAB (Lithuania).

- ***Local governments*** *(types of cooperation: in the implementation of the study process – visiting lectures, resolution of problems related to local government topics within the scope of study courses and drafting of diploma papers; scientific cooperation, upskilling for local government employees): Ludza Local Government, Valmiera Local Government, Limbažu Local Government, Salaspils Local Government, Dobele Local Government, Jelgava Local Government, Liepāja Local Government, Saldus Local Government, Ikšķile Local Government, Ķegums Local Government, Daugavpils Local Government, Krāslava Local Government, Gulbene Local Government, Ventspils Local Government, Grobiņa Local Government, Ogre Local Government, Balvi Local Government, Pļaviņas Local Government, Mārupe Municipality Council.*
- ***Public authorities*** *(types of cooperation: in the implementation of the study process – visiting lectures, resolution of problems related to topics significant for the state within the scope of study courses and drafting of diploma papers; participation in diploma paper committees; scientific cooperation, popularisation of study and science and development in the field of environmental protection; organisation of joint thematic seminars and thematic work groups): State Centre for Defence Military Sites and Procurement, National Armed Forces Air Force Aviation Base, National Library of Latvia, State Environmental Service, Latvian Chamber of Commerce and Industry, Ministry of Environmental Protection and Regional Development, Ministry of Economics, Investment and Development Agency of Latvia, Rural Support Service, Latvian National Accreditation Bureau, Latvian Academy of Sciences, Environmental State Bureau, Central Statistical Bureau, State Development Financial Institution Altum, State Construction Control Bureau.*
- ***Embassies and state councils*** *(promoting international cooperation in the field of environmental science and education, attracting visiting lecturers, organising joint thematic events (seminars, events for students and potential students), cooperation in the initiation of new projects): Embassy of the United States of America in Latvia, Embassy of Denmark in Latvia, Embassy of Kazakhstan in Latvia, Embassy of Uzbekistan in Latvia, Embassy of Norway in Latvia, Embassy of Germany in Latvia, British Council in Latvia, Goethe Institute in Riga, French Institute in Latvia, the Nordic Council of Ministers.*
- ***Professional associations*** *(types of cooperation: in the implementation of the study process – visiting lectures, discussions on resolution of problems related to environmental protection topics significant for society; scientific cooperation, popularisation of study and science and development in the field of environmental protection; organisation of joint thematic seminars and thematic work groups): Latvian Biogas Association, Association of Latvian Environmental Science Students, Latvian Association of Energy Auditors, Latvian Association of Solar Energy, Latvian Association of Heat Supply Companies; Latvian Association of Waste Management Companies, Association of Latvian Young Scientists, Latvian Bioenergy Association, Latvian Researchers Union, Latvian Association of Professors of Higher Education Institutions, Latvian Council of Environmental Science and Education, Latvian Renewable Energy Confederation, Vidzeme Planning Region, LATAK Council, Latvian Agricultural Organization Cooperation Council.*

In order to ensure constant bilateral dialogue with company representatives, working groups, seminars, events and conferences, where all the stakeholders (employers, graduates, academic

staff of the university and students) can meet, are organised on a regular basis. Quality of programmes, curriculum and form of study courses, organisation and implementation of practical work is organised during such meetings. The study programmes included in the study direction are supplemented and updated during their implementation based on labour market research and consultations with employers and practicing specialists. Recommendations of graduates, students and academic staff of the higher education institution play an important role in the implementation of the study direction. Surveys of graduates and employers are organised on a regular basis. Respondents are urged to evaluate programmes, knowledge and skills of graduates of programmes and their compliance with labour market requirements. Overall, survey results show that employers evaluate positively all the study programmes of the directions and their topicality. When evaluating the results of surveys of employers in the last years, a conclusion can be made that employers appreciate graduates of the programme and the wish of young specialists to professionally improve, as well as the lack of young engineering specialists in the industry is emphasised.

The link with employers is strengthened also through **active participation of teaching staff** of the study direction "Environmental protection" **in professional organisations and associations**, from which the most significant are Latvian Biogas Association, Latvian Academy of Sciences Terminology Commission, RTU Alumni Association, Association of Latvian Environmental Science Students, Latvian Association of Energy Auditors, Latvian Association of Solar Energy, Association of Latvian Young Scientists, Latvian Bioenergy Association, Ministry of Environmental Protection and Regional Development Climate Technology Cooperation Council, Latvian Researchers Union, Latvian Association Heat, Gas and Water Technology, SETAC Society of Environmental Toxicology and Chemistry, Latvian Council of Environmental Science and Education, Society "Dabas koncertzāle", Society "Pēdas LV", Latvian Renewable Energy Confederation, Latvian Association of Heat Supply Companies.

Since 17 June 2017, RTU has been having a newly elected RTU Advisory Board. The Board includes specialists of the national economy, whose principal work is not RTU and who may promote the development of RTU by their professionalism. The main aim of the RTU Advisory Board is to facilitate development of RTU setting the strategic directions of their operation in accordance with national economy needs. The Advisory Board advises the Senate and the rector in RTU development strategy matters and supports the formation of material and financial resources of the higher education institution. The Senate, the rector or faculty councils may propose as members of the RTU Advisory Board specialists in science, education, culture and national economy, whose principal work is not RTU and who may promote the development of the higher education institution by their professionalism. At least one a year the Board evaluates the operation of RTU and provides recommendations and proposals on the development of the higher education institution in general. The current RTU Advisory Board includes several environmental protection related specialists, with whom there is close cooperation within the study direction "Environmental protection": chairman of the Board Āris Žīgurs (Chairman of the Management Board of AS «Latvenergo»), board members – Normunds Talcis (Chairman of the Management Board of AS «Rīgas siltums»), Andris Lubiņš (head of SIA «Grandeg»).

In addition, there were meetings with top officials and heads of public authorities (only the most important visits of recent years are mentioned):

- In April 2018, the President of the State Raimonds Vējonis visited FEEE. During the visit, the President of the State R. Vējonis met the RTU rector, academician Leonīds Ribickis and administration of FEE organisational units, as well as representatives of the Student Parliament, discussed the importance, development and challenges of engineering education, was acquainted with academic and scientific achievements of the faculty, infrastructure supply for the study and scientific process (auditoriums, scientific and student research

laboratories, etc.).

- In December 2019, there was a meeting with the management of the Ministry of Environmental Protection and Regional Development to discuss the scientific contribution to the achievement of national climate change policy targets, as well as the contribution of RTU IESE to the ministry and the environmental protection sector in the preparation of missing specialists.
- On 16 October 2020, there was a meeting with the management of the Ministry of Economics discussing potential cooperation in the implementation of scientific research projects (in particular the results achieved by FEEE scientists in the National Research Programme (NRP) "Energy") to ensure the needs of the national economy, as well as preparation of new specialists.
- In October 2020, there was a meeting with IDAL management discussing potential cooperation in the field of scientific research.

Academic staff of the study direction participates councils of industry experts of national importance at the Ministry of Environmental Protection and Regional Development, the Latvian Council of Science and other organisations (for more information on personnel's CV).

Academic staff of the study direction actively participates in different public activities. For instance:

- Since 2018, professors of RTU IESE have been participating in the "Lampa" conversation festival. The festival is a large scale initiative, an open platform, the content of which is formed by more than 300 organisations and active individuals jointly creating a place to exchange opinions in a free, informal atmosphere and discuss with respect topics of importance for society. RTU IESE teaching staff participates in discussions on higher education matters and scientific innovations in the field of environmental protection. For example, in 2020, RTU IESE professor, Director of the study direction "Environmental protection" *hab.sc.ing*. Dagnija Blumberga participated in the "Lampa" discussion "Does solar energy generation in Latvia have a future?" (05.09.2020), but RTU IESE professor, RTU FEEE Vice-Dean for Research *Dr.sc.ing.* Andra Blumberga participated in the discussion "Breaking heat supply myths" (02.09.2020).
- Every year community based participation in court proceedings as experts in environmental protection and energy experts.
- Participate on a regular basis in meetings of Saeima Committees of the Republic of Latvia debating on the improvement of the higher education process in the country (Education, Culture and Science Committee), as well as industry policy matters (National Economy, Agrarian, Environmental and Regional Policy Committee, Sustainable Development Committee).
- In January 2019, RTU IESE prepared several questions and tasks on environmental protection topics for the Vidzeme Television pupil game "Vides erudīts".
- In 2018-2019, two doctoral students of RTU IESE participated in the Latvian Television game "Gudrs, vēl gudrāks" as experts asking pupils questions on environmental protection topics.

Moreover, every year the RTU FEEE Student Self-Government organises educational trips to provide students with the possibility to get acquainted by local companies and learn about the activity of environmental protection and energy sector (for example, waste management company SIA "Getliņi EKO", Riga second combined heat and power plant (CHPP-2), etc.).

To promote the interest of future students on environmental protection specialities and to develop critical systemic thinking in pupils, RTU IESE organises different event for pupils:

- every year RTU IESE receives **pupils' trips** and organises **educational seminars for teachers**. For instance, in the year of studies 2018/2019 RTU IESE visited 14 delegations of

Latvian schools (pupils and teachers). These usually are pupils of grades 10 to 12, who supplement their knowledge in specific speciality, visiting different study directions. In the year of studies 2018/2019 two seminars for teachers were organised (they were attended by 26 teachers from Zemgale and Kurzeme schools) on biotechnomics. See below the list with different events for pupils and teachers:

- 20.04.2018. – RTU IESE teaching staff and doctoral students led a Scientific Workshop "Why is biotechnomics our joint future?" in the conference organised by the Environmental School at the culture palace "Ziemeļblāzma"
- 21.09.2019 – RTU IESE teaching staff and doctoral students read a lecture on biomimicry and applied game "Supply of energy sources for electricity generation" for teaches of exact sciences and life sciences from Kurzeme and Zemgale. More information – https://videszinatne.rtu.lv/?s=skolot%C4%81ji (Latvian only).
- 27.02.2020 Participation of RTU IESE in a teacher seminar funded by the Riga City Council with a lecture and applied game for teachers on energy sources.
- September 2018: Visit of 28 pupils and a teacher of Riga Secondary School 10. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE, a lecture and practical work on biomimicry and a visit to the RTU IESE scientific laboratory were provided. Visit of 19 pupils and a teacher of Riga Secondary School 22. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE, a lecture and practical work on biotechnomics and a visit to the RTU IESE scientific laboratory were provided. Visit of 27 pupils and a teacher of Jurmala City Kauguri Secondary School. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE, a lecture and practical work on biotechnomics, renewable energy sources and a visit to the RTU IESE scientific laboratory were provided.
- 04.10.2018 - Visit of 24 pupils of grade 9 of the Riga State German Gymnasium. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE RTU, a visit to the IESE scientific laboratory, a lecture and practical work on recovery of resources from waste were provided.
- 27.11.2018 – Visit of 38 pupils of grade 11 of Salaspils Secondary School 1. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE RTU, a visit to the IESE scientific laboratory, a lecture and practical work on energy efficiency of buildings were provided.
- 18.01.2019 – Visit of 31 pupils of grade 11 of Riga Secondary School 95. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE RTU, a visit to the IESE scientific laboratory, a lecture and practical work on biotechnomics were provided.
- March-May 2019 – visit of pupils of Riga Secondary School 95 (pupils of grade 11-12, 4 classes in total, 30 pupils in each). A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE RTU, a visit to the IESE scientific laboratory, a lecture and practical work on different environmental science topics and a visit to RTU IESE scientific laboratory were provided.
- 26.06.2019 – visit of 13 pupils/young rangers. A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU Values a lecture and practical work on the use of logging residue for production of value added products and a visit to the RTU IESE scientific laboratory were provided.
- 02.10.2019 – Visit of pupils of grade 10 and a teacher (29 people) of the Danish State Technical Gymnasium (Struer Statsgymnasium) to RTU IESE. A lecture and practical work on biomimicry and a visit to the RTU IESE scientific laboratory were provided.
- 30.03.2020 – two groups of grade 9 of Riga regional school (30 pupils in total 15+15

pupils) A lecture on study opportunities at RTU and exactly in the study programmes implemented by RTU IESE, a lecture and practical work on biotechnomics, renewable energy sources and a visit to the RTU IESE scientific laboratory were provided.

- Additional school visits and different activities for schools take place in cooperation with the **RTU University for Children and Youths** (for more information on https://www.rtu.lv/lv/bju (Latvian only)). For instance,
  - 29.11.2018 – RTU IESE teaching staff and doctoral students led a cycle of practical classes "Energy consumption" for pupils of Riga schools of the University for Children and Youths groups of grades 2-3, grades 4-6 and grades 7-9.
  - 07.12.2019 – RTU IESE led a cycle of practical classes "Energy consumption" for pupils of grades 2-3, grades 4-6 and grades 7-9 from Ogre of the University for Children and Youths.
- Since 2015, RTU IESE has been organising scientific performance within the **Researchers' Night** every year. In 2019, about 650 people (pupils, families with children and other target groups) attended events organised by RTU IESE (12 scientific workshops in total) within the Researchers' Night.
- Every year, 8-10 teaching staff members of RTU IESE participated in shadow days offering young people an opportunity to get acquainted with the daily life of teaching staff and scientists.

Main criteria for selecting appropriate cooperation partners for study programms were - ths field of scientific and professional activity of the cooperation partners, reputation, experience of previous cooperation, etc.

5.2. Specify the system or mechanisms, which are used to attract the students and the teaching staff from abroad and provide a description of the dynamics of the number of the attracted students and the teaching staff.

To attract foreign students to RTU, two communication target groups are mainly addressed:

1. the internal: management team; general staff, academic staff; existing students;
2. the external: prospective foreign students (foreign students studying in Latvia, foreign pupils and students, parents of foreign pupils and students); foreign graduates; mass media; opinion leaders; educational institutions; student recruitment education agencies; diplomatic and consular missions of the Republic of Latvia.

The communication strategy uses several types of information channels, choosing the most appropriate for each target audience – paid advertising channels, earned and owned ones. Marketing communication is an essential part of addressing foreign audience using all the traditional marketing tools – advertising in media and other channels, event marketing, direct marketing etc. The main marketing tool used to reach foreign audience is participation in various educational exhibitions and seminars organized by educational agencies in target markets. Continuity in the provision of information and promotion of studies is ensured by the long-term partner universities and educational agencies.

Public relations tools (press releases, media events, face-to-face meetings, interviews, opinion polls, etc.) and RTU social media channels (Facebook, WeChat, WhatsApp, YouTube, etc.) are used in corporate communication. RTU internal channels (ORTUS portal, email, etc.), information seminars and special events are used for internal communication.

It should be emphasised that the following plays a special role in attracting foreign students (both full-time students and exchange students) within the study direction “Environmental protection”

- **Summer schools organised by RTU IESE**. For example, a summer school called “Tickets to the Future” was organised in August 2015 and attended by 25 German students and an international summer school “Latvian Biocapacity” was organised in August 2018 and was attended by 13 participants from 11 countries. On the other hand, 5 of 14 students enrolled in the Master studies admitted that they obtained information on the opportunities for studies in the Master’s programme of the study direction “Environmental protection” from friends who participated in these summer schools.
- **lectures and scientific research activities of teaching staff**. Students apply for exchange studies in the RTU study direction “Environmental protection” by getting acquainted with teaching staff during visiting lectures in their home countries or with the scientific research work of the teaching staff through projects or scientific publications. For example, especially good cooperation with Master and doctoral students on the basis of this platform was established with Italian universities (La Sapienza University, University of Brescia, University of Perugia, University of Milano-Bicocca, Insubria University, University of L’Aquila, Marche Polytechnic University), where foreign RTU IESE teaching staff professor, *Dr.sc.ing.* Francesco Romagnoli and professor, *Dr.sc.ing.* Claudio Rochas promote this cooperation. Every semester, 1-2 students of Master’s or doctoral programmes of Italian universities go for 6-month mobility to RTU IESE. Similar cooperation is also observed with the Vilnius Gediminas Technical University, Kaunas University of Technology and Vytautas Magnus University. For example, in the spring 2017, a doctoral student from Vytautas Magnus University (Lithuania) A. Sabūnas spent the spring semester of 2017 at RTU IESE within the framework of ERASMUS+ mobility and, as part of his doctoral thesis, studied algae growth trends in the Baltic Sea and their transfer under artificial cultivation conditions.

The number of applications processed is much higher than the number of students actually enrolled. For example, in academic year 2017/2018, 1813 applications were received from prospective students, while 632 students commenced their studies; in academic year 2018/2019, 2627 applications were received, but 774 students were enrolled, in academic year 2019/2020 3340 applications were received and 870 students were enrolled. As it can be seen, the dynamics of foreign students have been growing in recent years. However, due to travel restrictions caused by COVID-19, the number of students enrolled in 2020/2021 is expected to decrease.

The Figure shows changes in the number of full-time and exchange foreign students in the period from academic year 2013/2014 to academic year 2019/2020 in the study direction “Environmental protection”.

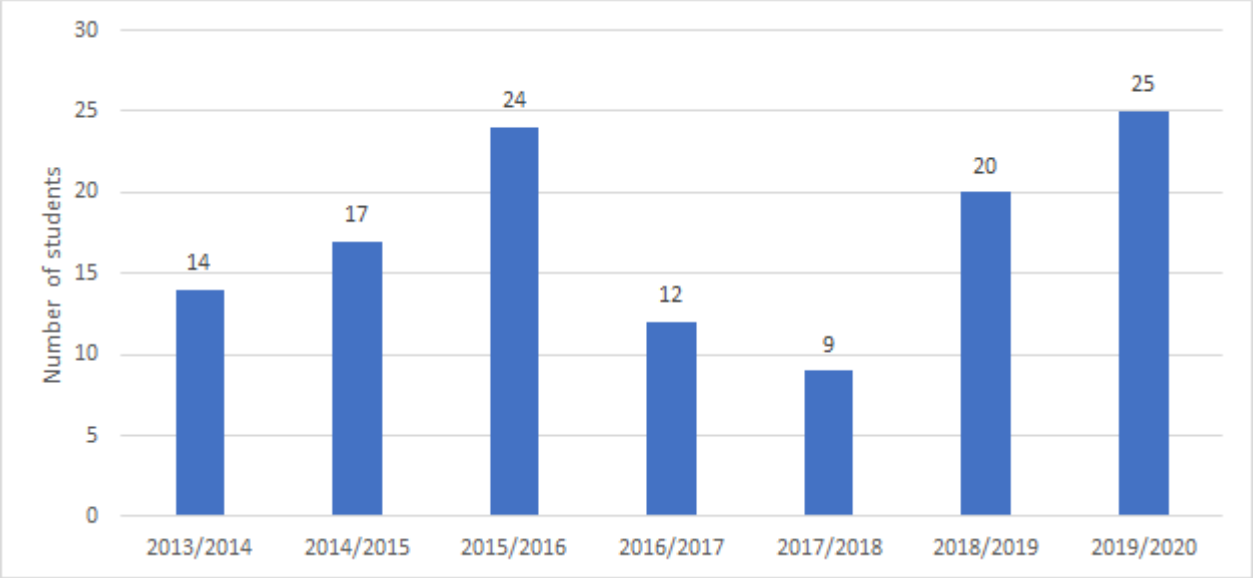

Figure: *Number of foreign students in the period from academic year 2013/2014 to academic year 2019/2020 in the study direction "Environmental protection".*

Only Master and doctoral study programmes were available in English within the study programmes "Environmental Science". 121 foreign students studied in these programmes in the reporting period, of which 97 or 80% were full-time foreign students and 24 or 20% were exchange students. In the year of studies 2019/2020, most of foreign students – 23 students – were enrolled in full-time studies. The increase, among other things, is related to two organised summer schools, as well as teaching of RTU IESE teaching staff in foreign countries. The total number of foreign students increased more than 3 times compared to the beginning of the period, which is a serious increase. The increase in foreign students indicated that the interests of foreign students in studies in Latvia increases year on year, in particular highest level study programmes.

The distribution of incoming students by countries is demonstrated in the attached figure "Breakdown of incoming students by country".

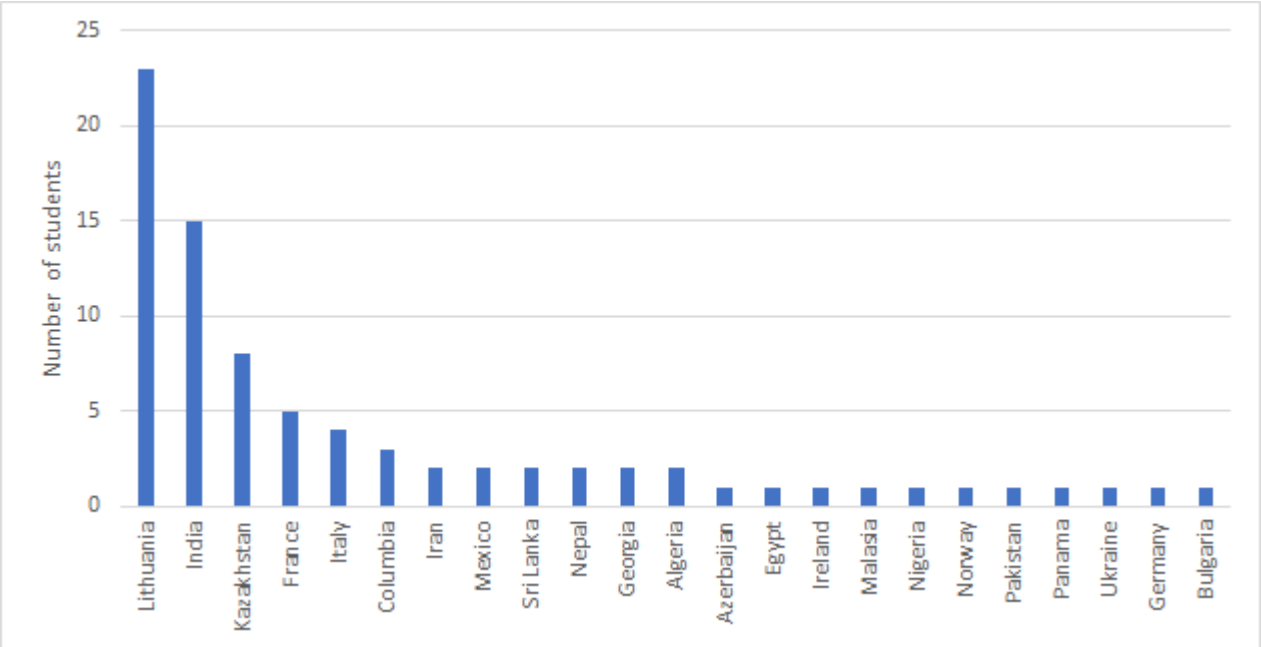

Figure: *The distribution of incoming students by countries in the reporting period in the study direction "Environmental protection".*

As it can be seen from the figure above, most students come from India, Kazakhstan, Lithuania,

Germany, Norway, Sri Lanka, South Africa. Within the Erasmus+ program, incoming students are not divided by particular programmes, as they choose the study courses offered by the faculty study programs themselves. The increase in foreign students in the study direction shows that the study programmes and study courses in English are becoming increasingly more in demand in the international environment.

Generally, the number of foreign students in study programmes “Environmental protection” is expected to increase considerably compared to the students applying to study in the study programmes “Environmental Science”. There are several reasons for that:

- **more attractive and specific name of study programmes**. Foreign students were misled by the name of the study programme “Environmental Science”, which by its sounding badly reflected the nature of engineering study directions implemented by RTU IESE and thus requested additional explanatory work with potential students in the process of their recruitment and enrolment. The name of environmental engineering study programmes (“Environmental Engineering”) is widely used and is recognisable by potential foreign students.
- RTU as the university implementing high quality study programmes is gaining **increasing international visibility** and opening of RTU Study Information Centres in several countries (Uzbekistan, India, Sri Lanka, Turkey).
- **The information and advertising activities for attraction of foreign students** performed within SO 8.2.1 project in the new study programmes “Environmental Engineering”, incl. preparation of audio-visual materials, posting of information on RTU and related websites in accordance with the language of instruction of study programmes, dissemination of information at education supply events in Latvia and abroad.
- **The international visibility and professionalism of RTU IESE**, demonstrated by academic and scientific research activities, will contribute to the attraction of new students from universities of cooperation partners, as well as the attraction of new students through the recommendations of graduates of RTU study programmes.
- **Publicity and information activities of RTU** for attraction of foreign students, including international summer schools.

The Table shows the forecasts for the proportion of foreign students in the “Environmental Engineering” study programmes of all levels (Bachelor, Master and doctoral). The attraction of students to the new study programmes is expected to take place gradually with the development of campaigns to popularise the new study programmes. In the year of studies 2020/2021, due to the entry restrictions caused by COVID-19, the attraction of foreign students to study programmes was at a lower level than expected: no students were enrolled in Bachelor studies, one student was admitted to Master studies (i.e. 2% of all students enrolled to Master studies) and 1 students was enrolled to doctoral studies, representing 10% of all doctoral students enrolled.

Table: *Forecasts of the share of foreign students in study programmes “Environmental engineering”*

Study programme	Year of studies				
	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
Academic **Bachelor's** study programme "Environmental Engineering"	5% (actual 0 %)	15%	25%	40%	50%
Academic **Master's** study programme "Environmental Engineering"	5% (actual 2 %)	15%	25%	40%	50%
Doctoral study programme "Environmental Engineering"	0% (actual 10 %)	20%	25%	30%	35%

In the reporting period, 82 students of the study direction "Environmental protection" used exchange studies in the Erasmus+ mobility programmes. Furthermore, 13 students used the Erasmus internship exchange opportunities in foreign countries in 2015-2020.

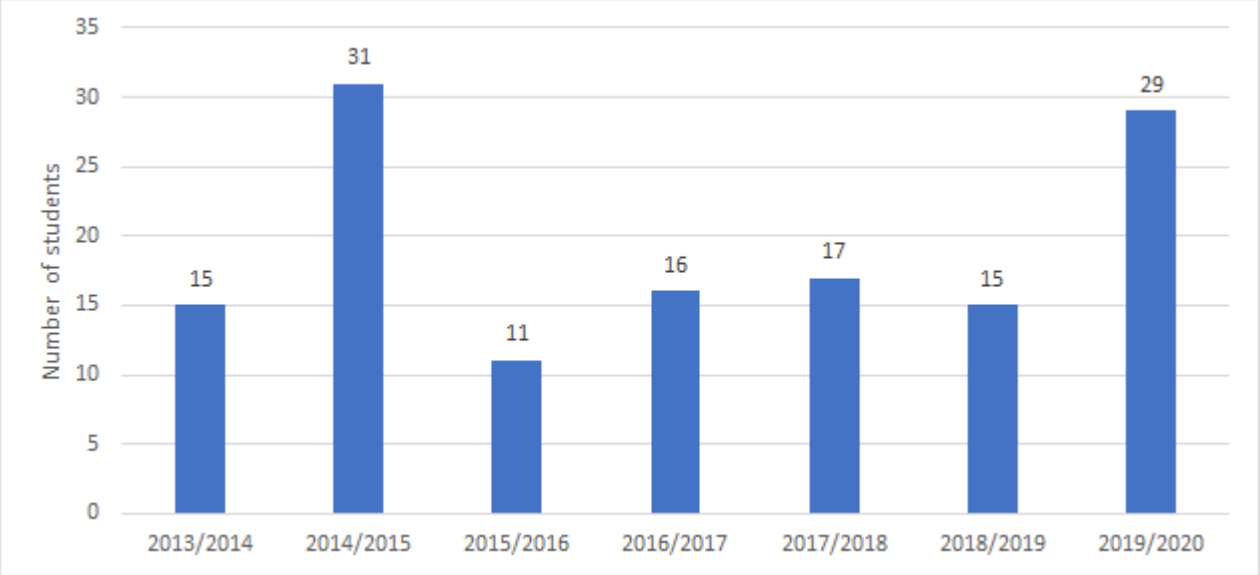

Figure: *Changes in the number of study mobility of students in the study direction in the period from academic year 2013/2014 to academic year 2019/2020.*

In 88% of cases students went to Lithuania, 6% – to Portugal and 2% to Norway, the Netherlands and Iceland each. The choice of mobility countries is linked to the implementation of similar study programmes at universities of these countries. In all cases, there is an equal share of women and men who go to study mobility. On the other hand, in terms of the duration of mobility, most frequently (53%) it lasts 3 to 6 months.

Internship mobility is not particularly popular among students because study programmes of the study direction "Environmental protection" are academic programmes. However, in recent years (2015-2020), Master and doctoral students have started to choose it as well. In 46% of cases students went to Lithuania, 15% went to Slovenia and 15% to Denmark, 24% to Portugal, the Netherlands and Italy. The choice of countries for internship mobility is linked to available internship places in industry companies in these countries. In all cases, there is an equal share of women and men who go to study mobility. On the other hand, in terms of the duration of mobility, most frequently (38%) it lasts 3 months.

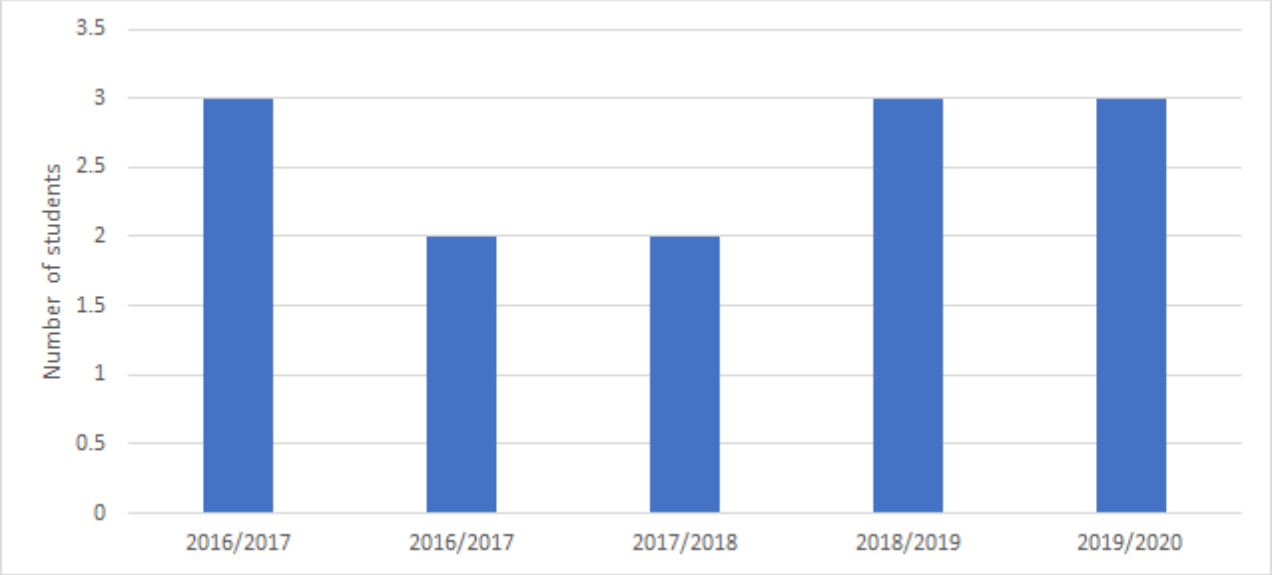

Figure: *Changes in the number of Erasmus+ internship mobility of students in the study direction in the period from academic year 2013/2014 to academic year 2019/2020.*

Apart from participation in international exchange programme, students can also make educational trips to foreign countries within the scope of the direction. RTU IESE students also actively participate in summer schools and other student mobility activities organised by different universities.

- On 9-11 November 2016, K. Bāliņa, a doctoral student of the study programme "Environmental Science" participated in the summer school "Microalgae based processes: upstream and downstream" (Lisbon, Portugal), where she obtained knowledge of the cultivation and pre-processing of microalgae for their further use in economic sectors. The topic of the summer school was fully in line with the topic of her doctoral thesis and made a valuable contribution to the drafting of the doctoral thesis.
- On 5-11 March 2017, M. Feofilovs, doctoral student of the study programme "Environmental Science" participated in the summer school "BISS 2017 – Bertinoro International Spring School 2017". The summer school was focused on the use of approximation algorithms to solve problems. The knowledge learned at the summer school has been successfully integrated in drafting of a doctoral thesis on mitigation of disaster risks.
- In June 2013, L. Timma, a doctoral student in the study programme "Environmental Science" participated in the summer school "Energy perspectives: Present and Future Technologies" in Zurich, Switzerland. 30 students from around the world through a competition had the opportunity to familiarise themselves with lectures on solar and wind energy, hydrogen, provided by top-level international university teachers. Participants visited several important Swiss energy-producing sites, such as the Mont-Soleil solar power plant, the Mont Crosin wind power plant and the Innertkirchen hydroelectric power plant. The programme also included visits to the PSI, EPFL, NAGRA rock lab and Alstom rotor factory in Birr.

Information on the involvement of foreign academic staff is provided in section 3.6.

5.3. In the event that the study programme entails a traineeship, provide a description of the traineeship options offered to the students, as well as the provision, and work organisation. Specify whether the higher education institution/ college provides assistance in finding traineeships.

The Bachelor level study programme “Environmental Engineering”,, as one of the courses in the block of elective study courses, also offers the “Internship” course (2 CP or 4 CP). Annex "Internship management procedure" contains a revised Senate decision of 2019 on the Internship Organisation Procedure at RTU. The internship organisation procedure provides that the internship coordinator in the organisational unit helps to provide students with an internship. If additional help is necessary, it is possible to go to Career Support and Services Division, where a career adviser and a project manager helps students to search and contact internship places, as well as promotes the development of career skills, which may provide successful results in the process of internship, using different events. Once a year, the Career Support and Services Division organises the RTU Career Day, when students can meet company representatives in person and communicate in future opportunities. More information about the event and participants of the previous years is available at https://www.rtu.lv/lv/studentuserviss/karjeras-centrs-ssc/karjeras-diena in Latvian).

An additional resource developed in 2015 is a website that invites companies to post vacancies that are relevant to RTU students (https://ekarjera.rtu.lv/). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

Foreign students have the same practice opurtunities as native latvian students.

RTU Development Fund provides additional support for practical skills promotion (https://www.rtu.lv/en/developmentfund). Several hundred competitions were held for promotion of practical skills over the year which were organised in cooperation with companies offering students an opportunity to learn practical skills.

In addition, within the study direction “Environmental protection” (at academic Bachelor study level, where the “Internship” study course (2 CP or 4 CP) is offered), students are provided with an opportunity to have internship in RTU IESE cooperation companies (for example, the companies, with which the study direction has been cooperation in part of scientific research or contract work for a long time) or in RTU IESE scientific laboratories. For example, in the period from 2017 to 2020, 21 students chose the “Internship” course, 7 students used the opportunity to have internship in RTU IESE scientific laboratories, and 5 of them continued working at RTU IESE after they obtained their Bachelor degree.

There is no internship for Master and doctoral students. Summary of statistical data on the number of Bachelor students, who chose internship in the block of elective study courses, as well as internship places, are provided in Annex "Student's internship companies".

5.4. In the event that joint study programmes are implemented in the study direction, provide the justification of the creation of the joint study programmes and a description and assessment of the selection of the partnering higher education institutions by including information on the principles and the procedures for the creation and implementation of these joint study programmes. In the event that no joint study programmes are implemented in the study direction, provide a description and assessment of the plans of the higher education institution/ college for the creation of such study programmes within the study direction.

The development and implementation of joint study programmes are governed by "Procedure for

the application, elaboration and amendment of the study programmes" (see the file of Appendix 06 of the list of Internal regulations). The choice of partner higher education institutions is the responsibility of the initiator of the joint study programme development, in agreement with the Study Direction Committee and RTU Vice-Rector for Academic Affairs.

Currently, there are no joint study programmes in the study direction “Environmental protection”. However,

- Since 2011, when implementing the Master’s study programme “Environmental science” (volume of the study programme is 80 CP or 120 ECTS), RTU IESE has been cooperating with the Vilnius Gediminas Technical University (VGTU) in Lithuania by implementing a Master level study programme “Environmental Engineering” (120 ECTS). A precondition for the creation of a double diploma programme in the field of environmental protection between RTU and VGTU was similarity of implemented study programmes, previous positive experience in the implementation of the study process (visiting lectures, mobility of students and teaching staff, etc.). Within the scope of the cooperation, when starting studies, RTU and VGTU students have the opportunity to apply for a double diploma programme. Cooperation takes place in the implementation of joint study courses and jointly leading graduation Master theses. The dynamics of graduates in the double diploma programme is shown in the Figure. The number of students is variable and depends on motivation of students and on financial opportunities to study in both universities. A limiting factor for studies of VGTU studies at RTU frequently is insufficient level of English, while for RTU students it is impossibility to combine studies in Vilnius with work. References of graduates on the double diploma programme are positive: students recognise that a diploma of other country provides a better competitiveness in the labour market. For example, in 2018, the RTU students and graduate of the double diploma programme M. Megne after graduation found work in Kaunas (Lithuania).

By continuing successful double diploma cooperation between RTU and VGTU, there are intentions to develop a joint Master study programme “Environmental Engineering”.

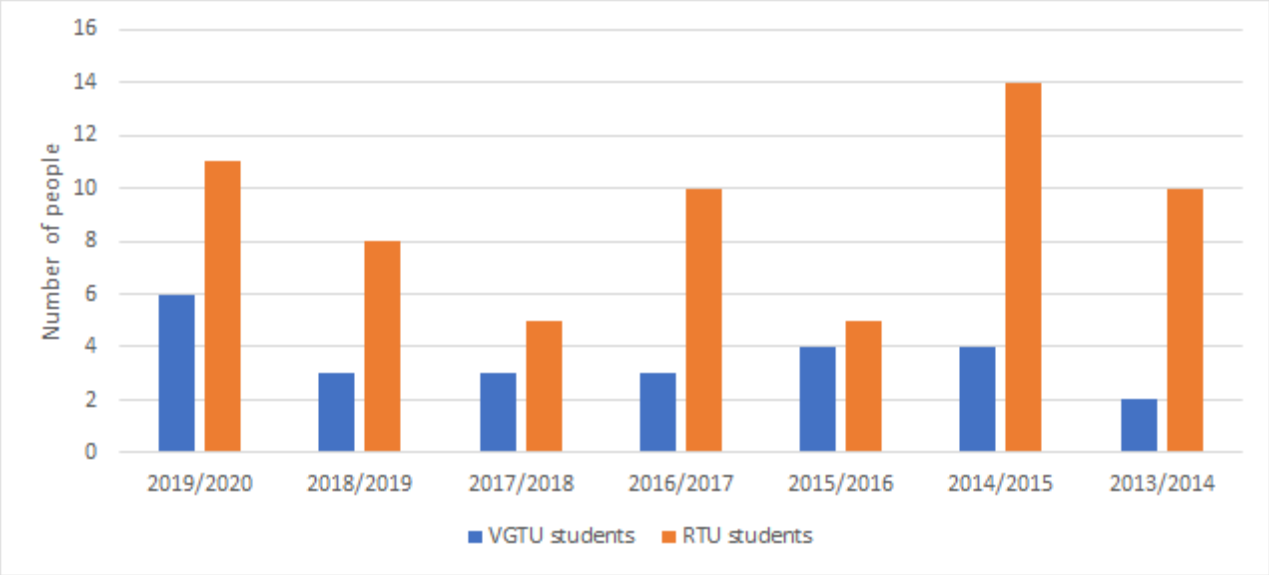

Figure: *The dynamics of graduates of the Master level cooperation programme between RTU and VGTU (Lithuania).*

In 2019, talks started with the Kaunas University of Technology (Lithuania) o the creation of a joint study programme at doctoral level. The choice in favour of Kaunas University of Technology (Lithuania) is justified by the themes of scientific research papers, scientific capacity of the

university, as well as is based on previous positive experience in mobility of doctoral students between RTU and the Kaunas University of Technology.

II - Description of the Study Direction (6. Implementation of the Recommendations Received During the Previous Assessment Procedures)

6.1. Assessment of the fulfilment of the plan regarding the implementation of the recommendations provided by the experts during the previous accreditation of the study direction, as well as the assessment of the impact of the given recommendations on the study quality or the improvement of the study process within the study direction and the relevant study programmes.

The summary of recommendations provided by experts in the previous accreditation of the study direction and their fulfilment is provided in the Table below.

Recommendation	Implementation
To increase funding for the study direction	Funding of the study direction has quadrupled since 2013. The increase was achieved through the attraction of funding for scientific projects, contract work, tuition fees of international students and performance funding for science.
To improve the material and technical provisions of the study process (premises, equipment, access to scientific databases)	Since 2014, the implementation of the study direction takes place in the RTU Student Campus on Ķīpsala, in the new FEEE building. Compared to the areas available at Kronvalda bulvāris 1, the areas of RTU IESE for the study process and scientific laboratories is 12 times bigger. Since 2013, RTU has considerably developed access to scientific databases. Continuous work takes place on the new databased, purchasing of literature.
To promote the development of a joint study programme “Environmental Engineering” in Latvia	Within joint academic events with those Latvian universities, where “Environmental Engineering” study programmes are implemented, the matter of the analysis of opportunities for creation of a joint study programme has become topical. The analysis conducted so far points out to different thematic profiles in study programmes of each universities, as well as in the matter of combining study programmes each of the universities primarily focuses to consolidation of study programmes within the university.

The provided recommendations and their implementation allowed to improve the quality of studies, expand the directions of scientific research, which in turn allowed to offer students new laboratories and practical works and improved the quality of the experimental part of bachelor's, master's and

doctoral theses. The improvement of the material and technical base of the study program has allowed to achieve better quality indicators in the scientific work and study process, as well as has increased the satisfaction of the academic staff and employees with the work and study environment and available resources.

6.2. Implementation of the recommendations given by the experts during the evaluation of the changes to the relevant study programmes in the respective study direction or licensed study programmes over the reporting period or recommendations received during the procedure for the inclusion of the study programme in the accreditation form of the study direction (if applicable).

Three new study programmes were licenced in the study direction “Environmental protection” in the reporting period:

- Academic Bachelor’s study programme “Environmental Engineering” (licenced on 27.04.2020)
- Academic Master’s study programme “Environmental engineering” (licenced on 27.04.2020)
- Doctoral study programme “Environmental Engineering” (licenced on 27.04.2020)

The recommendations provided by the licencing committee and their implementation are summarised below.

The recommendations provided by the Licensing Commission and their implementation have allowed to improve the quality of the study process.

Recommendation	Implementation

To continue to develop and regularly evaluate language skills of teaching staff in order to ensure a better quality study process and raise knowledge above minimum B2.	Associate professors and professors of RTU IESE speak English fluently. The high Hirsch index from 5 to 19 of teaching staff cannot be obtained without good English knowledge. The knowledge of languages of the teaching staff involved in the study programme is continuously improved in the following ways: • Participation in international conferences (they are invited to participate in plenary sessions and discussions). • Participation in international research projects (in *H2020* and *Interreg* programmes). • During *Erasmus* and *Erasmus+* exchange trips to foreign cooperation universities, where teaching staff's English-language skills are also improved. • Developing scientific articles in high-level anonymously reviewed journals and analysing language editor's and reviewers' suggestions for article language improvements. • Participation in English trainings (e.g. currently, the RTU provides teaching staff with both an English-language tests and an improvement in the level of training by implementing the SO 8.2.2 project). Following expert recommendations, an action plan for improving language skills of teaching staff has been developed for RTU IESE. This includes attendance of training courses, including within the SO 8.2.2 project. (responsible persona – SO 8.2.2. coordinator L.Sniega).

To ensure long-term planning for the maintenance and renewal of research laboratory equipment and devices.	Implementers of the study programme with evaluate the possibility and implementation mechanism to ensure long-term planning for the maintenance and renewal of research laboratory equipment and devices. Currently work is ongoing on the development of the Environmental Management System for RTU IESE scientific research laboratories (in accordance with LVS EN ISO 14001:2017), thus updating and supplementing the RTU IESE Environmental Management System Manual, which has been used since 2007. We will familiarise the developers of the RTU IESE Environmental Management System Manual with expert recommendations to be able to integrated this recommendations for successfully in the daily work of RTU IESE laboratories. At university level, there already exists the UseScience system for maintenance of research laboratory equipment and devices, which provides for more efficient use of equipment and devices of research laboratories of the university. Following expert recommendations, we will propose to supplement the *UseScience* platform with long term planning tools for maintenance and renewal of research laboratory equipment and devices. Following expert recommendations, RTU IESE has drafted an operating strategy for long-term planning of maintenance and renewal of research laboratory equipment and devices and a responsible employee (M.Dzikēvičs) has been designated.

RTU management should consider the possibility to provide separate support staff in research laboratories to promote long-term service of research equipment and effective use of resources.	The implementers of the study programme will consider the possibility to provide separate support staff in research laboratories to promote long-term service of research equipment and effective use of resources. Currently work is ongoing on the development of the Environmental Management System for RTU IESE scientific research laboratories (in accordance with LVS EN ISO 14001:2017), thus updating and supplementing the RTU IESE Environmental Management System Manual, which has been used since 2007. We will familiarise the developers of the RTU IESE Environmental Management System Manual with expert recommendations to be able to integrated this recommendations for successfully in the daily work of RTU IESE laboratories. RTU IESE has acquainted the RTU management with the expert opinion and an in-depth analysis of implementation of the proposed recommendation is taking place.

To evaluate the transfer of the administration of IESE library stocks to the RTU Scientific Library.	The management of RTU IESE has acquainted the teaching of IESE with the expert opinion. It was decided to carry out an in-depth analysis of the implementation of the proposed recommendation, identifying its strengths, weaknesses, opportunities and threats and their multiple-criteria analysis. In addition, a survey of Master and doctoral students (as part of the survey of graduates) has been carried out with a view to learning whether students would support such an approach. The survey results show that 19% were FOR, 64% were AGAINST, and 17% did not have an opinion on this initiative.
To regularly integrate current labour market trends and research topics into the content of the programme, to promote closer cooperation with labour market representatives	Following the expert recommendations, at the meeting in August 2020 the management of the study direction emphasised the need for teaching staff to regularly integrate current labour market trends and research topics into the content of the programme, to promote closer cooperation with labour market representatives. (responsible person - head of the department). It should be added that labor market trends and labor market representatives are regularly invited to participate in the implementation of study courses at various levels (guest lectures, practical and laboratory works, co-supervision of final theses, etc.).

To ensure regular visits and lectures of visiting professors, visiting lecturers, etc. (both academic environment and industry representatives from Latvia and foreign countries) on pressing topics, pedagogical and scientific challenges.	When developing the new RTU IESE strategy for 2021-2025, as goal was set to promote visits and lectures of visiting professors, visiting lecturers, etc. on pressing topics, pedagogical and scientific challenges. Short-term and long-term indicators for the achievement of the goal have been set in order to facilitate their implementation. Person responsible for documenting the implementation of the accounting system - A.Kalnbaļķīte. In addition, visiting professors, guest lecturers, etc. (both academic and industry representatives from Latvia and abroad) visits and lectures on hot topics, pedagogical and scientific challenges are also provided by implementing SO 8.2.2. within the project (responsible person - SO 8.2.2. coordinator L.Sniega).
To integrate in the results of the study programme the requirement to participate in experience exchange visits, courses or traineeship abroad related to their scientific work, to provide all students with available support for the implementation of this requirement	RTU IESE has acquainted the RTU management with the expert opinion and an in-depth analysis of implementation of the proposed recommendation and a search for support instruments are taking place. Person responsible for implementation - head of the department.
To ensure regular cooperation with foreign and Latvian academic and scientific institutions, in which similar research directions are implemented	RTU IESE has regular cooperation with foreign and Latvian academic and scientific institutions, in which similar research directions are implemented. It is implemented through joint scientific cooperation projects, publications, organisation of conferences and seminars, etc. Person responsible for implementation implementation - A.Kalnbaļķīte

To create a plan for regular improvement of scientific and pedagogical qualifications of the teaching staff involved in the implementation of the study programme and to begin its implementation.	RTU IESE has drafted a plan for regular improvement of scientific and pedagogical qualifications of the teaching staff involved in the implementation of the study programme and has begun its implementation. In addition, the regular raising of the scientific and pedagogical qualification of the teaching staff involved in the implementation of the study program takes place in following levels: • Election of teaching staff to vacant positions, within the framework of which the teaching staff must continuously prove the improvement of the scientific and pedagogical qualification of its academic activity. • When implementing SO 8.2.2. within the project (responsible person - SO 8.2.2. coordinator L.Sniega).

Annexes

I. Information on the Higher Education Institution/ College		
List of the governing regulatory enactments and regulations of the higher education institution/ college	List of the main internal normative acts and regulations.zip	Galveno_normativo_aktu_saraksts.zip
Information on the implementation of the study direction in the branches of the higher education institution/ college (if applicable)		
Management structure of the higher education institution/ college	RTU_strukturvienibas_jan2021_EN.pdf	RTU_strukturvienibas_jan2021_LV.pdf
II. Description of the Study Direction - 1. Management of the Study Direction		
Plan for the development of the study direction (if applicable)	Study direction development plan.pdf	Studiju virziena attīstības plāns.pdf
Management structure of the study direction	RTU Study Direction Management Structure.pdf	RTU studiju virziena parvaldibas struktura.pdf
II. Description of the Study Direction - 3. Resources and Provision of the Study Direction		
Basic information on the teaching staff involved in the implementation of the study direction	Basic info of involved teaching staff.xlsx	Pamatinfo par iesaistītajiem mācībspēkiem.xlsx
Biographies of the teaching staff members (in Europass Curriculum Vitae format)	CV_eng.zip	CV_lv.zip
Summary of the statistical data on the incoming and outgoing mobility of the teaching staff over the reporting period	Incoming_outgoing mobility of teaching staff.pdf	Ienākošā_izejošā mācībspēku mobilitāte-converted.pdf
II. Description of the Study Direction - 4. Scientific Research and Artistic Creation		
List of the publications, patents, and artistic creations of the teaching staff over the reporting period	List of publications and patents of teaching staff.pdf	Mācībspēku publikāciju un patentu saraksts.pdf
II. Description of the Study Direction - 5. Cooperation and Internationalisation		
List of cooperation agreements	List of Corporate Agreements.pdf	Sadarbibas ligumu saraksts.pdf
Statistical data on the teaching staff and the students from abroad	Statistical data on foreign students.pdf	Statistikas dati par ārvalstu studējošajiem.pdf
Statistical data on the mobility of students (by specifying the study programmes)	Statisitical data on student mobility.pdf	Statistikas dati par studējošo mobilitāti.pdf
Description of the organisation of the traineeship of the students	Internship management procedure.pdf	Prakses organizēšanas kārtība.pdf
Information on the agreements and other documents confirming the traineeship of the students in companies	Student's internship companies.pdf	Studejoso prakses nodrosinajums.pdf
II. Description of the Study Direction - 6. Implementation of the Recommendations Received During the Previous Assessment Procedures		
Overview of the implementation of the provided recommendations	Report on the implementation of recommendations.pdf	Rekomendāciju ieviešanas pārskats.pdf
Description of the Study Programme - Other mandatory attachments		
Confirmation signed by the rector, director or the head of the study programme or the study direction of the higher education institution/ college which states that the official language proficiency of the teaching staff involved in the implementation of the relevant study programmes of the study direction complies with the regulations on the level of the official language knowledge and the procedures for testing official language proficiency for performing professional duties and office duties.	02000-2.2.1-e_23.edoc	02000-2.2.1-e_23.edoc
III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	4.0.Statistikas dati_mag_LV+ENG.pdf	
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard		
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme		
Curriculum of the study programme (for each type and form of the implementation of the study programme)		
Descriptions of the study courses/ modules		
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.		
Description of the Study Programme - Other mandatory attachments		
Document confirming that the higher education institution/ college will provide the students with the options to continue the acquisition of education in another study programme or at another higher education institution/ college (a contract with another accredited higher education institution/ college), in case the implementation of the study programme is discontinued		

Document confirming that the higher education institution/ college guarantees to the students a compensation for losses if the study programme is not accredited or the licence of the study programme is revoked due to the actions of the higher education institution/ college (actions or failure to act) and the student does not wish to continue the studies in another study programme		
Confirmation of the higher education institution/ college that the teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language according to European language levels (see the levels under www.europass.lv), if the study programme or any part thereof is to be implemented in a foreign language.		
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education		
Sample (or samples) of the study agreement		
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.		
Description of the Study Direction - Other mandatory attachments		
Electronically signed application form for assessment of a study direction	01000-2.2.1-e_137.edoc	01000-2.2.1-e_137.edoc

Other annexes

Name of document	Document
Bakalaura studiju programmu salīdzinājums	Bakalaura studiju programmu salīdzinājums.pdf
Maģistra studiju programmu salīdzinājums	Maģistra studiju programmu salīdzinājums.pdf
Doktora studiju programmu salīdzinājums	Doktora studiju programmu salīdzinājums.pdf
Caurviju izglītības pieeja caur studiju rezultātiem	Caurviju izglītības pieeja caur studiju rezultātiem.pdf
RTU VASSI stratēģiskie darbības virzieni	RTU VASSI stratēģiskie darbības virzieni.pdf
Transversal approach to education.pdf	Transversal approach to education.pdf
Comparison of bachelor study programs	Comparison of bachelor study programs.docx
Comparison of master's study programs	Comparison of master's study programs.docx
Comparison of doctoral study programs	Comparison of doctoral study programs.docx
Studiju kursu kartējums_doktori	Studiju kursu kartējums_doktori.docx
Mapping of the study courses_doctors	Mapping of the study courses_doctors.docx
RTU IESE strategic action lines	RTU IESE strategic action lines.pdf
Studiju virziena komisijas satāvs	Studiju virziena komisijas satāvs.pdf
Composition of the Study Direction Committee	Composition of the Study Direction Committee.pdf
Studiju programmu pašnovērtējuma darba grupas	Studiju programmu pašnovērtējuma darba grupas.pdf
Study programmes self-evaluation working groups	Study programmes self-evaluation working groups.pdf
RTU IT sistēmu saskarsnes	RTU IT sistemu saskarnes.zip
Screenshots of RTU IT systems	Screenshots of RTU IT systems.zip
Maģistrantūras uzņemšanas noteikumi ar grozījumiem	Magistranturas uznemsanas noteikumi ar grozijumiem.docx
Regulations for Admission to Master's Studies with Amendments	Regulations for Admission to Master's Studies with Amendments.docx
Doktorantūras uzņemšanas noteikumi ar grozījumiem	Doktorantūras uzņemšanas noteikumi ar grozījumiem.docx
Regulations for Admission to Doctoral Studies with Amendments	Regulations for Admission to Doctoral Studies with Amendments.docx
Bakalaura studiju kursu atzīšanas saraksts	Bakalaura studiju kursu atzīšanas saraksts.docx
List of recognition of bachelor courses	List of recognition of bachelor courses.docx
Maģistra studiju kursu atzīšanas saraksts	Maģistra studiju kursu atzīšanas saraksts.docx
List of recognition of master's courses	List of recognition of master's courses.docx
Doktora studiju kursu atzīšanas saraksts	Doktora studiju kursu atzīšanas saraksts.docx
List of recognition of doctoral courses	List of recognition of doctoral courses.docx
RTU Studējošo priekšlikumu un sūdzību iesniegšanas un izskatīšanas kārtība	RTU_studeoso_priek_un_sudz_iesn_un_izsk_kart.pdf
Procedure for Submission and Examination of RTU Students' Proposals and Complaints	RTU_proposals_complaints.pdf
Stud_progr_Vides_inzenierija_akad_bak.pdf	Stud_progr_Vides_inzenierija_akad_bak.pdf
Study_program_Environmental_Engineering_bach.pdf	Study_program_Environmental_Engineering_bach.pdf

Stud_progr_Vides_inzenierija_akad_mag.pdf	Stud_progr_Vides_inzenierija_akad_mag.pdf
Study_ program_Environmental Engineering_mast.pdf	Study_ program_Environmental Engineering_mast.pdf
Stud_progr_Vides_inzenierija_dokt.pdf	Stud_progr_Vides_inzenierija_dokt.pdf
Study_programm_Environmental Engineering_doc.pdf	Study_programm_Environmental Engineering_doc.pdf

Environmental Engineering (51529)

Study field	*Environmental Protection*
ProcedureStudyProgram.Name	*Environmental Engineering*
Education classification code	*51529*
Type of the study programme	*Doctoral study programme*
Name of the study programme director	*Dagnija*
Surname of the study programme director	*Blumberga*
E-mail of the study programme director	*dagnija.blumberga@rtu.lv*
Title of the study programme director	*Dr.habil.sc.ing.*
Phone of the study programme director	*29419783*
Goal of the study programme	*The aim of the doctoral study programme is to acquire a doctoral scientific degree in the field of environmental engineering and energy science and to prepare internationally competitive higher qualifications for academic and scientific work in universities, research centres, as well as organisational work in public and private institutions.*
Tasks of the study programme	*- carrying out independent research work to obtain a doctoral degree on the selected topic in the field of environmental engineering and energy, and to reflect the results of scientific studies in scientific publications and present them to scientists and decision-makers;* *- within the framework of the study program, in post-graduate studies and in the system for obtaining a doctorate, in lectures, practical and laboratory activities, and in independent studies, using basic and applied scientific achievements, acquiring in-depth theoretical knowledge in the environmental research methodology;* *- acquiring skills through modern research methods, performing high-quality scientific research and providing advice on climate and environmental technologies and energy supply systems;* *- acquiring the skills to manage and develop sustainable development processes at the level of the industrial and energy sector or scientific institutions;* *- promoting the introduction of scientific research in manufacturing and public and private enterprise management;* *- improving teaching skills.*

Results of the study programme	*Graduate of the study programme:* *- is capable of carrying out independent, critical analysis and synthesis, identifying causation, providing evaluation, addressing significant research challenges and developing innovative solutions in the fields of environmental engineering and energy and related interdisciplinary areas;* *- contributes to the extension of knowledge borders or gives new understanding to existing knowledge and their use in practice;* *- is able to successfully present, plan, structure, manage and conclude large-scale scientific studies, including in the international context, the environmental engineering and energy sectors and related industries;* *- is able to carry out an essential original study and present the achievements of these projects to the scientific community (high-level internationally quotable scientific publications, participation in scientific conferences);* *- is capable of developing, validating and introducing new research methods to mitigate impacts on the environment and climate change;* *- demonstrates considerable authority and take responsibility for the ethical aspects of his or her research activities;* *- is able to manage and implement the academic process (development, management, evaluation);* *- is able to independently increase his or her scientific qualifications and manage research or development tasks in companies, institutions and organisations where extensive research knowledge and skills are needed.*
Final examination upon the completion of the study programme	*Defence of the doctoral thesis (dissertation) in the promotion council.*

Study programme forms

Full time studies - 4 years - latvian

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*192*
Admission requirements (in English)	*An academic degree or a fifth level professional qualification and a professional master's degree in engineering and technology, social and human sciences, law science, life sciences, physical sciences, mathematics and statistics, computing, manufacturing and processing, architecture and construction, agriculture, forestry and equivalent education. Doctoral candidates are evaluated according to criteria that characterize the quality of research work, participation in local and international projects, the applicant's contribution to the provision of research and pedagogical work at the faculty of Energy and Electrical Engineering.*

Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (PhD) in Environmental Engineering and Energy*
Qualification to be obtained (in english)	-

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 4 years - english

Study type and form	*Full time studies*
Duration in full years	*4*
Duration in month	*0*
Language	*english*
Amount (CP)	*192*
Admission requirements (in English)	*An academic degree or a fifth level professional qualification and a professional master's degree in engineering and technology, social and human sciences, law science, life sciences, physical sciences, mathematics and statistics, computing, manufacturing and processing, architecture and construction, agriculture, forestry and equivalent education. Proof of English language knowledge is required.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Doctor of Science (PhD) in Environmental Engineering and Energy*
Qualification to be obtained (in english)	-

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The doctoral study program “Environmental engineering” (hereinafter referred to as the Study Program) is being implemented at Riga Technical University from September 2020. Graduates of the study program will get a doctoral science degree (Ph.D.) in the field of science “Environmental engineering and energy”. The doctoral study program “Environmental Engineering” is licensed at 27.04.2020. The scope and duration of the study program is 192 CP. The means of implementation are full-time presence only (4 years). The place of implementation of the study program wis Riga. It is not implemented by the RTU branches. The study program is implemented in Latvian and English.

According to the decision of the licensing commission, changes have been made to the content of the doctoral study program “Environmental Engineering”. Experts recommended “integrating programs into the mandatory part of a variety of general skills that are essential to graduates of doctoral programs, such as academic writing skills. An insight into the skills learned in paragraph 8 of the Salzburg Principles”.

For academic staff in the development of the study program, an evaluation of doctoral courses under the heading “Environmental Protection” showed that the course “EAS757 Doctoral garage: analysis and publication of scientific research results” met the requirements referred to by the experts. Accordingly, the compulsory part program also includes the study course “EAS603 Environmental Assessment” (9 CP).

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

The statistical data on students during the reference period for the doctoral program “Environmental engineering” has been constructed on the basis of the admission figures of the study year 2020/2021, the first year of admission for the “Environmental engineering” study program. However, in order to ensure the overall picture of the study program, the indicators previously achieved will be compared to the doctoral program “Environmental Science”, since the new research program “Environmental Engineering” is built on the basis of this program.

In the year of study 2020/2021, 10 students in the Latvian language flow and 1 student in the English flow have been enrolled in the study program. The figures show dynamics compared to those of all doctoral students enrolled in RTU and the share of those of “Environmental Science” (2013/2014-2019/2020) and “Environmental Engineering” (2021/2021 year of study) study

programs.

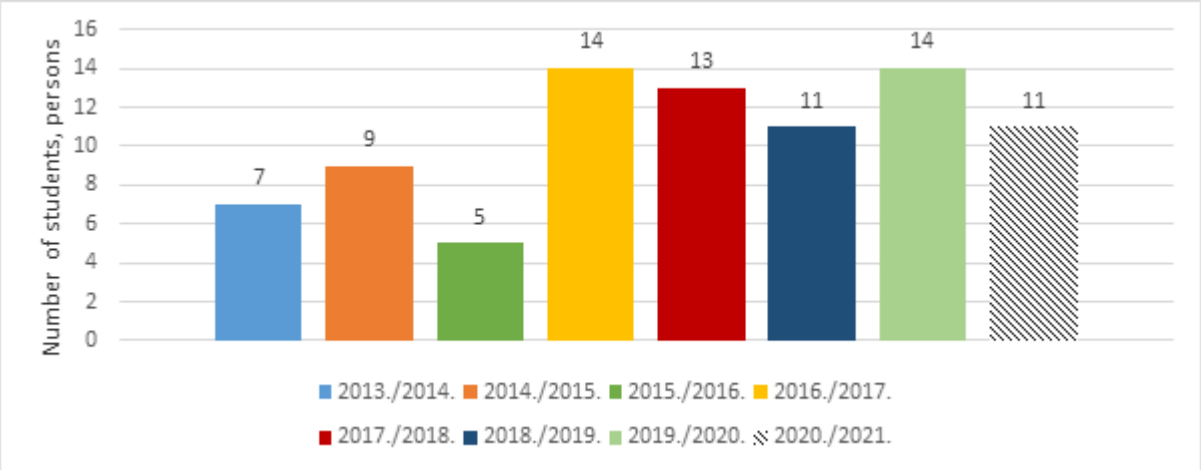

Figure: *Number of doctoral candidates (persons) admitted in "Environmental science"/"Environmental engineering".*

The variation in the number of students is related to:

- the number of students imatriated to the Master's degree study who are potential doctoral students.
- developments in the field of environmental engineering in Latvia, as well as global trends. According to the information provided by RTU IESE cooperation companies, there is also a lack of environmental protection specialists in Latvia.
- the social-economic situation, including employment, in the country.

A majority of students (up to 98%) have the possibility to study in the State financed budget places. For foreign students, studies take place for a fee.

Statistics on the Environmental Science study program show that up to 20% of students are deducted from studies each year during the reporting period. On the main reasons why students are leaving doctoral studies, students mention the employment of students outside the RTU and the inability to combine their studies with their work, which work in parallel with doctoral studies outside the RTU, and family conditions.

In analysing the dynamics of the number of students in relation to the developments of the sector in the world and the situation of Latvia, as well as the strategic objectives set by the Ministry of Education and Science for increasing the number of graduates of doctoral studies (thereby also the introduction of the potentially available support instruments in the future), the doctoral study program "Environmental engineering" provides a stable number of students and extensive development opportunities.

Table: *Estimates of the number of students in the doctoral level study program "Environmental engineering".*

	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
Students					
Admitted	12	14	16	20	22
% outside EU	0%	20%	25%	30%	35%
Drop-off (year-to-year)	5%	5%	5%	5%	5%
Total number of students	12	26	40	58	77
Annual tuition fee					
EU	9350	9350	9820	9820	10311
Outside EU	9350	9350	9820	9820	10311

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The doctoral study program “Environmental engineering” has been implemented in accordance with the Law on Higher Education (adopted on 02.11.1995), the Law on Scientific Activities (adopted on 19.5.2005), the Education Law (29.10.1998), the BOM Regulations “Procedures and Criteria for Granting a Doctors Scientific Degree (Promotion)” (adopted on 31.12.2005), RTU Constitution, RTU Senate decisions and the RTU's doctoral study statute. The program shall be implemented in accordance with the main lines of RTU research, as well as the preparation of a new generation of teaching staff and scientists, in accordance with BOM Order 95 “Guidelines for the Development of Education 2021-2027”. The development of the doctoral study program shall respect the documents of the European Qualifications Frameworks, compliance with the Bologna Process, the Salzburg Principles, etc. regulatory enactments.

The title of the doctoral study program is **“Environmental Engineering”.**

Students with an academic master's degree in engineering and technology or a fifth-level vocational qualification and a professional master's degree in engineering and technology and the equivalent education **shall be admitted** to the study program.

Degree to be obtained – doctoral scientific degree (Ph. D.) in the field of science “Environmental engineering and energy”.

The **aim** of the doctoral study program “Environmental engineering” is to acquire a doctoral scientific degree in the field of environmental engineering and energy science and to prepare internationally competitive higher qualifications for academic and scientific work in universities, research centres, as well as organisational work in public and private institutions.

The **tasks** of the doctoral study program shall include:

- carrying out independent research work to obtain a doctoral degree on the selected topic in the field of environmental engineering and energy, and to reflect the results of scientific studies in scientific publications and present them to scientists and decision-makers;
- within the framework of the study program, in post-graduate studies and in the system for obtaining a doctorate, in lectures, practical and laboratory activities, and in independent studies, using basic and applied scientific achievements, acquiring in-depth theoretical knowledge in the environmental research methodology;
- acquiring skills through modern research methods, performing high-quality scientific research

and providing advice on climate and environmental technologies and energy supply systems;
- acquiring the skills to manage and develop sustainable development processes at the level of the industrial and energy sector or scientific institutions;
- promoting the introduction of scientific research in manufacturing and public and private enterprise management;
- improving teaching skills.

Measurements of performance of tasks are the results of the examinations of the courses of studies provided for in the study plan, independently developed promotional work with significant theoretical relevance and potential for practical use, including original scientific results obtained by independent evaluation and selection of relevant methods of modern research, and providing new scientific knowledge in the field of environmental engineering and energy sciences. In addition to that, relevant competences relevant to the level of international achievements of the relevant scientific sector, corresponding to the upper limits of knowledge and enabling critical environmental engineering challenges to be addressed in research and innovation, enabling independent professional, scientific or academic activities to be launched, extending existing knowledge and providing a new understanding of environmental engineering and energy topics.

As a result of the acquisition of the study program, the graduate (**expected results**):

- is capable of carrying out independent, critical analysis and synthesis, identifying causation, providing evaluation, addressing significant research challenges and developing innovative solutions in the fields of environmental engineering and energy and related interdisciplinary areas;
- contributes to the extension of knowledge borders or gives new understanding to existing knowledge and their use in practice;
- is able to successfully present, plan, structure, manage and conclude large-scale scientific studies, including in the international context, the environmental engineering and energy sectors and related industries;
- is able to carry out an essential original study and present the achievements of these projects to the scientific community (high-level internationally quotable scientific publications, participation in scientific conferences);
- is capable of developing, validating and introducing new research methods to mitigate impacts on the environment and climate change;
- demonstrates considerable authority and take responsibility for the ethical aspects of his or her research activities;
- is able to manage and implement the academic process (development, management, evaluation);
- is able to independently increase his or her scientific qualifications and manage research or development tasks in companies, institutions and organisations where extensive research knowledge and skills are needed.

The objectives, taks and results of studies under the Environmental Engineering study program are interrelated and their reach is very high.

The program is in line with the basic setting of the Strategy and Development Program of Riga Technical University (RTU) for 2021-2027: ensure the implementation of the guiding themes of the National Development Plan for 2021-2027 – implement the “economic breakthrough” in Latvia. RTU is positioning itself as one of the cornerstones of Latvia's development, preparing specialists for the Latvian economy, as well as creating new products and services, serving as the basis for sustainable growth in Latvia. RTU Strategy includes key development settings for the RTU for the period up to 2025 as well as setting out the division of activities and responsibilities to be carried

out for the performance of the tasks to be performed.

In order to achieve the vision of the RTU to become an internationally competitive, dynamic and modern university of science and technology by 2025, the strategy sets out four university objectives: excellence in science, quality study process, sustainable valorisation and institutional excellence. Specific performance indicators are defined for these purposes.

The purpose of a quality study process is internationally competitive, analytical and creative-thinking specialists prepared in prestigious, internationally recognized high-quality studies, who ensure the development of the Latvian economy and who have the capacity to learn long-term. The aim of excellent research is high-quality scientific studies that meet the needs of Latvia and the international economy, are widely involved in international, national and sectoral research programs and are integrated into the study process. Sustainable valorisation aims at an efficient technology transfer and innovation development environment that promotes the creation of new technological companies and the creation of products.

The RTU Strategy for 2021-2025 can be consulted: https://files.rtu.lv/public/ortus/Strategija_RTU.pdf (Latvian only).

The study program is fully in line with the objective of the RTU Faculty of Electrical and Environmental Engineering strategy for 2014-2020 to become Latvia's leading internationally recognized study, science and innovation institution in the energy, electrical engineering and environmental science sectors, ensuring high quality study process, internationally recognised scientific research and sustainable innovation, commercialisation and knowledge transfer in the economy.

The RTU Institute of Energy Systems and Environment (IESE) has developed a concept for the development of the Department of Energy Systems and Environment (2016-2020), which includes four strategic objectives regarding the quality of the study process and awareness of the nature and quality of the program, the recognition of IESE as an international and local brand, the development of IESE as the leading institution in Latvia, offering scientific services in the fields of environmental protection and energy for the private sector and the improvement of the quality of the science of IESE. The implementation of the study program helps to achieve these objectives by preparing scientists in the fields of environmental engineering, energy, bioeconomy and environmental management.

Admission to doctoral study programs takes place on a competitive basis in accordance with the RTU Admission Regulations. Applicants are evaluated according to the following criteria: weighted average mark of the master's diploma supplement; publications and their scientific quality; participation in scientific research projects; participation in scientific conferences; scientific and pedagogical work at RTU.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour

market, and science. In case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation.

The study program was approved at the Senate meeting of the RTU on 25 November 2019, Protocol No 634.

The study program is licensed on 27.04.2020 (licence No.04051-183).

The means of implementation shall be **full-time presence**. The RTU standard programming for each study year shall be 2 semesters, each semester shall be 20 weeks, 16 weeks of study and 4 weeks of session. The **place of implementation** of the study program is Riga. The program is implemented in **Latvian and English**.

The program's relevance to the needs of the labour market and the employment of scientists in scientific institutes, as well as scientific trends, is supported by **the high and continuously increasing demand** for people with a PhD in all fields of engineering.

The content of study courses shall be renewed **at least once a year in line with the development of the environmental engineering industry, advice from external experts, labour market requirements, advice from the study direction board, etc.** For the renewal of the content of the study course, working groups involving the study program director, teaching staff, guest employers and doctoral students shall be organised.

For example, in 2013 an evaluation of scientific activities was carried out at the RTU, which noted the major shortcomings attributable to doctoral studies: studies and publications are nationally oriented, have little impact on the science sector and no publication in the top-level international editions, lack a publishing strategy. Following the evaluation of scientific activities, the "Scientific Action Strategy" was approved in 2013. Later, the strategies have been re-launched through the development and review of the RTU IESE strategy. In line with the renewed RTU IESE strategy, the development of the content of the "Environmental Engineering" doctoral program took place.

When hosting doctoral candidates for studies, promotion managers shall ensure that topics are consistent with EU research interests, research projects carried out by RTU IESE, as evidenced by the participation of many doctoral candidates in the realisation of various types of international projects (e.g. Horizon 2020, Erasmus+, etc).

Doctoral students in the "Environmental Protection" section of the RTU studies are leaders in the development of scientific results on the environmental engineering and energy sector in Latvia: opinions of promotion works are used in the development of national and EU policy documents, strategies, planning documents, integrated in the content of study courses, and studies initiated during doctoral work are continued in scientific projects and in industries. All teachers and doctoral candidates involved in the program shall participate in the realisation of international or local scientific or research projects. More information can be found in section 4.4.

The doctoral program, the study courses, includes issues related to the National Research and Innovation Strategy for the transformation of the economy "Smart Specialisation Strategy (RIS3) in research.

The promotion works include **the development of terminology** for the environmental sciences and energy sector, which complements the terms and definitions to be examined in the Terminology Committee of the Latvian Academy of Sciences. Following their approval, the relevant

terms are also integrated into study courses and scientific research.

Doctoral candidates in the study program actively participate in feedback with industry experts, the public, taking part in various publicity activities such as round table discussions, industry workshops, TV broadcasts and radio interviews. For example, Kriss Spalvins's interview on July 14, 2019 in LTV1's "Panorama" show about extracting fish oil from residues (https://www.lsm.lv/raksts/dzive--stils/tehnologijas-un-zinatne/rtu-zinatnieki-peta-iespejas-iegut-zivju-ellu-no-atkritumiem.a325613/ (Latvian only)) and doctoral candidates Baiba Ievina's and Kriss Spalvins's radio interview on 14 February 2019 in Latvian Radio 1 broadcast "Known in Unknown" on the use of biogas digestat in algae farming (https://lr1.lsm.lv/lv/raksts/zinamais-nezinamaja/petijums-rtu-biogazes-razosanas-atliekvielas-palidz-algu-audzesa.a114708/%C2%A0 (Latvian only)).

Graduates of the program are granted with doctoral scientific degree (PhD) in the field of science "Environmental engineering and energy", if the promotion work, which is an original completed study of significant importance in the environmental engineering sector, is defended. The impact of the results on the environmental engineering industry shows that PhD applicants have:

- at least one anonymously reviewed scientific publication in an edition indexed in the SCOPUS database, with a stated source impact indicator (Source Normalized Impact per Paper (SNIP)) on a publication or indexed in a database on the Web of Science for which an impact factor indicator is defined (Impact Factor (IP));
- anonymously reviewed scientific publications in scientific journals or conference reporting publications indexed in the database SCOPUS or Web of Science;
- a study carried out in one of the research projects;
- reports at international scientific conferences or seminars;
- modern data analysis and processing methods used in the study.

Graduates of the doctoral study programme of the RTU study direction "Environmental protection" usually considerably exceed the above-mentioned criteria. For example, the summary of data from the *SciVal* tool on graduates of the doctoral programme of academic year 2019/2020 of the doctoral study programme "Environmental Science", 8 graduates in total (list with graduates and topics of their doctoral theses can be found in section 2.5 of the description of the programme), leads to the conclusion that in the period from 2015 to 2020:

- the graduates drafted 99 publications in total, which are indexed in SCOPUS databases and were cited 472 times (the most cited publication (29 citations) is "*Raimonda Soloha, Ieva Pakere, Dagnija Blumberga, Solar energy use in district heating systems. A case study in Latvia, Energy, Volume 137, 2017, Pages 586-594.*").

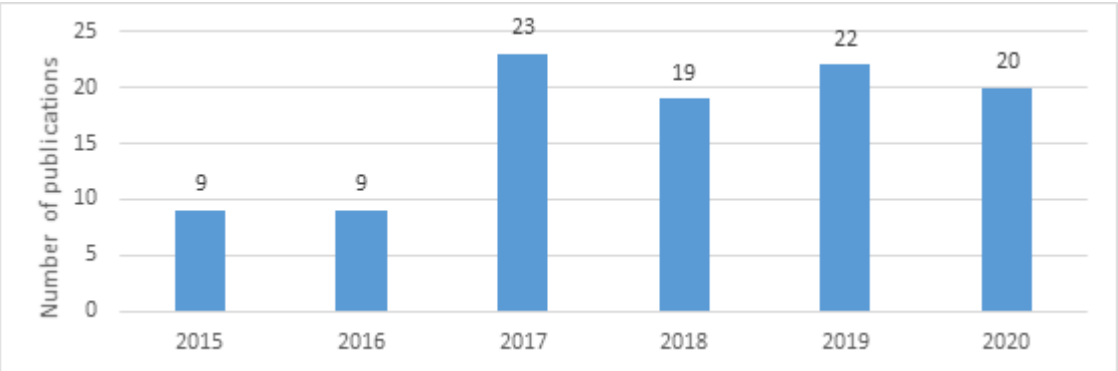

Figure: *Dynamics of SCOPUS indexed publications of graduates (8 persons) of the doctoral study programme "Environmental Engineering" in academic year 2019/2020 in 2015-2020 (data from the SciVal Tool).*

- 13.1 % of all publications are *in the top 10 % most cited publications worldwide*.

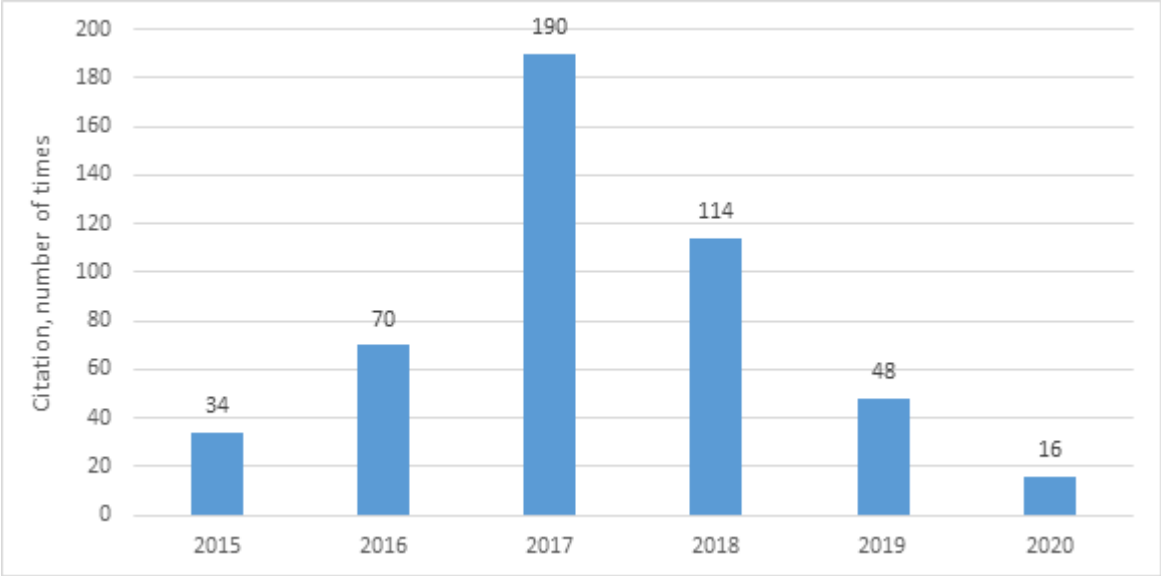

Figure: *Citation of SCOPUS indexed publications of graduates (8 persons) of the doctoral study programme "Environmental Engineering" in academic year 2019/2020 in 2015-2020 (data from the SciVal Tool).*

- The average citation of one publication is 4.8 and the Field-Weighted Citation Impact is 1.17.
- The graduates made a contribution to 44 research areas (according to the categories defined in *SciVal*), main of which are energy (46 %), engineering (9.9 %), material science and mechanical engineering (6.8 %), agricultural sciences and biology (5.6 %).
- The publications have also been developed jointly with other scientific institutions such as the Latvian State Institute of Wood Chemistry (Latvia), Vilnius Gediminas Technical University (Lithuania), Rudny Industrial Institute (Kazakhstan), the University of Göttingen (Germany), Cracow University of Technology (Poland) and industry companies – AS "Latvenergo".

A more detailed insight in the scientific excellence indicators of graduates of the doctoral study programme "Environmental Science" of 2019/2020 I. Pakere, who defended her doctoral thesis in June 2020, are provided below.

Scientific publications

1. ***Pakere I****., Blumberga D. Solar power or solar heat: What will upraise the efficiency of district heating? Multi-criteria analyses approach (2020) Energy 198, 117291. (SCOPUS, WoS)*
2. *Gravelsins A., **Pakere I**., Tukulis A., Blumberga D. Solar power in district heating. P2H flexibility concept (2019) Energy 181, 1023–1035. (SCOPUS, WoS)*
3. ***Pakere, I.****, Blumberga, D. Solar Energy in Low Temperature District Heating (2019) Environmental and Climate Technologies 23 (3), 147–158. (SCOPUS, WoS)*
4. *Feofilovs, M., **Pakere, I**., Romagnoli, F. Life Cycle Assessment of Different LowTemperature District Heating Development Scenarios: A Case Study of Municipality in Latvia (2019) Environmental and Climate Technologies 23 (2), 272–290. (SCOPUS, WoS)*
5. *Tukulis A., **Pakere I.**, Gravelsins A., Blumberga D. Methodology of system dynamic approach for solar energy integration in district heating (2018) Energy Procedia, 147, 130–136. (SCOPUS)*
6. ***Pakere, I.****, Lauka, D., Blumberga, D. Solar power and heat production via photovoltaic thermal panels for district heating and industrial plant (2018) Energy, 154, 424–432. (SCOPUS, WoS)*
7. ***Pakere I.****, Romagnoli F., Blumberga D. Introduction of small-scale 4th generation district*

heating system. Methodology approach. Energy Procedia, 149, 2018, 549–554. (SCOPUS)

8. *Lauka D., **Pakere I.**, Blumberga D. First solar power plant in Latvia. Analysis of operational data, Energy Procedia, 147, 2018, 162–165. (SCOPUS)*
9. *Soloha R., **Pakere I.**, Blumberga, D. Solar energy use in district heating systems. A case study in Latvia (2017) Energy, 137, 586–594. (SCOPUS, WoS)*
10. ***Pakere I.**, Ziemele J., Blumberga, D. DH company in prosumers role (2017) Energy Procedia, 128, 234–239. (SCOPUS)*
11. *Ziemele J., **Pakere I**., Blumberga D. The future competitiveness of the non-Emissions Trading Scheme district heating systems in the Baltic States (2016) Applied Energy, 162, 1579–1585. (SCOPUS, WoS)*
12. *Cirule D., **Pakere I.**, Blumberga D. Legislative Framework for Sustainable Development of the 4th Generation District Heating System (2016) Energy Procedia, 95, 344–350. (SCOPUS)*
13. *Ziemele J., **Pakere I.**, Chernovska L., Blumberga D. Lowering temperature regime in district heating network for existing building stock (2016) Chemical Engineering Transactions, 52, 709–714. (SCOPUS)*
14. *Ziemele J., **Pakere I.**, Blumberga D. Development of District Heating System in Case of Decreased Heating Loads (2014) The 27th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2014): Proceedings, 2044–2055.*
15. *Ziemele J., **Pakere I.**, Talcis N., Blumberga D. Multi-criteria analysis of district heating systems in baltic states (2014) Energy Procedia, 61, pp. 2172–2175. (SCOPUS)*
16. ***Pakere I.**, Lauka D., Blumberga D. Estimation of Carbon Emission Reduction from Upgrading the DH Network to the 4th Generation. Multivariate Linear Regression Model (2019) Environmental and Climate Technologies, 23 (2) 64–73. (SCOPUS, WoS)*
17. ***Pakere I.**, Purina D., Blumberga D., Bolonina A. Evaluation of Thermal Energy Storage Capacity by Heat Load Analyses (2016) Energy Procedia, 95, pp. 377–384. (SCOPUS)*
18. *Ziemele J., **Pakere I.**, Blumberga D., Zogla G. Economy of Heat Cost Allocation in Apartment Buildings (2015) Energy Procedia, 72, pp. 87–94. (SCOPUS)*
19. *Ziemele J., **Pakere I.**, Talcis N., Cimdina G., Vigants G., Veidenbergs I., Bluberga D. Analysis of wood fuel use development in Riga (2014) Agronomy Research, 12 (2), pp. 645–654. (SCOPUS)*
20. *Dace E., **Pakere I.**, Blumberga D. Evaluation of Economic Aspects of the DepositRefund System for Packaging in Latvia (2013) Management of Environmental Quality: An International Journal 24 (3) pp. 311–329. (SCOPUS)*
21. *Dace E., **Pakere I.**, Blumberga D. Analysis of Sustainability Aspects of the Packaging Deposit-Refund System in Latvia (2013) Sustainable Development and Planning VI: WIT Transactions on Ecology and the Environment (173) C.Brebbia red. New Forest. pp. 729– 740. (SCOPUS)*

Scientific conferences:

1. ***Pakere I**., Blumberga D. "Solar power or solar heat: What will upraise the district heating?". International conference "5th International Conference on Smart Energy Systems", Denmark, Copenhagen, September 10–11, 2019.*
2. ***Pakere I**, Lauka D., Blumberga D. "Estimating carbon emission reduction from low temperature district heating implementation trough multivariate linear regression model". International scientific conference of Environmental and Climate Technologies, CONECT 2019, Latvia, Riga, May 15–16, 2019.*
3. ***Pakere I**, Blumberga D. "Solar energy in low temperature district heating". International scientific conference of Environmental and Climate Technologies "CONECT 2019", Latvia, Riga, May 15–16, 2019.*
4. *Feofilovs M., **Pakere I.**, Blumberga D. "Life cycle analysis of different Low-temperature*

district heating development scenarios: A case study of municipality in Latvia". International scientific conference of Environmental and Climate Technologies "CONECT 2019", Latvia, Riga, May 15–16, 2019.

5. *Tukulis A., **Pakere I**., Blumberga D. "Solar DH system sustainability and flexibility increase forecast via power-to-heat technology integration. System dynamic approach". 12 International conference "4th International conference on Smart Energy Systems and 4th generation District Heating", Denmark, Alborg, November 13–14, 2018.*
6. ***Pakere I**., Romagnoli F., Blumberga D. "Introduction of small-scale 4th generation district heating system. Methodology approach". International conference "The 16th International Symposium on District Heating and Cooling", Germany, Hamburg, September 9–12, 2018.*
7. *Tukulis A., **Pakere I.**, Gravelsins A., Blumberga D. "Methodology of system dynamic approach for solar energy integration in district heating". International conference; International scientific conference of Environmental and Climate Technologies "CONECT 2018", Latvia, Riga, May 16–18, 2018.*
8. ***Pakere I.**, Ziemele J., Blumberga D. "DH Company in Prosumers role". International scientific conference of Environmental and Climate Technologies "CONECT 2017", Latvia, Riga, May 16-18, 2017.*
9. ***Pakere I**, Blumberga D. "Solar collectors versus solar panels in DH". International conference "3rd International conference on Smart Energy Systems and 4th generation District Heating", Denmark, Alborg, September 12–13, 2017.*
10. *Soloha R., **Pakere I.,** Blumberga D . "Solar Energy Share in DH system. Case study in Latvia" "2nd International conference on Smart Energy Systems and 4th generation District Heating", Denmark, Alborg, September 27–28, 2016.*
11. *Purina D., **Pakere I**., Blumberga D. Bolonina A. "Evaluation of thermal energy storage capacity by heat load analyses". International scientific conference of Environmental and Climate Technologies "CONECT 2015" , Latvia, Riga, October 14–15, 2015.*
12. *Cirule D., **Pakere I.,** Blumberga D. "Legislative framework for sustainable development of the 4th generation district heating system". International scientific conference of Environmental and Climate Technologies "CONECT 2015" , Latvia, Riga, October 14– 15, 2015.*
13. *Ziemele J**., Pakere I**., Blumberga D., Zogla G. "Economy of Heat Cost Allocation in Apartment Buildings". International conference "Environmental and Climate Technologies". Latvia, Riga, October 14–15, 2014.*
14. *Ziemele J., **Pakere I**., Blumberga D. "Development of District Heating System in Case of Decreased Heating Loads". International conference "The 27th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems (ECOS 2014)", Finland, Turku, June 15–19, 2014.*

Monographs

1. *Barisa A., Blumberga A., Blumberga D., Gravelsins A., Gusca J., Lauka D., Karklina I., Muizniece I., **Pakere I**., Priedniece V., Romagnoli F., Rosa M., Selivanovs J., Soloha R., Veidenbergs I., Vigants E., Vigants G., Ziemele J. Energy System Analysis and Modeling. Riga: RTU Izdevnieciba, 2018. 144 p. ISBN 978-9934-22-037-1.*

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a

description of the main research roadmaps and the impact of the study programme on research and other education levels.

The content of the study program and its implementation have been formed on the basis of the regulatory enactments and regulations of the Republic of Latvia, RTU internal laws and regulations, EUA's (European University Association's) proposed doctoral education principles, EQUAL guidelines for doctoral studies (EQUAL guidelines for doctoral programs in business and management, May 2016), respecting the strategic development and sustainable development objectives of the RTU and FEEE and United Nations Sustainable Development Goals (SDG) in higher education.

The European University Association (EUA) has established a common understanding of the fundamental principles for doctoral education and PhD. The study program uses four key principles:

- The main part of doctoral education is the development of knowledge by carrying out original studies necessary for the economy and contributing to the development of higher education and research;
- All doctoral students are young researchers (Early Stage Reasechers) who, in cooperation with experienced researchers, make a significant contribution to the creation of new knowledge;
- Management of doctoral candidates and regular evaluation of achievements (including development of competences) play a key role in doctoral education and the development of young scientists;
- The doctoral program offers cross-disciplinary, cross-sectoral and geographically wide research, ensuring cooperation with a wide range of partners in Europe and around the world, as well as student mobility.

One of the objectives of the European Commission Joint Research Centre for change is the introduction of SDG in education, so the study courses and joint surveys included in the study program are based on the achievement of SDG objectives

In the framework of the doctoral research program "Environmental engineering", a doctoral degree is obtained in the field of environmental engineering and energy science, and a broad profile of internationally competitive higher-skilled environmental engineering professionals with integrated education and systemic thinking, independent scientific and pedagogical skills, knowledge and skills are prepared for work in economic institutions that can work in a scientific way, research institutes, engineering companies, local governments, ministries, environmental quality monitoring bodies, as well as activities as evaluators of scientific achievements, experts from international organisations, etc.

The doctoral program shall be implemented in lectures, practical and laboratory activities, as well as in independent studies, learning the latest developments in the field of environmental engineering, using the achievements of basic and applied science, gaining in-depth theoretical knowledge in the methodology of environmental research.

The study program is designed to ensure a sequential development of knowledge, skills and competences based on the scientific work of individuals and groups, continuous communication between doctoral candidates and their leaders.

First year of study (total 48 CP):

- **mandatory study courses of 6 CP** to the extent in the course of study EAS757 "Doctoral garage: Analysis and publication of results of scientific research" (6 CP). The course is linked

to scientific communication, from the preparation of a scientific article until it is accepted in an internationally quoted scientific journal. The topics concerning scientific writing styles, types and structures of publications, visual presentation of results, ethical issues and the choice of the most appropriate scientific edition for the manuscript concerned are examined. Both permanent jobs and group jobs are being performed in combination with role games elements. The course consists of a majority of the teaching staff of the study program (see study course descriptions).

- **free-choice study courses (21 CP)**, for example, “Environmental policy. Theoretical aspects of climate technologies” (9 CP), or “Ecological aspects of energy technology” (9 CP), “Modern Environmental Problems. Solutions. Modelling” (15 CP), “Solar Energy Systems” (6 CP), “Life Cycle Analysis” (6 CP), “Biohydrogen. System analysis” (6 CP) or other courses.
- **Scientific work (21 CP)** shall be in cooperation with the manager of the promotion work. At the end of the first year of study, at least one publication shall be prepared and submitted for publication, a report drawn up and presented at an international conference.

Second year of study (48 CP):

- **mandatory study courses of 9 CP** to the extent, through study course EAS603 “Environmental assessment” (9 CP).
- **Free-choice study courses (6 CP)**, for example, “Solar Energy Systems” (6 CP), “Life Cycle Analysis” (6 CP), “Biohydrogen. System analysis" (6 CP) or other courses.
- **Scientific work (33 CP)** shall be in cooperation with the manager of the promotion work. At the end of the second year of study, at least two publications and reports at international conferences shall be prepared and published. Promotion readiness at this stage is 30...40%.

Third year of study is devoted to scientific work, research, publishing research results, participation in experience exchange and mobility projects. The individual work of the doctoral candidate is strengthened, cooperation with the driver is ensured, as well as the regular possibility of meeting with other doctoral candidates to ensure the transfer of experience and knowledge. Ongoing work on scientific publications (at least 2 publications should be developed and submitted for publication), international cooperation between the young scientist is being developed. Promotion readiness at this stage is up to 70%.

Fourth year of study the final phase of the study, preparation for submission to the Promotion Board, shall be ensured during the period. Ongoing work in the field of scientific publications (at least 2 publications have to be developed and submitted for publication) is developing international cooperation between the young scientist. During the fourth year of study, there is also a pre-defending of the promotion work: it consists of the members of the RTU promotion council P-19, the head of the promotion work, doctoral candidates, other interests. During pre-defending, it is decided whether the promotion work is directed for submission or whether improvements to the promotion work should be made (including Hearing recommendations on how to improve promotion work). The fourth year of study concludes with the submission of promotion work to the promotion. It should be noted that not all doctoral candidates can be part of the study plan. After the second or third year of study, some doctoral candidates choose to go on academic leave (in the “Environmental Science” study program, academic leaves mostly up to 15% of all doctoral candidates), during which individual work strengthens knowledge in the specific field of research. The average period for the development of promotion work in the RTU study program “Environmental Science” was 4.8 years.

In implementing the study program, its objective “acquisition of a doctoral scientific degree in the field of environmental engineering and energy science and the training of internationally competitive higher qualifications specialists for academic and scientific work in universities,

research centres and organisational work in public and private institutions", corresponding to the European Qualifications Framework (EQF) and the Latvian Qualifications Framework (LQF) level 8, is being achieved. The study program shall comply with the RTU doctoral by-law.

Graduates of the study program acquire competences relevant to the level of international achievements of the environmental engineering industry, corresponding to the upper limits of knowledge and enabling critical environmental engineering challenges in research and innovation to be addressed, enabling independent scientific or academic activities to be launched, expanding existing knowledge and providing a new understanding of environmental engineering and energy topics. The result of the study program is a self-developed promotion work with significant theoretical relevance and practical potential, which includes original scientific research results obtained by independent evaluation and selection of relevant methods for modern research, and provides new scientific knowledge in the field of environmental engineering and energy sciences.

As part of a free-choice course, students can take up any course at the level of a doctoral study. Free-choice courses depend on the subject of the student's research and on the skills to be learned for the development of promotion and to complement students' competencies. In parallel to learning study courses, students do research work.

The interdisciplinary nature of the study program and the diversity of the courses offered enable students to develop the necessary competencies, thereby contributing to the training of highly qualified environmental engineering professionals who are suited to the demands of today's labour market and knowledge-intensive economy, and enabling students to reach the upper limit of knowledge in the selected field of specialisation. All courses in Parts A, C and E shall contribute to the achievement of each of the results of the study programs referred to in this document.

The information contained in study courses constitutes a logical interlinking, ensuring the upward development of learners' knowledge and skills. In the first year of study, a general framework for individual research in a selected field is being developed and strengthened in each subsequent year by the development of young scientists able to carry out independent, critical analysis, synthesis and evaluation, to address significant research or innovation challenges in the fields of environmental engineering and interdisciplinary. The interlinking of the results to be achieved, targets, and other indicatiors (didactic matrix) can be found in the Annex "Mapping of the study courses_doctors".

At all stages of study, students are involved in the study process through pedagogical work (conducting lectures and managing closing jobs), thereby ensuring the transfer of knowledge, experience and research results at different levels of study. Findings and knowledge of bachelor's and master's works conducted by doctorants, as well as, for example, experimental stands developed, are integrated into the development of promotion work, as well as in the development of study courses.

The doctoral program shall be designed to cover all the main research directions of RTU IESE. The active involvement of students and graduates in the "Environmental Engineering" doctoral program in RTU IESE research is likely to increase the number of high-quality and internationally recognised researchers.

It is essential to improve and provide an incentive environment for researchers, so faculty are currently trying to improve the research environment:

- Following the completion of academic or doctoral studies, establishing and maintaining a research partnership, etc.;
- Ensure an internationally recognised research process, taking into account the increasing dynamics of publications, research projects, conferences, etc.;

- Ensure efficient research infrastructure by investing in the development of high-quality research infrastructures and providing comprehensive resources for research;
- Ensure sustainable innovation, commercialisation and technology transfer by promoting the creation of interdisciplinary knowledge and technology through the development and maintenance of an international research partnership;
- Improving internal and external communication and cooperation.

Industry experts believe that the program prepared by the RTU meets current and future sectoral needs, includes study courses, the acquisition of which will make it possible to acquire the necessary skills and knowledge to work in research institutes, engineering companies, municipalities, ministries, environmental quality monitoring bodies, as evaluators of scientific achievements, international organisations experts, etc. The study process is implemented in appropriate quality.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

The methods used in the study program contribute to the achievement of study courses and program objectives and results, taking into account the student-centered teaching and learning principles. Compliance with the **principles of student-centred education** (hereinafter – SCL) is constantly ensured. According to the SCL manual defined, the participation of students in the study process and in the development of content is ensured, which gives students both additional duties and powers. Students have the opportunity to influence their studies, exercise their autonomy, provide feedback on the study process by matching their expectations. The RTU FEEE student self-government, which actively participates in all these processes and carries out the annual evaluation of teaching staff, plays an important role in ensuring a link between students, teaching staff and the program administration. In a number of documents, the Code of Academic Integrity, the rules for the evaluation of the results of studies, guidelines for the development of studies and closing works, etc., the guidelines for teaching and learning are defined.

The study program and the **study courses included therein are student-centred**, because it takes into account and respects the different contingent of students, their past knowledge, skills and experience, the diversity of doctoral needs, thus applying individual learning pathways to each. The implementation of the study program includes a variety of ways of implementing the content of the study course. Teaching staff works with students in small groups or individually, allowing them to use pedagogical and andragogenic teaching methods that are relevant to the circumstances. The study process has been organised in such a way as to promote the independence of doctoral candidates, while ensuring the leadership and support of the teaching staff as scientific manager and mentor. The study process organised in this way contributes to mutual respect and contributes to the growth of all parties involved in the study process. At the same time, objective consideration of initiatives and objections shall be ensured.

The evaluation of study results shall take place in accordance with the by-law for the evaluation of the results of studies

(https://www.rtu.lv/writable/public_files/RTU_1_studiju_rezultatu_vertesanas_nolikums.pdf (Latvian only)).

The assessment of studies, in line with the decisions of the RTU Senate, uses a summary achievement assessment approach. At the beginning of the study course, doctoral candidates shall be presented with the criteria and methods for evaluating the course of the studies concerned. The specific evaluation criteria for each study course should be presented to students in the first lesson and published in the course's e-study environment on the RTU intranet ORTUS.

The evaluation results are designed to give students an insight into the extent to which they have achieved the results of their studies. Teaching methods, structure of study courses and evaluation methods shall be selected by the teaching staff responsible for the study course, in accordance with the specific nature of the content and program of the course, as well as the needs of students. Training courses and seminars on the latest teaching, pedagogical methods are organised for academic staff, as well as the promoting the attendance of refresher courses, both at internal faculty events and at RTU level, and internationally. The RTU Centre for Academic Excellence organizes activities for the development of academic staff at university level.

Students receive feedback, which typically provides advice on learning processes and research skills development. In all courses, the evaluation shall be carried out by at least three examiners (experts with PhD in the field concerned), known as the examination commission within the program. At the beginning of each academic year, the composition of the subject commission shall be reviewed and renewed. The composition of the commission shall take into account the developments of the sector, the achievements of the teaching staff during the relevant year of study, the feedback of students. The members of the examination commission shall be familiar with the testing and examination methods and shall receive support for the development of their skills in their area of competence. The evaluation is consistent, uniformly applied to all students and is implemented in accordance with procedures approved by the RTU. As at all levels, students in the doctoral program have been presented with the procedures in the RTU for examining student appeals.

The **achievement of study courses and program objectives and results** within the framework of the program shall be carried out at regular intervals by organising teaching staff seminars and discussions on the results of studies and the basic principles for quality assurance. The study program shall ensure the full implementation of the results of studies. The results of studies are formulated at the level of both study program and study courses. Students shall be informed of the results of the studies to be achieved at the beginning of each study course, as well as shall be available in the ORTUS environment. As mentioned above, there is a link between the results achieved by the study program and study courses. The **interlinking and sequence of study courses** in learning the content of studies shall be evaluated at least once a year and, in addition, in cases where proposals are received from students. According to the results achieved by the study program, the content and extent of study courses in credit points are created, while topics and their extent in hours are created according to the results achieved by the study course. The results to be achieved in all study courses shall be verified by appropriate evaluation methods. Students have a chance to dispute the assessments of the results of studies - this is specified in the by-law for the evaluation of the results of studies (29.05.2017. Senate decision, Protocol No 610).

Independent studies of doctoral students play an important role. A description of their procedure is included in the description of the study course as a mandatory component. The skills of students to study independently shall be developed purposefully in all study courses and in the framework of scientific work. Students acquire research skills by working regularly with literature and Internet resources, conducting scientific studies, preparing publications, reporting at conferences, etc.

The impact of **mobility** programs and increased opportunities for intercultural communication are becoming increasingly active in the daily lives of doctoral candidates. For students who arrive at RTU IESE within the mobility, support is provided both at the level of self-governance of students and at the level of the study program and at the level of faculty management (for incoming mobility see more sections 5.2 of the field of study of the self-assessment report). For example, in a particularly good collaboration, PhD students have developed with Italian universities (La Sapienza Univeristy, University of Brescia, University of Perugia, University of Milano-Bicocca, Insubria University, University of L' Aquila, Marche Polytechnic University), where cooperation is promoted by the foreign teaching staff of RTU IESE, Professor Dr.sc. ing. Francesco Romagnoli and Professor, Dr.sc. ing. Claudio Rochas.

Students of the doctoral research program Environmental Science did not fully benefit from mobility opportunities. This is most often due to the fact that doctoral candidates are employed and cannot afford to go in short- or long-term mobility, as well as a large proportion of doctoral candidates have family conditions preventing them from travelling on mobility trips.

In order to be able to carry out not only theoretical but also practical studies, the quality-equipped RTU IESE laboratories give students the opportunity to perform high-quality measurements and to operate with the latest technological equipment of their generation. A broad scientific and research structure is available for doctoral candidates (see point 3 of the field of study report). Students have access to extensive real-time databases, research and analysis tools. Many resources are also available to students outside audiences: RTU Scientific Library, Scientific Databases Web of Science, Scopus, Ebray, ProQuest, etc. online databases and readings.

The implementation of the doctoral study program shall take place in close cooperation with the head of the thesis work. In addition, there is a cross-examination of RTU IESE (not less frequently for freshman students than twice in the semester, and for students of other courses not less than once in the semester). The mechanism for the implementation of this type of study program shall ensure that the results of studies are achieved.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The study program does not include practices, but the practical knowledge of research is strengthened by active involvement of doctoral candidates in both local and international projects and contract work. All doctoral candidates are involved in research projects (see statistics in point 4.4).

In addition, project SO 8.2.2. financed by the European Social Fund implemented by the RTU "Strengthening the academic staff of Riga Technical University in strategic areas of specialisation" RTU IESE doctoral candidates/teaching staff improved their competencies, traineeships with merchants. For example, first course doctoral candidate K. Bumbiere holds JSC "BAO."

2.5. Analysis and assessment of the topics of the final theses of the students, their

relevance in the respective field, including the labour market, and the evaluations of the final theses.

Topics of student promotion works (field of study) shall be selected by submitting an application for admission to studies. At the same time, the program director recommends a potential head of scientific work and advisers. At the beginning of the doctoral studies, for each doctoral candidate, with an order of the prorector of the RTU, the manager of the promotion work is approved by the Division of the Studies of the doctoral candidates. The theme of the promotion work is clarified before defending the promotion work.

Promotion works defended under the "Environmental Protection" doctoral program (95%) are internationally oriented, including case studies for Latvia.

The themes of the environmental engineering study: limiting climate change, energy issues, moving towards a low-carbon economy, clean and efficient energy, monitoring and adaptation to climate change, energy efficiency, the bioeconomy and the circular economy, cleaner transport, renewable energy, agriculture and land-use planning, waste management - are topics of concern for the European Union in its environmental policy. The developed study program is focused on addressing these issues, as it aims at environmental engineering and energy science, and the training of internationally competitive higher qualifications for academic and scientific work in universities, research centres and organisational work in public and private institutions. Evaluation of the promotion work in conformity with Regulation No 1001 of the Cabinet of Ministers on 27.12.2005 "On the Procedure of and Criteria for Awarding of Doctoral Scientific Degree", performed by the Promotion Council, a review of three reviewers and defending public promotion work shall ensure the interlink between the results of the doctoral study program and their reach.

Graduates of the doctoral study program "Environmental Science" have carried out studies in the fields of research identified by RTU IESE: smart energy, bioeconomy, resource recovery, development of biotechnologies, high value added products and their environmental assessment, etc.

Promotion works defended during the reporting period:

2013/2014 *year of study graduated and defended promotion works* ***3 doctoral candidates:***

- *E. Dace "Model of the Integrated Waste Management System of Primary Packaging";*
- *S. N. Kalnins "Low Carbon Society:Evaluation Methodology";*
- *J. Pubule "Cleaner production in biowaste management".*

2014/2015 *year of study graduated and defended the promotion works* ***4 doctoral candidates:***

- *L. Zogla "Methodology for Modelling Energy Efficiency Policy Instruments in Industrial Sector";*
- *G. Vigants "Low Carbon District Heating Systems";*
- *I. Laicane "The Trilemma of Electricity Users";*
- *J. Latvels "Photoelectrical Properties of Innovative Organic Materials for Solar Cells".*

2015/2016 *year of study graduated and defended the promotion works* ***2 doctoral candidates:***

- *G. Cimdina-Pundure "Scaling-Up from a Single Energy Production Unit to State Energy Sector";*
- *A. Kubule "Novel Methods for Integrated Assessment of Industrial Symbiosis and Energy Efficiency".*

2016/2017 *year of study graduated and defended the promotion works* ***6 doctoral candidates:***

- *J. Vilgerts "Triple helix approach in hazardous waste management system";*
- *A. Barisa "Modelling Transition Policies to a Low-Carbon Road Transport in Latvia by 2030";*
- *H. Vigants "Sustainable Development of Pellets Production";*
- *J. Ziemele "Multi-Perspective Analysis for the Transition towards 4th Generation District Heating";*
- *L. Timma "Methodology for Socio-Technical Transition Research";*
- *M. Repele "Ecodesign of Biomethane Production and Supply System".*

2017/2018 *year of study graduated and defended the promotion works* ***4 doctoral candidates:***

- *U. Bariss "Aspects of Energy Effieciency and Smart Metering";*
- *D. Lauka "Sustainability Analysis of Renewable Energy Sources";*
- *I. Muizniece "Biotechonomy Analysis Metodology";*
- *V. Kirsanovs "Wood Chips Gasification for Syngas Production".*

2018/2019 *year of study graduated and defended the promotion works* ***2 doctoral candidates:***

- *R. Vanaga "Climate Adaptive Building Shell for Nearly Zero Energy Buildings: Application of Biomimicry Principles";*
- *P. Brazdausks "Production of Furfural from Industrial Hemp Shives in the Pretreatment Stage of a Biorefinery System";*

2019/2020 *year of study graduated and defended the promotion works* ***6 doctoral candidates:***

- *E. Terehovics "Energy and Exergy Indicators for Increasing Energy System Efficiency";*
- *M. Dzikevics "Solar Energy Accumulation with Packed Bed Phase Change Materials";*
- *A. Fridrihsone "Life Cycle Assessment of Renewable Polyol Monomers for Polyurethane Production";*
- *K. Klavenieks "Efficient Waste Management Sector";*
- *K. Locmelis "Latvia's Energy Efficiency Policy for the Manufacturing Industry in the Green Deal Transition";*
- *I. Pakere "Solar Energy in Low Temperature District Heating";*
- *L. Zihare "Bioresource Transition towards Sustainable Bioeconomy ";*
- *K. Spalvins "Single-cell Protein and Single-cell Oil Production from Agro-industrial By-products".*

In academic year 2020/2021, ***11 students*** *started doctoral studies in the doctoral study programme* "***Environmental Engineering***" *on the following topics of doctoral theses:*

- *K. Bumbiere "Biogas potential in transport in Latvia" (scientific supervisors Jeļena Pubule, Vladimirs Kirsanovs)*
- *A. Dzalbs "Place of bioresources containing starch in the development of bioeconomy" (scientific supervisor Francesco Romagnoli)*
- *K. Eglīte "Policy promotion tool for energy communities of carbon-neutral neighbourhoods" (scientific supervisor Andra Blumberga)*
- *S. Raita "Use of ABE fermentation for production of biobutanol from agricultural by-products" (scientific supervisors Krišs Spalviņš, Ivars Veidenbergs)*
- *R. Kaķis "Development prospects of small district heating systems" (scientific supervisors Ieva Pakere, Ivars Veidenbergs)*
- *E. Kudurs "Commercialisation policy in the bioeconomy sector" (scientific supervisor Dagnija Blumberga)*
- *Z. Kušnere "Use of microbial fermentations for production of biohydrogen and biobutanol*

from agricultural by-products" (scientific supervisors Krišs Spalviņš, Ivars Veidenbergs)

- *A. Vēciņa "Implementation of competence based environmental engineering study process in university level education" (scientific supervisor Dagnija Blumberga)*
- *A. Villere "Methodology of implementation of district heating climate benchmarks" (scientific supervisors Ieva Pakere, Ivars Veidenbergs)*
- *A. Zandberga "Prospects of circular economy in management of industrial waste" (scientific supervisor Jūlija Gušča)*
- *N. A. Patel "Bioresources Value-added Model" (scientific adviser Dagnija Blumberga)*

Research developed and promotion works defended are of high added value for scientific and economic development. Feedback from companies and industry organisations has been received on promotion works (for their public defence). This is also reflected in the victories of RTU IESE doctoral students in competitions organised by companies. For example,

- In 2013, F. Romagnoli, a doctoral student in the "Environmental Science" program, received the *Werner von Siemens* Excellence Award in the promotion work category for the promotion work "Model for sustainable bioenergy production and use". Scientific head of promotion work, RTU IESE professor *hab. sc. ing.* Dagnija Blumberga and RTU IESE professor *Dr. sc. ing*. Ivars Veidenbergs.
- In 2015, J. Latvels, a doctoral student in the "Environmental Science" program, received the *Werner von Siemens* Excellence Award in the promotion work category for the promotion work "Photoelectrical Properties of Innovative Organic Materials for Solar Cells". Scientific head of promotion work – RTU IESE professor *hab.sc. ing*. Dagnija Blumberga.
- In 2019, V. Kirsanovs, a doctoral student in the "Environmental Science" program, received the *Latvenergo* Annual Award for promotion work "Wood Chips Gasification for Syngas Production". Scientific head of promotion work –RTU IESE professor, *sc. ing.* Claudio Rochas.
- M. Dzikēvičs, a student of the doctoral study programme "Environmental Science" received the *Latvenergo* Annual Award 2020for his doctoral thesis "Solar Energy Accumulation with Packed Bed Phase Change Materials". Scientific supervisor of the doctoral thesis – professor of RTU IESE, *sc.ing.* Ivars Veidenbergs.

As 80-90% of the graduates of the program continue to work in higher education institutions or provide guest-lectures, the results of the studies carried out in the promotion works are also included in the study process, which ensures knowledge transfer and further exploitation.

On the basis of the results of the promotion work, several monographs have also emerged. For example, A. Barisa's promotion work was developed and published in the form of a collective monograph: Barisa A., Rosa M. Modelling of Road Transport Policies in Latvia. Riga: RTU Press, 2017. pp. 198. ISBN 978-9934-10-994-2. (In English).

On the other hand, the vast majority (around 90%) of the lessons and know-how generated by the promotion works of doctoral candidates are integrated into the new project applications and continued in RTU IESE. Here are a few examples of the integration of the results of the study process (pormotion works) into science:

- The promotion work of A. Barisa "Modelling Transition Policies to a Low-Carbon Road Transport in Latvia by 2030" continues in the National Research Program "Energy" project "4muLATe: Sustainable and renewable transport policy formulation in Latvia" (2018-2021).
- The promotion work of A. Kubule "Novel Methods for Integrated Assessment of Industrial Symbiosis and Energy Efficiency" is continued in the National Research Program "Energy" project "Assessment and analysis of energy efficiency policy" (2018-2021).
- The promotion work of D. Lauka "Sustainability Analysis of Renewable Energy Sources" is continued in the "Blind spots in the energy transition policy" – Latvia's state budget

Fundamental and Applied Research Project (2018-2020).

- The promotion work of I. Muižniece “Biotechonomy Analysis Metodology” is continued in the “Bioresource Value Model (BVM)” project (2018-2021).
- The promotion work of R. Vanaga “Climate Adaptive Building Shell for Nearly Zero Energy Buildings: Application of Biomimicry Principles” continues in the National Research Program “Energy” project “Improvement of building energy efficiency technologies” project (2018-2021).

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

The results of surveys of students, employers and graduates shall be used to improve the quality of the study program. The quality monitoring and assurance system introduced by the RTU in 2008 provides for regular electronic surveys of students on the content of studies and the quality of teaching staff, using an ORTUS environment. At the same time, it should be noted that, in the light of the small number of students in the doctoral program and in each study course separately, in order to ensure the acquisition of data, the program administration shall carry out individual annexation and interception. Every year after the autumn and spring semester, student surveys are organised. Questionnaires shall include questions on the availability of teaching literature for each particular course, teacher evaluation criteria, culture and quality of work, respect for students' rights during the course, the time spent on the student's own work and the discipline of training. The final part of the questionnaire is intended for student proposals and proposals to improve the quality of the course-matter and teacher's work. The questionnaires are filled out anonymously so that the responses provided are not likely to affect the teacher's attitudes towards the student or group of students and the objective of obtaining an objective assessment of students is reached. The results of the testing on the program in question are compiled and used to improve the quality of the program. Students themselves and the FEEE Student self-government are actively involved in the anketting and results analysis process.

The results of the anketting for the specific program are compiled and used for the quality of the program improving. Students themselves are actively involved in the process of testing and analysis of results FEEE Student self-government.

Student questionnaires are designed to help assess the quality of study courses and teaching staff, as well as to enable students to express their views and make proposals to improve the performance of the trainer and to improve the program of the specific study course. At the end of the semester, each teacher has the opportunity to assess the results of his or her work and to take measures to improve the quality of his or her studies.

Overall, the results of students' surveys over the reporting period are very positive, as of the maximum possible 5.0 notes, teachers’ assessment is above 4.7. Students have welcomed teachers who are preparing their own teaching tools and/or handouts for learning courses. The main recommendations for improving the curriculum on the student side relate to the wider availability of scholarships. Students' surveys in the ORTUS environment involve a different number of students in different courses, so the data obtained can be viewed with caution. The results of the survey questionnaires of students shall be analysed in sessions of the administration, departments and institutes of the study program, involving, where necessary, representatives of the self-government

of students. The following improvements are made:.

Every year, RTU Doctoral studies also carry out anketting of graduates of the doctoral program. The results of the surveys reflect the positive effects of the implementation of the program and the necessary improvements. The study program, its content and the benefits of graduates are evaluated.

As mentioned above, all the results of the surveys are used by the program administration in the development of the study process. Compared to years, the assessment of the students' study process, the acquired knowledge and practical skills shows that all results from previous year surveys that have been used to improve the study process and the content have been highly evaluated.

RTU has a survey cycle developed to analyse the courses of study and to obtain feedback:

- A survey of students in the study program on the quality of teaching work and the evaluation of the study program shall be carried out every semester.
- The annual and doctoral survey of doctoral candidates and the survey on doctoral candidates, the introduction of a survey of the reception process and the opening of studies have also been carried out.
- The feedback is also provided through the cross-section reports (first-course students not less than twice in the semester, students from other courses, not less than once in the semester, when reporting at the meeting of RTU IESE doctoral candidates). The mechanism for the implementation of this kind of study program makes it possible to ensure that the results of studies are achieved. The system for monitoring the progress of doctoral students shall be as follows: doctoral candidates shall report twice in the semester a month on the progress made in the development of promotion work, presenting the results to the commission (the commission shall include at least four IESE doctors). Student progress is assessed on the following criteria: acquisition of a compulsory study plan; progress in the development of promotion work (methods, results); progress in the development of scientific publications; progress on conference participation; pedagogical activities.

According to the results of the survey, the students of the study program highly appreciate the every-semester reporting of RTU VASSI, which takes place regularly throughout the study period.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

Every doctoral student has the opportunity to participate in the mobility of students. Students take advantage of incoming and outgoing mobility opportunities, learned during mobility is recognised within the scope of the study program. This option is used annually only for up to 10% of doctoral candidates (for the period from 2015/2016 year of study to 2019/2020. For the year of study, only four doctoral candidates in "Environmental Science" used ERASMUS+ mobility, each spending 6 months at foreign universities. This is due to the active involvement of doctoral candidates in the implementation of various research projects, including international missions and works abroad.

Here are a few examples of the mobility of student under the Environmental Science study program: For example, the doctoral candidate M. Dzikevics during the period 01.06.2017 -30.11.2017 was on a mobility visit to Kaunas University of Technology to use the university's

scientific equipment to develop an experimental part of his promotion work. On the other hand, doctor J. Ziemele, during the period from 13.01.2016-31.03.2016, was on a mobility visit to Vilnius Gediminas Technical University, where she used the available data-lowering tool to develop her promotion work and, in cooperation with the university professor, learned the use of this tool.

In an objective assessment of doctoral candidates, mobility opportunities are not sufficiently exploited. In order to ensure the transfer and integration of international experience and research practices in the research process, it is necessary to plan for more active participation of doctoral candidates in mobility and to develop support instruments for improving the mobility of doctoral candidates during the next accreditation period.

Inbound mobility opportunities were not used during the reporting period. Taking into account the close cooperation of RTU VASSI workforce with several foreign universities, improvement of material and technical base and diversity of scientific research directions, it is expected that in the future mobility opportunities will be used.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

The course of study report provides full information on these issues in the criteria 3.1 to 3.3 of Chapter 3 of Part II. This paragraph contains only additional information separately distributed and highlighted on the study program.

The RTU has a decentralised budget and therefore each unit has a separate budget. The budget is, in general, a revenue and expenditure plan for a specified period, work, measure or function (see the description of Bachleor's study program point no. 3.1.).

The source of funding for the doctoral program “Environmental Engineering” is both the resources of the State budget and the fees of physical individuals for studies. The number of budget places in the doctoral program is governed by annual agreements between RTU and MESRL, so the number of places allocated to the program varies by year. The statistics of students, broken down by type of funding, are shown in the figure.

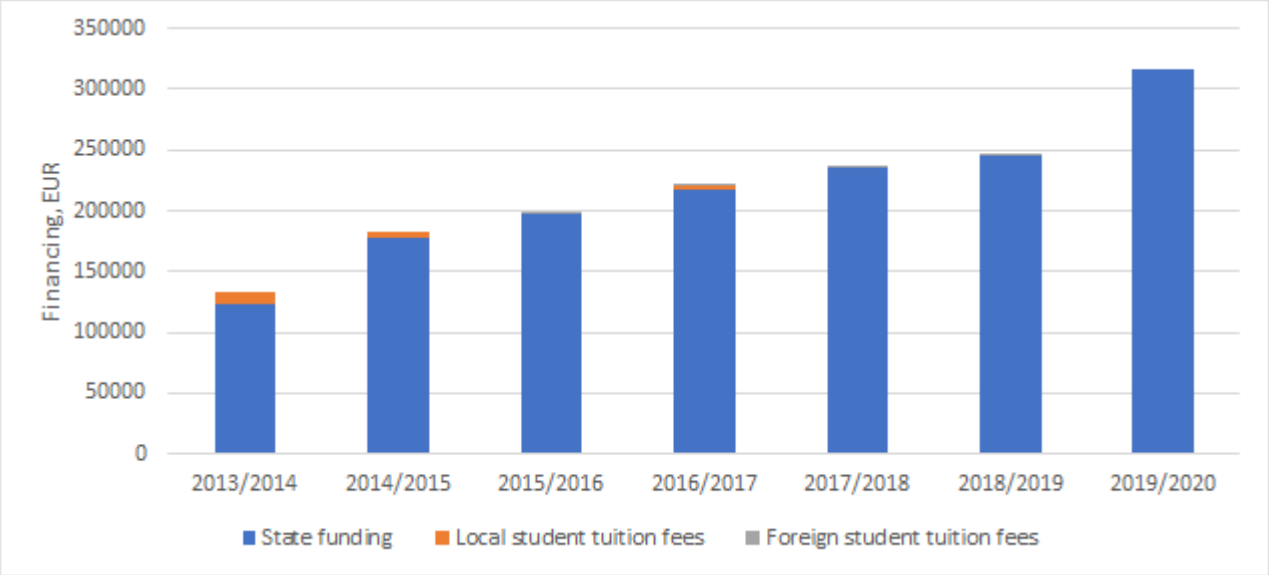

Figure: *Financing of the doctoral research program "Environmental science" for funding sources (2013-2020).*

Tution fee for the master's program "Environmental Engireering" **in the new 2021./2022. study year is 9350 EUR.** Tution fee is the same as studying in Latvian or English.

Calculation of the study place costs for the Doctor's study program "Environmental Engineering" see in the appendix "Study_progam_Environmental_Engineering_doc".

The resources available for the implementation of the study program are successfully complemented by research budgets, thereby ensuring that the results presented in the study program are achieved at present and in the long term.

The study base for students in doctoral programs, as well as teachers and employees, is primarily available in an electronic study environment ORTUS. The system is a comprehensive system of common identity and application. The portal provides an e-study environment, a career section, a virtual class and session plan system, a system of support for scientific activities, information for employees, a legislative base and a project management system. Extensive information resources are available to ORTUS students and teaching staff, including library resources, which are constantly being restored.

RTU IESE and RTU FEEE are equipped with individual jobs for all researchers, doctoral candidates and post-doctoral students and have free access to scientific resources. The studies of the "Environmental Engineering" program are mainly carried out at the Riga Technical University FEEE. FEEE provides for the acquisition of all levels of higher education in the environmental engineering, energy and electrical engineering industries, conducts teaching methodological development and international research. The location of the FEEE is on Azenes Street 12/1. The location has developed infrastructure where public transport stops, cafes, shops, student hotels and RTU Student Service Department, RTU swimming pool are readily available in the neighborhood. The total area of the building shall be 5137.30 m^2 with six surface floors, accessible wheel accommodation and more than 50 parking spaces, and access to people with special needs shall be provided to the faculty. The area is well-fitted, tarred driveways, cobbled pedestrian sidewalks, cobbled lawn, benches. Other components of the RTU infrastructure are also available for students and teaching staff: facilities are provided on each floor, a specialised water drinking container, an elevator, an open student classroom/reading room, several rest rooms, audiences and teaching rooms, meeting rooms, coffee shop, as well as commercial machines for various drinks and snacks are installed.

Table: *RTU FEEE building infrastructure.*

Training enclosure at Azenes Street 12 k.1		
Use of room	Number of rooms	Useful area m^2
Consultation rooms/presentation room	5	202
Computer audit	5	249,9
Audience	7	497,1
Cabinets	38	664,6
Docents/doctoral students' rooms	5	165,9
Dining room	1	412,8
Library	1	32,9
Workspace/workshop	8	222,2
Laboratory room	30	1788,2
Reading room	1	104,6
Teaching facilities	21	415,3
Warehouse	16	190
Hallway	3	58
Server rooms	2	31,5
Student management and records	2	68,1
Kitchens	6	34,2
Total	**151**	**5137,3**

In 2014, the student program implementer, RTU IESE, has created a separate room for doctoral students – Doctoral garage (Azenes Street 12/1–607). It is a room where students, teachers, dissertation job leaders, etc. can come together and carry out scientific discussions, studies, etc.

The science base consists of laboratories at the disposal of FEEE, databases, diverse software, as well as extensive scientific resources at the disposal of RTU. Modern world-class equipment and laboratories are available for different research purposes. Significant investments in research infrastructure have been made in 2013-2020. Doctoral candidates for the "Environmental Engineering" study program may carry out their research in one of the five RTU IESE laboratories: the Environment Monitoring Laboratory, the Biosystems Laboratory, the Research Laboratory for burning processes, the Solar Energy Systems Laboratory or the Energy Efficiency Laboratory for Buildings. Various support services and technical personnel exist for the proper functioning of laboratories and equipment at RTU IESE.

The RTU shall administer the research equipment and services portal "UseScience" to research institutions, students, entrepreneurs and other stakeholders, partner institutions and industry companies in Latvia and abroad. The portal provides an opportunity to communicate with the person responsible for certain equipment and to agree on the use of services or equipment.

RTU has concluded cooperation agreements with other research institutes on the use of research equipment; it is also available to commercial enterprises, provided that the conditions for financing finaced so permit.

RTU Research Department manages the Research Support Fund, which provides support for research activities, provides the maintenance and availability of research infrastructure, and provides financial support for publication of *Open Access Journals* and RTU scientific newspapers in open access.

The RTU Information Technology Department administers the RTU Research Support System (ORTUS), which includes information on RTU research personnel, research activities, publications and research data, and manages infrastructure that ensures the implementation of the RTU's open access policy. RTU researchers place all publications and study data in RTU publishing and research data storage and provide them with open access.

International databases are available for students in the RTU ORTUS environment: Web of Science, EBSCO, SCOPUS, SCIENCE DIRECT, SpringerLink full-text journals and books, multiple databases and other informative resources. Students shall be provided with the literature required for specialisation by a profiled department.

The library of the Institute of Energy Systems and Environment, which includes around 400 books in the field of environmental engineering, including thesis works and summaries thereof in the field of environmental engineering and energy sciences, as well as the methodological materials “Protection of the Environment”, is available for use by students of “Environmental Protection” field of study of “Environmental Engineering” study program.

For the provision of the study base, see Part II, Chapter 3. Section 3.1.

For the provision of the scientific base, see Part II, Chapter 3. Section 3.1.

For the information base, see Part II, Chapter 3. Section 3.3.

For the provision of the technical base, see Part II, Chapter 3. Section 3.2.

For the financial base, see Part II, Chapter 3. Section 3.1.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

Major co-operation partners for the realisation of a doctoral program between Latvian universities may be mentioned The University of Latvia, Latvia University of Life Scieneces and Tehnologies.

For example: University of Latvia and Latvia University of Life Scieneces and Tehnologies – co-operation in doctoral training and post-doctoral training, participation of RTU IESE teaching staff in promotion councils, organisation of scientific conferences and seminars.

The most important partners for the realisation of the doctoral program between foreign universities are the University of Alto (Finland), Bergen University (Norway), the Danish Technical University (Denmark), Tallinn University of Technology (TalTech), Estonia, KTH (KTH Royal Institute of Technology, Sweden), and others (list of collaborative universities is presented in section 5.1).

All collaborative universities share scientific and informative resources, exchange of knowledge and experience, summer schools, intensive study programs, doctoral and teaching traineeships, project implementation, joint publication, etc. This is mentioned in more detail in Chapter 3.1 and in the report of the field of study.

Doctoral candidates are involved in research projects.

In an objective assessment, the sharing of resources could be more intensive because, for example, the capacity to use infrastructure, software, databases, etc. can be doubled.

The study program's task is acquiring skills through modern research methods, performing high-quality scientific research and providing advice on climate and environmental technologies, as well as energy supply systems. It will be achieved through the development of promotion work, practical and laboratory work, which is carried out in close cooperation with other institutions and businesses.

Capacity to independently increase their scientific qualifications and capacity to manage research or development tasks in companies, institutions and organisations where non-sustainable research knowledge and skills are interlinked with the study program's task of acquiring the skills to manage and develop sustainable development processes in the industrial and energy sectors or at the level of scientific institutions and promoting the uptake of scientific research in manufacturing and the administration of public and private companies. This competence will be developed by working both on the theme of the thesis work and by developing practical and laboratory works in the framework of study courses in close cooperation with companies and by working on applications and initiatives for new projects, together with their scientific work leaders or a group of scientists.

The direction of environmental science and environmental engineering studies RTU IESE was originally developed on the basis of *BALTECH* cooperation, which started in 2000 when RTU, in cooperation with Kaunas Technological University, Linkoping University, Lund University, Royal Technological Institute and Vilnius Gediminas Technical University, established study programs.

Currently, the RTU, along with other *BALTECH* universities in the Baltic States (Vilnius Gediminas Technical University, Vilnius, Lithuania, Kaunas Technological University, Kaunas, Lithuania and Tallinn Technical University, Tallinn, Estonia), is part of the *NORDTEK* network of Nordic and Baltic countries. *NORDTEK* network operates 20 universities.

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

The overall assessment of academic staff is reflected in the information provided in Criteria 3.5 to 3.6 by the Section II of Chapter 3 of the field of study report and in the CV’s of the teaching staff. In this point the changes and competencies of the academic staff involved in the program in the teaching of specific study courses will be highlighted.

Scientific and academic staff of RTU IESE with a PhD are involved in the implementation of the study program – 25 science doctors, 20 of whom are experts from the Latvian Council of Science (LCS) in environmental engineering or environmental science and 18 European experts (*CORDIS*). Scientists and young scientists involved in the implementation of the study program have specialised in the fields of environmental engineering and energy. The justification for the selection of teaching staff is related to the experience of scientists, research interests, scientific performance, etc., taking into account the specificities of study programs and study courses.

The table List of teaching staff responsible for the study course and teaching staff in the doctoral study programme “Environmental Engineering” (see Annex "List of teaching staff responsible_doctors") summarises information on qualifications of teaching staff in the doctoral

study programme “Environmental Engineering”. The information in the table on study courses taught at doctoral level includes compulsory (Part A) and Part E (final / state examination) study courses. However, almost all this teaching staff participates in the implementation of doctoral level courses of Part C (Elective study courses) (since elective study courses are students’ choice, but they are not listed in this table, but are available in annexes to study course descriptions).

For the implementation of study courses (practical work, laboratory work), the responsible teaching staff shall also invite guest lecturers with a PhD (industry experts, business executives).

The teaching staff of the study program “Environmental Engineering” is mostly the same teaching staff who participated in the implementation of the study program “Environmental Science”. Activities are taken regularly in the “Environmental Engineering” study program in order to have a positive impact on the quality of the implementation of the study program and to ensure that the study program complies with the requirements specified in regulatory enactments.

The most common reason why teachers cease to work in the curriculum is termination their employment relationship with RTU (retirement). The main objectives of RTU IESE in the context of scientific staff are:

- **Reinvestment of academic and research staff, attraction of foreign researchers and professional development of existing research and academic staff.** Build a new generation of researchers and academic staff, actively involving young researchers in research projects. This helps ensure the logical development of staff and clear career opportunities. Scientific staff can also be restored by increasing the number of doctoral students and doctoral degrees awarded. RTU doctoral grants and post-doctoral grants play an important role in this activity, which allow attracting new researchers to RTU from abroad and other Latvian research institutions, and providing academic career opportunities to doctoral students who graduate from RTU. In addition, the project SO 8.2.2 “Strengthening of academic staff of the Riga Technical University in strategic specialisation areas” funded by the European Social Fund and implemented by RTU focuses on renewal of academic staff at RTU. The objective of the project is to strengthen RTU academic staff in strategic specialisation areas in 10 study directions, including in the “Environmental protection” study direction by employing foreign academic staff, doctoral students and candidates for scientific degrees at RTU. The project activities focus in three directions: (1) involvement of doctoral students in academic work at RTU, (2) employment of foreign academic staff at RTU, (3) improvement of the competence of existing academic staff, including traineeships of academic staff with an undertaking, teaching of business English to academic staff and specialised training for academic staff (for more information on the project see section 3.5 of the description of the study direction).
- **Allocation of an international nature for research activities and attracting foreign researchers.** Greater research mobility and joint research projects allow foreign best practices to be taken over. The increasing number of joint scientific publications is one of the positive indicators for achieving this objective.
- **Keeping and motivating human resources, improving corporate culture.** Human resources motivation tools are diverse, including a variety of benefits, as well as wage and performance-assessment links. By increasing the number of international staff, it is important to focus more on corporate cultural issues, building an interdisciplinary, multicultural environment.
- **Development of the research ecosystem, renewal of software and hardware.** RTU constantly improved its research ecosystem by participating in infrastructure development projects (incl. the creation of «RTU – City in a city» – more information on http://www.pilseta.rtu.lv/ (Latvian only)), as well as in scientific research projects. It should be

mentioned that RTU achieved rapid development of digitalisation exactly in spring 2020, when the emergency situation due to COVID-19 was announced, by extending remote work opportunities of students, teaching staff and scientific personnel.

In order to ensure and increase the impact of scientific activity and staff development, the RTU management signs an annual agreement with each RTU faculty setting specific development objectives.

In an objective assessment of the situation, it should be noted that the study program needs to increase the number of full-time foreign trainers during the next accreditation period.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

The overall assessment of academic staff is reflected in the information provided in Criteria 3.5 to 3.6 by the Section II of Chapter 3 of the field of study report and in the CV's of the teaching staff. In this point the relevance of the qualification and competence of the academic staff involved in the teaching of specific study courses will be highlighted.

As one of the essential indicators for the high quality survey of RTU IESE, the high number of publications could be indicated during the reference period, e.g. 2012-2014 (see "Riga Technical University Research Program 2016-2020", p. 224). Compared to other FEEE institutes, the Institute of Energy Systems and Environment publishes the most scientific publications annually, demonstrating that the teaching staff at the Institute are highly qualified and will be able to provide strong support for the new doctoral candidates under the Environmental Engineering study program.

The implementation of the study program shall be attended by 9 professors (see the description of Bachleor's study program point no. 4.2.).

Summaries about the **qualification** of **RTU IESE professors** (as mentioned before, teaching staff of RTU IESE forms 86 % of all the teaching staff in the study programme "Environmental Engineering", teaching staff of other organisational units – 14 %) are provided below:

Professor, ***Dr.hab.sc.ing. Dagnija Blumberga.*** *Dagnija Blumberga, habilitated doctor of engineering sciences and RTU professor, founder of the RTU study direction "Environmental protection", Director of RTU IESE. Is the Director of the RTU study direction "Environmental protection", Director of Bachelor's, Master's and doctoral study programmes "Environmental Engineering" and "Environmental Science". Her total service record in energy and environmental protection is over 50 years. She has extensive experience by leading and participating many national and international projects in the field of energy and environment, for example, bioeconomy, renewable sources, climate change, energy and other environmental engineering related topics. She is on editorial boards of international scientific journals and conference organising committee. Dagnija Blumberga is the author of more than 300 publications, which were mainly published in scientifically reviewed with a high citation*

rate. The total number of scientific publications is over 400, of which 389 are published in Scopus. Co-author of 14 patents. Experience in more than 50 scientific projects and research, of which more than 30 as project manager. Hirsch index 22. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Environmental Technologies", "Production of Biobased Resources", "Bioenergy Technologies".

Professor Dr.sc.ing. Andra Blumberga. *Professor Andra Blumberga is an expert with large experience in the field of energy performance of buildings and system dynamics. She has more than 25 years of professional experience. She works as the head of the Ventilation Department at ABB Latvia, then as Managing Director and the Energy Consultant and in the last 20 years she has been RTU academic staff and since 2012 she has been the RTU FEEE Vice-Dean for Research. She has extensive experience by leading and participating many national and international projects in the field of energy and environment. A.Blumberga is a co-author of 115 scientific publications, which are available in SCOPUS, and her H-index is 17. She is a co-author of 4 patents. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Environmental Policy and Economy", "Energy Efficiency and Energy Audit of Buildings", "Sustainable Rural and Urban Development".*

Professor Dr.sc.ing. Francesco Romagnoli. *Professor Francesco Romagnoli was graduated from the Faculty of Georesources and Geotechnology of the Polytechnic University of Turin, obtaining the degree of an environmental engineer in 2001. In 2002-2008, Francesco Romagnoli worked as an engineering for geotechnical and tunnelling projects in Rocksoil, Italian design company (Milan, Italy). In 2012, he was graduated from Riga Technical University defending the doctoral degree "Model for Sustainable Production and Use of Bioenergy". The main action direction include teaching of courses at the university, supervision of Bachelor's and Master's theses, conducting of scientific research and project management. The main topics of research of Francesco Romagnoli are: biogas, alternative types of biomass for the production of biogas (e.g. seaweed and microalgae), growing of microalgae in a laboratory and their initial cultivation conditions, life cycle analysis and system dynamics modelling with technically provided and sustainably evaluated bioenergy capabilities, provision of cities with anti-flood resilience with a focus on significant infrastructure systems. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Adapting to Climate Change", "Eco-design and Life Cycle Analysis".*

Professor Dr.sc.ing. Gatis Bažbaeurs. *In 1995, Gatis Bažbauers was graduated from the Massachusetts Institute of Technology, obtaining a Master's degree in Mechanical Engineering, and in 1999 obtained a doctoral degree in Environmental Engineering. Since 2009, he has been working at the RTU Faculty of Energy and Environmental Engineering as a professor. Since 2012, Gatis Bažbauers is a RTU Vice-Rector for Research, whose direct job duties include management of the research system and research policy making. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Socio-Economic Aspects of Energy Supply".*

Professor Dr.sc.ing. Ivars Veidenbergs. *Ivars Veidenbergs obtained the degree of a habilitated doctor in 1992. His total service record in thermal energy is 60 years, during which Ivars Veidenbergs work as an engineer in the Latvian Academy of Sciences and in the Diesel Train Laboratory of the Scientific Research Institute for Railway Cars. He continues his professional development at the RTU Institute of Energy Systems and Environment as a*

professor, project manager and expert in thermal energy and heat and mass exchange processes. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Energy Conversion and Efficiency".

Professor Dr.sc.ing. Jeļena Pubule. *In 2014, Jeļena Pubule obtained a doctoral degree in Environmental Engineering. In the last 10 years, she has been working in the field of environmental impact assessment, renewable energy sources, climate change, reading study courses and participating in the implementation of scientific research projects. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Environmental Impact Assessment", "Production of Biobased Resources", "Circular Economy and Waste Management".*

Professor Dr.sc.ing. Jūlija Gušča. *In 2011, she obtained a doctoral degree in Environmental Engineering, doctoral thesis "Development of Latvian energy sources, Study of the impact of carbon dioxide storage processes". Since 2014, she led the RTU Department of Energy Systems and Environment. Research and project management in climate technologies, resource and waste management, environmental performance assessment of products and processes. In 2004-2012, work experience in international companies and organisations in the field of environmental protection and energy – AS Ramboll, United National Development Programme. Since 2011, she has been on the board of the environmental education society "Dabas koncertzāle". Participates in several advisory councils of ministries as RTU representative. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Circular Economy and Waste Management", "Strategic Planning. Innovations and Ecomanagement", "Eco-design and Life Cycle Analysis".*

Professor, Dr.sc.ing. Claudio Rochas. *He obtained the Master's degree in the Polytechnic University of Turin, but in 2008 RTU obtained a doctoral degree in energy and continue working at RTU. Specialises in solar heat systems, combustion processes, optimisation of heat and mass exchange processes, combi-systems for renewable energy sources, planning of energy performance of buildings, energy planning and cost optimisation, and quantitative assessment of resilience of cities. In parallel to academic work, he has been actively working on boards of companies (Renesco, SIA Ekodoma) and in professional organisations (Solar Energy Association). Actively participates in drafting and implementation of scientific projects. He is the author of more than 70 scientific publications, which can be studied in detail in the research gateway profile or in his ortus.rtu.lv profile. quantitative assessment of resilience of cities. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Experiment Planning and Simulation of Processes".*

Professor, Dr.sc.ing. Marika Rošā. *Marika Rošā is an author of 57 scientific articles, which are indexed in the Scopus database, and her Hirsch index is 13. M.Rošā focuses on study of climate technologies in her scientific activity. In recent years, there was also research on energy efficiency from different aspects – her publications and activity in projects includes energy studies at local government level, in the fields of transport, industry, household and agriculture, as well as environmental impact assessment and assessment of climate change related aspects. She is a project coordinator in three Horizon 2020 projects (whether RTU IESE is the leading partner of the project), project manager or coordinator in six other projects (ERDF, IIE, EEA, Nordic Energy Research, etc.) and worked as an expert in another 12 international projects and 19 national level projects (both as participant and manager). In the*

Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Geographic Information Systems".

4 elected associate professors - science doctorates who have been elected as associate professors by the Council of Environmental Science or Energy or Environmental Engineering and Energy Professors and whose scientific and pedagogical qualifications comply with the criteria specified in the regulatory enactments regarding the evaluation of the scientific and pedagogical qualifications of the applicant for the position of associate professor. Associate professors elected by the Councils of Environmental Science or Energy or Environmental Engineering and Energy professors: Edgars Vīgants, *Dr. sc. ing*.; Agris Kamenders, *Dr. sc. ing*., Aiga Barisa, *Dr. sc. ing*. , Anna Kubule *Dr. sc. ing*.

Summaries about the **qualification** of **RTU IESE associate professors** (as mentioned before, teaching staff of RTU IESE forms 86 % of all the teaching staff in the study programme "Environmental Engineering", teaching staff of other organisational units – 14 %) are provided below:

Associate Professor Dr.sc.ing. Agris Kamenders. *A. Kamenders is an Associate Professor at Riga Technical University and he obtained a doctoral degree in engineering sciences. Specialises in energy performance of buildings and industry, district heating systems, renewable energy sources, energy planning and cost optimisation. A. Kamenders is currently actively working in the management of SIA "Ekodoma", where he is the project manager of several energy efficiency projects. Job duties of A. Kamenders include leading of study courses, supervision and implementation of energy projects using latest energy saving technologies and renewable energy systems. In general, A. Kamenders participated in many scientific research projects and research. During his career, Agris has proven his ability to work in a multicultural environment. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Sustainable Rural and Urban Development", "Energy Efficiency and Energy Audit of Buildings".*

Associate Professor Dr.sc.ing. Anna Kubule. *Obtained a doctoral degree in Environmental Engineering. While working at IESE, during 10 years he has obtained experience in direct work with students and scientific research. Participation in over 5 European and global and more than 5 Latvian scientific projects provided her with significant experience. Hirsch index 7. She has experience in reading of lectures to up to 200 people, as well as preparation of seminars and other individual works for smaller audiences, as well as conducting of practical experiments in fuel research and testing laboratory, as well as field trips to companies. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Case Studies on Biobased Products", "Development and Analysis of Biotechonomiy", "Production of Biobased Resources", "Environmental Technologies".*

Associate Professor Dr.sc.ing. Aiga Barisa. *Obtained a doctoral degree in Environmental Engineering. Dr.sc.ing. Aiga Barisa is the author of 21 SCOPUS indexed scientific publications, cited 206 times in total, her Hirsch index is 8. She is a co-author of 9 scientific monographs and textbooks. Her scientific activity is related to research topics line sustainable transport systems, energy efficiency in the transport sector, system dynamics modelling software "PowerSim". She has experience as a participant of 8 international and national level projects as a scientific manager and as a participant. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Biotechnologies", "Development and Analysis of*

Biotechonomy".

Associate Professor Dr.sc.ing. Edgars Vīgants. *Scientific activity of Dr.sc. ing. Edgars Vīgants is related to sustainable heat supply, development of energy technologies and combustion technologies. Scientific abilities have been confirmed by more than 20 scientific articles, which have been published in local and international scientific editions in the last 5 years. Experience of participation in EU projects as a manager and participant. He is a co-author of several state patents. Extensive practical experience in generation of energy from renewable sources. Actively participates in the work of the Latvian Association of Heating Companies, as well as in the Latvian Renewable Energy Federation. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Sustainable Industrial Processes and Technologies", "Bioenergy Technologies".*

The academic staff involved in the implementation of the study program shall carry out scientific research at international level, raising their qualifications and carrying out research activities (see biographies of teaching staff). Academic staff have the capacity to supplement professional knowledge and to acquire valuable experience in one of the foreign universities (through Erasmus, COST or project mobility facilities), consistent with the European Higher Education Area Development Strategy, as well as in businesses.

Table: *Summary of scientific specialisation of teaching staff involved in the implementation of the study program*

No.	Name and Surname	Scientific degree	Occupation	Field of research	h-index
1.	Andra Blumberga	*Dr.sc.ing.*	Professor	System dynamic analysis, modelling of policy instruments, energy performance of buildings, energy efficiency of historic buildings, low and zero-consumption buildings, bio-mimetics, bio-economy modeling, smart air exchange systems	17
2.	*Francesco Romagnoli*	*Dr.sc.ing.*	Professor	Bioresources, biogas and biomethane, life cycle analysis, biogas from algae, risk assessment, resilience to climate change	13

3.	Marika Rošā	*Dr.sc.ing.*	Professor	Energy management, sustainable transport, sustainable industry, GHG emission reduction technologies, GHG modelling	13
4.	Dagnija Blumberga	*Dr.hab. sc.ing.*	Professor	Climate technologies, renewable energy, cleaner production, bio-economy, sustainable heating and cooling, energy end-user management, energy sector modelling	22
5.	Jūlija Gušča	*Dr.sc.ing.*	Professor	Circular economy, waste recovery, sustainability assessment, ecodesign, CO2 capture and storage	8
6.	Anna Kubule	*Dr.sc.ing.*	Associate professor	Environmental pollution prevention technologies, cleaner production, industrial symbiosis, environmental sustainability assessment of production companies	7
7.	Kārlis Valters	*Dr.sc.ing.*	Assistant	Principles of research, prevention of water pollution, evaluation of chemical processes in enterprises	4
8	Gatis Žogla	*Dr.sc.ing.*	Assistant	Energy efficiency of buildings, energy audit	6

9.	*Claudio Rochas*	*Dr.sc.ing.*	Professor	Energy management, final energy consumer management, solar combisystems, technical-economic assessment of energy processes, biogasification	7
10.	Gatis Bažbauers	*Dr.sc.ing.*	Professor	Socio-economic assessment of energy supply, modelling of energy systems, heating processes	10
11.	Ivars Veidenbergs	*Dr.sc.ing.*	Professor	Mathematical modelling of energy technologies, sustainable heating and cooling supply, eco-technology analysis	9
12.	Jeļena Pubule	*Dr.sc.ing.*	Professor	Environmental impact assessment, resource management	5
13	Vladimirs Kirsanovs	*Dr.sc.ing.*	Assistant	Biogasification, sustainable heating	7
14.	Dace Lauka	*Dr.sc.ing.*	Assistante	Solar heating systems, renewable energy modelling, cleaner production in companies, resource recovery	9
15.	Silvija Nora Kalniņš	*Dr.sc.ing.*	Assistante	Environmental management, sustainability assessment, eco-management	5
16.	Aiga Barisa	*Dr.sc.ing.*	Associate professor	Sustainable transport, biogas, bioresources	8

17.	Edgars Vīgants	*Dr.sc.ing.*	Associate professor	District heating, biomass combustion technologies, biofuelable quality	7
18.	Ruta Vanaga	*Dr.sc.ing.*	Assistante	Biomimicry, passive buildings, energy efficiency of buildings	5
19.	Ģirts Vīgants	*Dr.sc.ing.*	Assistant	District heating, biomass combustion technologies, biofuelable quality	5
20.	Agris Kamenders	*Dr.sc.ing.*	Associate professor	Energy efficiency of buildings, energy switching, low consumption, zero consumption buildings	5
21.	Uldis Bariss	*Dr.sc.ing.*	Assistant	Smart Energy, final consumer of electricity	5
22.	Krišs Spalviņš	*Ph.D.*	Researcher	Biotechnology, processing of low quality resources into high value-added products, industrial microbiology	5
23.	Lauma Žihare	*Ph.D.*	Researcher	Bioeconomics, production of high value-added products from agricultural and logging residues, multi-criteria analysis of bioeconomy processes	5
24.	Ieva Pakere	*Ph.D.*	Assistante	Sustainable heating supply,renewable energy resources	7
25.	Miķelis Dzikēvičs	*Ph.D.*	Leading researcher	Latent heat, phase transition materials, pulse code modulation	4

Teaching staff have great experience in the development and execution of research projects which help young scientists to develop the capacity to independently raise the idea of research, to plan, structure and manage large-scale scientific projects in business and the economy, including international.

Since the study program and the study courses included therein are student-centered, and the diversity of students, their past knowledge, skills and experience is taken into account and respected, the diversity of doctoral needs and the assessment of studies are based on an overall achievement assessment approach, where the results of the evaluation are designed to give students an insight into the extent to which they are expected, the results of studies, then the feedback of teaching staff and in-depth involvement of each doctoral candidate provide an opportunity to achieve the results of studies.

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

Teaching staff of the doctoral program “Environmental Engineering” shall carry out regular scientific studies and scientific publications shall be prepared on the results of studies. The number and citation of scientific publications is confirmed by scientific excellence of teaching staff (see Figures below).

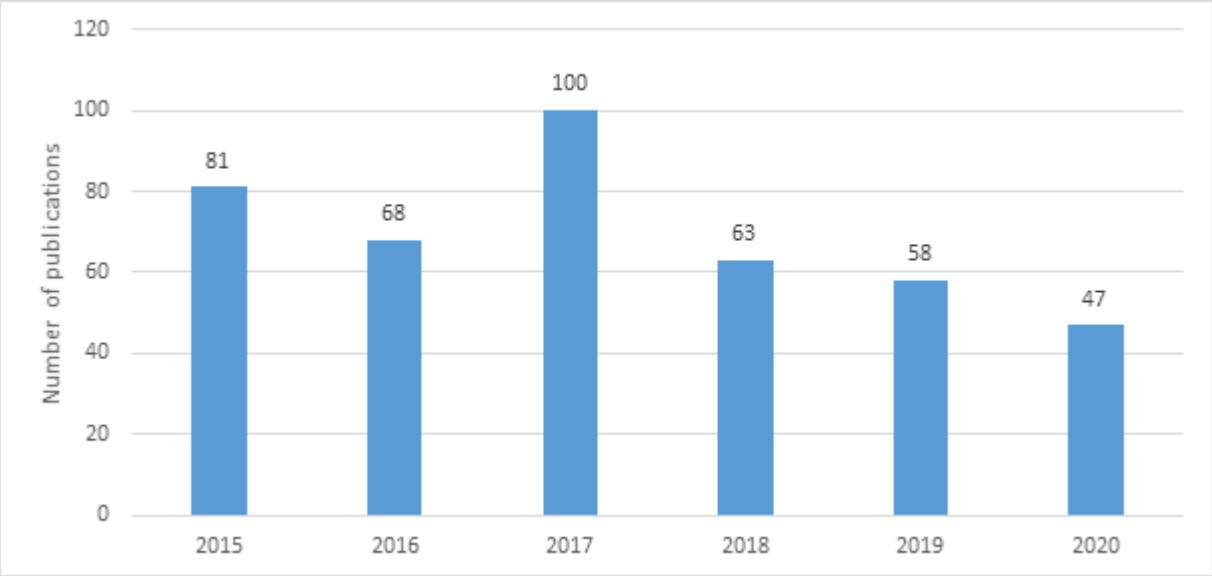

Figure: *Dynamism of SCOPUS publications indexed by the teaching staff in the doctoral study program “Environmental Engineering” (information from Scival tool).*

61 publication or 14.6 % of all the publications published in 2015-2020 are among the top 10 % most cited scientific publications worldwide. The main thematic areas of the journals, in which scientific articles were published, are energy (58.4 %), engineering (6.9 %), environmental science (21.9 %) and agricultural sciences and biology (3.9 %).

For the period 2015-2020, total of 417 publications of the teaching staff of the RTU doctoral

program were published and SCOPUS-indexed, of which 297 in Open Access publications. It should be noted that these publications of teaching staff included in the doctoral program have been quoted 402 times. The best publications and justification of the teaching staff can be found in the following text of the report.

Major publications indexed in Scopus and Wos databases:

1. **Romagnoli, F., Barisa, A., Dzene, I., Blumberga, A., Blumberga, D. *Implementation of different policy strategies promoting the use of wood fuel in the Latvian district heating system: Impact evaluation through a system dynamic model* (2014) Energy, 76, pp. 210-222. Field-Weighted Citation Impact – 1.48.**

   Reasoning: This paper is cited 20 times in Scopus and is published in the SCIMAGO Top 50 journals (28th rank) in energy field. Paper gives insight in the district heating system where different policies are modelled to replace natural gas with wood fuel. System dynamics approach is used for simulations. Results show how different types of policy interventions can speed up difussion of locally available resources and reduces impact on climate change.

2. **Blumberga, D., Muizniece, I., Blumberga, A., Baranenko, D. *Biotechonomy Framework for Bioenergy Use*. Energy Procedia, 2016. Field-Weighted Citation Impact – 6.69**

   Reasoning: This paper has 15 citations in SCOPUS, has high field-weighted citation impact and is outcome from international scientific project on biotechonomy. In this paper the concept of biotechonomy is introduced, as well as the main differences between bioeconomy and biotechonomy are explained. Biotechonomy is based on development of innovative biotechonologies for creation of products with high added value. This has been done due to the fact that both terms mostly are used interchangeably. However, while bioeconomy is a rational and efficient utilization of bio-resources, biotechonomy is the utilization of bioresources by producing new value-added products that are demanded and therefore are competitive with already existing products in the market. Moreover, these value-added products are produced by using innovative biotechnology methods. The focus of this biotechonomical study is on biomass types that could be used in the production of bio-energy. Factors influencing the biotechonomy of bioenergy, as well as basic principles that have to be taken account by using bioresources have been evaluated and developed.

3. **Zoss, T., Dace, E., Blumberga, D. *Modeling a power-to-renewable methane system for an assessment of power grid balancing options in the Baltic States' region.* Applied Energy, 2016. Field-Weighted Citation Impact – 4.44**

   Reasoning: This paper is cited 31 times in Scopus, has got FPEE prize for the best scientific paper of the year 2016 and is published in the SCIMAGO top 50 journals (10th rank) in energy field. Paper presents the concept of power-to-gas, where the excess energy is converted into hydrogen and/or further methanized into renewable methane, is gaining high popularity among researchers. In this study, the power-to-renewable methane system as the potential technology for power grid balancing was assessed. For the assessment, a mathematical model has been developed that assists in understanding of whether a power-to-renewable methane system can be developed in a region with specific installed and planned capacities of wind energy and biogas plants. Considering the varying amount of excess power available for H2 production and the varying biogas quality, the aim of the model is to simulate the system to determine, if wind power generation meets the needs of biogas plants for storing the excess energy in the form of methane via the methanation process. The results show that with the wind power produced in the region it would be possible to increase the average CH4

content in the methanized biogas by up to 48.4%. Yet, even with a positive H2 net production rate, not in all cases the maximum possible quality of the renewable methane would be achieved, as at moments the necessary amount of H2 for methanation would not be readily available, and the reaction would not be possible.

4. **Dace, E., Bazbauers, G., Berzina, A., Davidsen, P.I. *System dynamics model for analyzing effects of eco-design policy on packaging waste management system*. Resources, Conservation and Recycling, 2014. Field-Weighted Citation Impact – 2.77.**

   Reasoning: This paper is cited 30 times in Scopus and is published in the international peer reviewed journal with SNIP factor 2.11. This paper is outcome from international scientific project together with well-known co-author professor P.I.Davidsen from Bergen university. A system dynamics model was developed to analyse the policy mechanisms that promote packaging material efficiency in products through increased recycling rates. The model includes economic incentives such as packaging and landfill taxes combined with market mechanisms, behavioural aspects and ecological considerations in terms of material efficiency (the packaging material per product unit, recycled fraction in products). The paper presents the results of application of various policy instruments for increasing packaging material efficiency and recovery rate and reducing landfilled fraction.

5. **Balina, K., Romagnoli, F., & Blumberga, D. (2017). Seaweed biorefinery concept for sustainable use of marine resources. Paper presented at the Energy Procedia, , 128 504-511. Field-Weighted Citation Impact – 7.22.**

   Reasoning: This paper is cited 34 times in Scopus and is published in the international peer reviewed Open Access journal with SNIP factor 0.782. The role of seaweed biorefinery concept is analysed in this paper under the perspective of bioeconomy principles and through a SWOT analysis was made to indicate the role biorefinery concept can play to support the development of sustainable bioeconomy.

6. **Barisa, A., Romagnoli, F., Blumberga, A., & Blumberga, D. (2015). Future biodiesel policy designs and consumption patterns in latvia: A system dynamics model. Journal of Cleaner Production, 88, 71-82. Field-Weighted Citation Impact – 4.15.**

   Reasoning: This paper is cited 46 times in Scopus and is published in the international peer reviewed Open Access journal with SNIP factor 2.394. This research deals with the dynamic simulation modeling of a biodiesel market as a part of transportation fuel market and analyses of various policy support instruments on increasing the proportion of biofuel in total transport fuel demand. The study is carried out for Latvia's road transport sector. After it had experienced generous financial support from the government allowing the industry to develop, support was abruptly stopped creating stagnation in both biodiesel supply and demand. This threatened the national transport policy goals. The goal of this research is to find the most effective policy strategies for achieving the national transport policy goals by applying system dynamics modeling to the current market conditions of transport fuels.

7. ***Timma, L., Zoss, T., & Blumberga, D. (2016). Life after the financial crisis. energy intensity and energy use decomposition on sectorial level in latvia. Applied Energy, 162, 1586-1592. Field-Weighted Citation Impact – 2.57.***

   Reasoning: This paper is cited 34 times in Scopus and is published in the international peer reviewed journal with SNIP factor 2.865. This study explores the causes of changes in energy intensity and energy use in Latvia by applying logarithmic mean Divisia index decomposition

and mean-rate-of-exchange index analysis for energy sectors. Analysis on the latest data (2008-2012) reveals if any technological or structural changes have occurred during and after economic downturn in Latvia. The study explored effect of economic activity on final energy use. The results show that the reduction in energy intensity before the year 2008 can be largely attributed to decline in energy intensities within sectors, but the increase in energy intensity after the year 2008 is regarded to expansion of energy demanding sectors.

8. **Zagorskas, J., Zavadskas, E. K., Turskis, Z., Burinskiene, M., Blumberga, A., & Blumberga, D. (2014). Thermal insulation alternatives of historic brick buildings in baltic sea region. Energy and Buildings, 78, 35-42. Field-Weighted Citation Impact – 4.62.**

   Reasoning: This paper is cited 76 times in Scopus and is published in the international peer reviewed journal with SNIP factor 2.334. Publikācija ir starptautiskā zinātniskā projekta "COOL Bricks - Climate Change, Cultural Heritage & Energy Efficient Monuments" Latvijas un Lietuvas zinātnisko pētījumu rezultāts. This article covers the theme of retrofitting the historical buildings, when due to the valuable façade or other heritage preservation requirements only the inside insulation is allowed. The problems of moisture in brick wall construction, loosing space, etc. are discussed and method for selecting best insulation option is shown. The 5 modern insulation materials are selected, measurements are made and best alternative is found using TOPSIS method with grey numbers.

9. **Ziemele, J., Gravelsins, A., Blumberga, A., Vigants, G., & Blumberga, D. (2016). System dynamics model analysis of pathway to 4th generation district heating in latvia. Energy, 110, 85-94. Field-Weighted Citation Impact – 2.90.**

   Reasoning: This paper is cited 33 times in Scopus and is published in the international peer reviewed journal with SNIP factor 2.012. In the article, a possibility to introduce the 4th generation district heating (4GDH) in Latvia is analyzed with the system dynamic modeling. Three policy instruments were included into the system dynamic model: subsidies, instrument for risk reduction and instrument for efficiency increase, and their impact on the system operation was analyzed. Six development scenarios are examined in the article, two of which are supplemented with the transition of heat network to the low-temperature regime at a different share of the renewable energy.

Most important scientific monographs:

1. Blumberga, A., Bažbauers, G., Davidsens, P., Blumberga, D., Grāvelsiņš, A., Prodaņuks, T. System Dynamic Modelling in Bioeconomy Sector. Riga: RTU publishing house, 2016, 332 p. ISBN 978-9934-10-801-3. Available: doi:10.7250/9789934108013 (In Latvian)

Reasoning: The scientific monograph provides an insight into the biotechonomic science sector and looks at the feasibility of modelling systems. The monograph describes and illustrates the model of dynamism created by the authors, which provides for the full use of different bioresources to produce high value added products based on the principles of sustainable development. The monograph summarises the results of modelled sector analyses to illustrate the interaction between bioresources, biotechnologies and bioproducts.

2. Blumberga, D., Barisa, A., Kubule, A., Kļaviņa, K., Lauka, D., Muižniece, I., Blumberga, A., Timma, L. Biotechonomy. Riga: RTU publishing house, 2016. 338 p. ISBN 978-9934-10-789-4. (In Latvian)

Reasoning: In the collective monograpy, Biotechonomy provides an insight into the feasibility

of full use of bio-resources in order to obtain high value added products based on sustainability development principles. The book deals with interactions between bioresources, biotechnologies and bio-products.

3. Blumberga, A., Blumberga, D., Biseniece, E., Kamenders, A., Kašs, K., Vanaga, R., Žogla, G. Energy Efficiency in Buildings: Yesterday, Today and Tomorrow. Riga: RTU publishing house, 2017. 352 page. ISBN 978-9934-10938-6. (In Latvian)

Reasoning: The book was written by a collective of authors under the leadership of professor Andra Blumberga. "Creating, using and maintaining a sustainable building is one of the greatest challenges of modern humanity. This requires courage, imagination, knowledge and the ability to cooperate," says A. Blumberga. The book is a collection of many years of experience, insights, studies and insights from its authors, based on energy audits of buildings, research in laboratories and specific buildings, in cooperation with energy efficiency and climate policy makers and building owners.

4. Valtere, S. N.Kalniņš, D.Blumberga. Environmental management and energy management. RTU publishing house, ISBN: 978-9934-10-566-1, 288 page, 2014 (In Latvian)

Reasoning: The scientific monograph provides a reflection of environmental science management challenges and solutions. Environmental management has been analysed by evaluating and modelling processes, analysing programs and projects through the prism of environmental engineering. Particular attention is paid to one of the key environmental management lines – energy management – and reflects the common and different features of the science of environmental management and energy management. Analysis of environmental management, with particular emphasis on the role of energy management, implementation models, their structure, practical use, information provision and methods used/The presentation is based on scientific developments of the authors and their implementation in practice.

The annexes add a list of all teaching staff who are involved in the implementation of the study program (see Annex "Basic information of involved teaching staff" section *doctors*), the creative and scientific biographies of the teaching staff involved (see Annex "Teaching staff CV's") and the results of research activities (see Annex "List of patents and publications of academic staff").

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

RTU IESE teaching staff participate in a variety of scientific research projects at both local and international level. For more on the involvement of teaching staff in the implementation of research projects, see section 4.3 of the description of the field of study.

The current projects, where RTU IESE teachers act as project managers, are presented below, including the project name, source of funding, the amount of funding (reflecting the budget share of the RTU IESE project rather than the budget of all project partners). Managers of all projects have a doctoral scientific degree and some experience in managing international scientific projects.

1. ***Energy efficiency in renovated multi-apartment buildings SUNSHINE*** *(2015 – 2019/2020)*

   Project managers: Marika Rošā, Claudio Rochas

   The project is financed by: HORIZON 2020

   Project budget: EUR 183 553.00

2. ***RIBuild: Rubust Internal Thermal Insulation of Historic Buildings*** *(2015-2020)*

   Project manager: Andra Blumberga

   The project is financed by: HORIZON 2020

   Project budget: EUR 346 375.00

3. ***LowTEMP: Low Temperature District Heating for the Baltic Sea Region*** *(2017-2020)*

   Project manager: Francesco Romagnoli

   The project is financed by: The Interreg Baltic Sea Region Programme 2014-2020

   Project budget: 250 000.00 EUR

4. ***ActNow: Action for Energy Efficiency in Baltic Cities*** *(2017-2020)*

   Project manager: Francesco Romagnoli

   The project is financed by: The Interreg Baltic Sea Region Programme 2014-2020

   Project budget: 254 772.00 EUR

5. ***TEST-4-SME: Laboratory Network for Testing of Environmental Products*** *(2017-2020)*

   Project manager: Jūlija Gušča

   The project is financed by: The Interreg Baltic Sea Region Programme 2014-2020

   Project budget: 285 000,00 EUR

6. ***Improving production efficiency in the fish processing companies*** *(2018-2021)*

   Project manager: Dr.habil.sc.ing. Dagnija Blumberga

   The project is financed by: European Maritime and Fisheries Fund

   Project budget: 289 423.08 EUR

7. ***Climate investment capacity (CIC): climate finance dynamics & structure for financing the 2030 targets*** *(2018-2020)*

   Project manager: Agris Kamenders

The project is financed by: The European Climate Initiative (EUKI)

Project budget: 60 960 EUR

8. ***ICCEE - Improving Cold Chain Energy Efficiency*** *(2019-2022)*

   The project is financed by: HORIZON 2020

   Project manager: Francesco Romagnoli

   Project budget: 63 000 EUR

9. ***Supercritical Omega-3 oil from production by-products*** *(2018-2021)*

   Project manager: Krišs Spalviņš

   The project is financed by: ERDF, RTU co-financing

   Project budget: 27 777 EUR

10. ***Advancing Sustainable Circular Bioeconomy in Central and Eastern European countries*** *(2019-2022)*

    Project manager: Dagnija Blumberga

    The project is financed by: HORIZON 2020

    Project budget: EUR 104 937.5

11. ***Blind spots in the energy transition policy*** *(2018-2020)*

    Project manager: Dagnija Blumberga

    The project is financed by: Latvia's state budget Fundamental and Applied Research Project LZP-2018/2-0022

    Project budget: 199 000 EUR

12. ***Bioresources value model (BMV)*** *(2018-2021)*

    Project manager: Anna Kubule

    The project is financed by: Latvia's state budget Fundamental and Applied Research Project LZP-2018/1-0426

    Project budget: 285 000 EUR

13. ***Integrated CO2 biofilter and microalgae biomass production technology for biogas plants using novel Stacked Modular Open Raceway Pond approach (SMORP)*** *(2018-2021)*

    Project manager: Francesco Romagnoli

The project is financed by: Latvia's state budget Fundamental and Applied Research Project LZP-2018/1-0426

Project budget: 255 085 EUR

14. ***Improvement of building energy efficiency technologies*** *(2018-2021)*

    Project manager: Andra Blumberga

    The project is financed by: National Research Program "Energy"

    Project budget: 354 000 EUR

15. ***The Pathway to energy efficient future for Latvia*** *(2018-2021)*

    Project manager: Marika Rošā

    The project is financed by: National Research Program "Energy"

    Project budget: 354 000 EUR

16. ***Development of heat supply and cooling systems in Latvia*** *(2018-2021)*

    Project manager: Dagnija Blumberga

    The project is financed by: National Research Program "Energy"

    Project budget: 354 000 EUR

17. ***Assessment and analysis of energy efficiency policy*** *(2018-2021)*

    Project manager: Gatis Bažbauers, Andra Blumberga

    The project is financed by: National Research Program "Energy"

    Project budget: 354 000 EUR

18. ***4muLATe Sustainable and renewable transport policy formulation in Latvia*** *(2018-2021)*

    Project manager: Aiga Barisa

    The project is financed by: National Research Program "Energy"

    Project budget: 350 000 EUR

19. ***Assessment of Latvia's renewable energy supply-demand economic potential and policy recommendations*** *(2018-2021)*

    Project manager: Andra Blumberga

    The project is financed by: National Research Program

Project budget: 600 000 EUR

20. ***Smart facade for solar energy collection in buildings (EVEREST) (2019-2021)***

    Project manager: Dr.sc.ing. Ruta Vanaga

    The project is financed by: Latvia state budget Fundamental and Applied Research Programme

    Project budget: EUR 300,000

21. ***Bridge to carbon neutral energy communities: social sciences and humanities meet energy research (BRIDGE) (2021-2023)***

    Project manager: Dr.sc.ing. Andra Blumberga

    The project is financed by: Latvia state budget Fundamental and Applied Research Programme

    Project budget: EUR 300,000

22. ***Integrated decarbonisation solutions for the efficient valorisation of CO2 in regions (CO2 Deal)*** *(2021-2023)*

    Project manager: Dr.sc.ing. Jūlija Gušča

    The project is financed by: Latvia state budget Fundamental and Applied Research Programme

    Project budget: EUR 300,000

23. ***Circular economy solutions in health care waste management to ensure environmental protection and public health goals (Panacea) (2021-2023)***

    Project manager: Dr.sc.ing. Silvija Nora Kalniņš

    The project is financed by: Latvia state budget Fundamental and Applied Research Programme

    Project budget: EUR 300,000

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

The overall assessment of academic staff is reflected in the information provided in Criteria 3.5 to 3.6 by the Section II of Chapter 3, of the field of study report and in the CV's of the teaching staff. In addition, see section 2.5, link to the study process and the involvement of students in research.

The academic staff of the study program shall be involved, at both national and international level, in scientific research in the field of environmental protection, the information and experience acquired shall be integrated into the study process and in the development of new academic and scientific projects. For the scientific research directions in which the teaching staff works, see the description of the Bachelor's study program, Chapter III, Point no. 4.5.

Some of the most important research results, which are integrated into academic studies and are intended to be achieved and integrated in the future in the study process (see section 4.3 for more about scientific projects):

- **"Horizon 2020" project "Biowaste and Algae Knowledge for the Production of 2nd Generation Biofuels"** (01.04.2010 - 31.03.2015) an innovative, economically efficient and sustainable system is dedicated to producing second-generation biofuels from biological waste, using macroalgae as a catalyst. As a result of the project, RTU IESE was set up and developed by the Biosystems Laboratory.
- **Erasmus+ project "CABARET**" (2016-2019) sustainable international and regional cooperation between higher education institutions in Asia and Europe has been established during the project, with a view to establishing a sustainable early warning system and promoting the capacity to resist disasters in coastal communities. "CABARET" project RTU IESE initiated a new research direction – infrastructure resilience to natural disasters and one promotion job on this subject has now been completed and one doctoral candidate continues to work on his promotion work in this area.

The academic staff of the study program shall, at both national and international level, engage in scientific research in the field of their competence and integrate the information, experience and latest research methods into the study process. Research courses are in line with national priorities and are linked to RIS3 specialisation areas.

Results of each research project are internalised in the study process.

Teaching staff participate actively in mobility activities. If the number of students in mobility remains unaltered, the number of teachers participating in mobility activities is increasing rapidly.

The academic staff under the program shall regularly hold conferences, organise conferences in Latvia and abroad, be composed of different redboards (see academic staff's CV's) and carry out other research activities, the results of which are included in the implementation of the staging program and in the preparation of young scientists.

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study program operates a mechanism for mutual cooperation between teaching staff and contributes to the development and interlinking of study courses. The development of study courses takes place on a regular basis, on the basis of suggestions made by students and on developments in the sector (see the description of Bachelor's study program point no 4.6.).

The achievement of study courses and program objectives and results within the framework of the

program shall be carried out at regular intervals by organising teaching staff seminars and discussions on the results of studies and the basic principles for quality assurance. Thus, it can be said that there is a mechanism for mutual cooperation between teaching staff, which promotes the development and interlinking of study courses.

The study program is designed to ensure a sequential development of knowledge, skills and competences based on individual and group work, continuous communication between doctoral candidates and their leaders.

The final link of the courses is indicated in point 2.2 of Chapter 2 of Part 3 of the Accreditation Self-Assessment Report of the doctoral research program “Environmental Engineering”.

First year of study (total 48 CP):

- ***Compulsory courses of 6 CP*** *in extent of the study course, EAS757 “Doctoral garage: analysis and publication of research results” (6 CP). The course is linked to scientific communication, from the preparation of a scientific article until it is accepted in an internationally quoted scientific journal. The topics concerning scientific writing styles, types and structures of publications, visual presentation of results, ethical issues and the choice of the most appropriate scientific edition for the manuscript concerned are examined. Both permanent jobs and group jobs are being performed in combination with role games elements. The course consists of a majority of the teaching staff of the study program (see study course descriptions).*
- ***Free-choice study courses (21 CP),*** *g. “Environmental Policy”. Theoretical aspects of climate technologies (9 CP), or “Ecological aspects of energy technologies” (9 CP), “Modern Environmental Problems. Solutions. Modelling” (15 CP), “Solar systems” (6 CP), “Life cycle analysis” (6 CP), “Biomarine generation”. Systems analysis' (6 CP) or other courses.*
- ***Scientific work (21 CP)*** *takes place in cooperation with the promotion manager. At the end of the first year of study, at least one publication shall be prepared and submitted for publication, a report drawn up and presented at an international conference.*

Second year of study (48 CP):

- ***Compulsory courses of 9 CP*** *in the course of THE study course EAS603 “Environmental Assessment” (9 CP).*
- ***Free-choice study courses (6 CP)*** *such as “Solar systems” (6 CP), “Life cycle analysis” (6 CP), “Biohydrogen. System analysis” (6 CP) or other courses.*
- ***Scientific work (33 CP)*** *takes place in cooperation with the promotion manager. At the end of the second year of study, at least two publications and reports at international conferences shall be prepared and published. Promotion readiness at this stage is 30...40%.*

Third year of study *is devoted to scientific work, research, publishing research results, participation in experience exchange and mobility projects. The individual work of the doctoral candidate is strengthened, cooperation with the driver is ensured, as well as the regular possibility of meeting with other doctoral candidates to ensure the transfer of experience and knowledge. Ongoing work on scientific publications (at least 2 publications should be developed and submitted for publication), international cooperation between the young scientist is being developed. Promotion readiness at this stage is up to 70%.*

Fourth year of study *the final phase of the study, preparation for submission to the Promotion Board, shall be ensured during the period. Ongoing work in the field of scientific publications (at least 2 publications have to be developed and submitted for publication) is developing international cooperation between the young scientist. During the fourth years of study, there is also a pre-defence of the promotion work: the members of the RTU promotion council P-19, the head of the*

promotion job, doctoral candidates, other interests. During pre-replacement, it is decided whether the promotion work is directed for submission or whether improvements to the promotion work should be made (including Hearing recommendations on how to improve promotion work). The fourth year of study concludes with the submission of promotion work to the promotion. It should be noted that not all doctoral candidates can be part of the study plan. After the second or third year of study, some doctoral candidates choose to go on academic leave (in the "Environmental Science" study program, academic leave mainly goes up to 15% of all doctoral candidates), during which individual work strengthens knowledge in the specific field of research. The average period for the development of promotion work in the RTU study program "Environmental Science" was 4.8 years.

The information contained in study courses constitutes a logical interlinking, ensuring the upward development of learners' knowledge and skills. The following measures shall be used to improve the content and quality of the study program, as well as to ensure mutual cooperation between teaching staff, the exchange of experience and information related to study work:

- Teacher meetings (not less than 1 in semester);
- meetings of the Scientific Commission (not less than 1 time in 2 months);
- meetings of the Board of Promotion (if necessary but less than 4 times a year);
- within the framework of the Doctors' Certification Unit (each week, when the teachers change - average for one teaching member 2 x semester) and the faculty;
- Scientific conference (once a year);
- Seminars, conferences, think tanks, etc.

Together, 24 teaching staff with a PhD are involved in the execution of the doctoral program, of which 96% or 23 are drivers of promotion, 79% or 19 persons participate in the implementation of the program as teaching staff and promotion managers.

The number of students in the last 3 academic years of the study program "Environmental Science" has been (2016/2017) - 61 (all courses together), respectively (2017/2018) 64 (all courses together) and (2018/2019) 62, which means an average of 2 students per teacher in the study program. In view of the fact that academic subjects also work in other RTU departments, local and foreign experts, the ratio of students and teaching staff may also be assessed in the context of the direction and faculty of study.

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	Statistical data_doctors.pdf	Statistikas dati_doktori.pdf
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	Compliance with national standard_doctors.pdf	Atbilstība valsts standartam_doktori.pdf
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Mapping of the study courses_doctors.pdf	Studiju kursu kartējums_doktori.pdf
Curriculum of the study programme (for each type and form of the implementation of the study programme)	Study programme planning_doctors.docx	Studiju programmas plānojums_doktori.docx
Descriptions of the study courses/ modules	Study course descr_doctors.pdf	Studiju kursu apraksti_doktori.pdf
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	Diploma sample_doctors.pdf	Diploma paraugs_doktori.pdf
Description of the Study Programme - Other mandatory attachments		
Document confirming that the higher education institution/ college will provide the students with the options to continue the acquisition of education in another study programme or at another higher education institution/ college (a contract with another accredited higher education institution/ college), in case the implementation of the study programme is discontinued	Agreement for possibility to continue studies_doctors.zip	Vienošanās par studiju turpināšanu_doktori.pdf
Document confirming that the higher education institution/ college guarantees to the students a compensation for losses if the study programme is not accredited or the licence of the study programme is revoked due to the actions of the higher education institution/ college (actions or failure to act) and the student does not wish to continue the studies in another study programme	01000-2.2.1-e_178.edoc	01000-2.2.1-e_178.edoc
Confirmation of the higher education institution/ college that the teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language according to European language levels (see the levels under www.europass.lv), if the study programme or any part thereof is to be implemented in a foreign language.	02000-2.2.1-e_22.edoc	02000-2.2.1-e_22.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.	04000-2.2.1-e_10.edoc	04000-2.2.1-e_10.edoc
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education	02000-2.2.1-e_24.edoc	02000-2.2.1-e_24.edoc
Sample (or samples) of the study agreement	Study agreement sample_doctors.pdf	Studiju līguma praugs_doktori.pdf
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.	AIP conclusion_doctors.zip	AIP atzinums_doktori.pdf

Environmental Engineering (45529)

Study field	*Environmental Protection*
ProcedureStudyProgram.Name	*Environmental Engineering*
Education classification code	*45529*
Type of the study programme	*Academic master study programme*
Name of the study programme director	*Dagnija*
Surname of the study programme director	*Blumberga*
E-mail of the study programme director	*dagnija.blumberga@rtu.lv*
Title of the study programme director	*Dr.habil.sc.ing.*
Phone of the study programme director	*29419783*
Goal of the study programme	*The objective of the study programme is to prepare systemically thinking highly skilled specialists focusing on preventive environmental prevention activities and the development and implementation of innovative zero-pollution technologies with an integrated academic education (Master's degree in engineering sciences) in two specialisations – "Environmental Engineering" and "Circular Bioeconomy". Students will multiply their understanding of environmental protection technologies, will learn how to assess the environmental impact of processes on the local and global scale, and use progressive methods and modelling tools to describe, quantitatively and qualitatively evacuate and solve environmental problems.*
Tasks of the study programme	*- to provide competitive academic higher education of Master level meeting international standards in the field of environmental engineering in two specialisations – "Environmental Engineering" and "Circular Bioeconomy", thus ensuring continuous improvement of the quality of environmental education and preparing highly educated environmental engineering leaders for the private and public sector;* *- to promote the capacity of students to develop environmental and climate technologies fitting local conditions and stimulating the national economy, as well as to develop the capacity of students to carry out research in the field of bioeconomy, climate and environmental technologies, who are capable of improving the processes of the environmental protection sector at national and international level;* *- to achieve interaction between students and academic staff in the development of research papers and to demonstrate best practices for the practical implementation of the results* *obtained in environmental engineering companies at the international level, as well as the disclosure of the scientific results obtained in high-impact international scientific journals;* *- to encourage the interest of students and graduates in doctoral-level study programmes, lifelong learning, as well as academic and scientific excellence.*

Results of the study programme	*Graduate of the study programme:* *- demonstrates extended knowledge and understanding in the field of environmental protection and is able to create values, including intellectual values, in environmental engineering, and, using theoretical, methodical and problem-solving system thinking skills, to be able to critically analyse integrated solutions that match the latest findings to improve the environmental situation by focusing on long-term pollution evaluation methods;* *- is able to conduct research and professional projects and develop comprehensive recommendations for the prevention of environmental pollution in the fields of bioresources, bioeconomy, environmental and climate technologies, environmental policy, cleaner production, smart energy, energy efficiency, climate adaptation and so on;* *- is able to integrate knowledge into the implementation of environmental protection measures, to make a contribution to the creation of new knowledge, the development of environmental engineering research or professional activity methods, to formulate and collect scientific research results in scientific papers and present these results to industry professionals and society as a whole;* *- using new learning approaches is able to independently develop improvement of own competencies in environmental engineering and related interdisciplinary areas, driving innovation in the field of environmental research and their implementation in sectors of the national economy.*
Final examination upon the completion of the study programme	*Master Thesis*

Study programme forms

Full time studies - 2 years - latvian

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor degree in engineering science, social sciences, or comparable education. If necessary (for example, applicants who have obtained a bachelor's or professional bachelor's level education in a non-engineering field and lack professional experience in the study program field) should take education equalization courses by the order of the study program director, taking into account the applicant's previous education documents and knowledge gained in professional activity.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Environmental Engineering*
Qualification to be obtained (in english)	*-*

Places of implementation

Place name	City	Address

Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 2 years - english

Study type and form	*Full time studies*
Duration in full years	*2*
Duration in month	*0*
Language	*english*
Amount (CP)	*80*
Admission requirements (in English)	*Bachelor degree in engineering science, social sciences, or comparable education. Proof (certificate) of English language knowledge is required.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Master of Engineering in Environmental Engineering*
Qualification to be obtained (in english)	-

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The Master's academic study programme "Environmental Engineering" was created on 28 October 2019 (RTU Senate decision No.633). The programme was licenced on 27.04.2020 and is now advanced for accreditation to obtain accreditation for six years.

The forms of implementation are full-time intramural studies (20 CP per semester). RTU standard planning includes 2 semesters per year of studies; duration of each semester is 20 weeks: 16 study weeks and 4 session weeks. Mastering of study courses in the specified time period in this programme is planned in the form of "modules" or 2-3 study courses take place at the same time, and a test is passed at the end, and then next study courses are planned. Therefore, one semester lasts 20 weeks, without dividing into individual session weeks.

Since 2003, adapting to the students' demand, the programme "Environmental Science" was been mainly implemented on working days at evenings, so in the form of full-time intramural studies. Therefore, the programme was mainly implemented as part-time studies.

The place of implementation of the study program is Riga. The study program is no longer implemented in the RTU affiliations. The study programme is implemented only in Latvian and English.

Implementation of the study program "Environmental Engineering" started in September 2020. During the academic year 2020/2021, taking into account the limitations of COVID-19 and changes in the number of incoming students, the studies were carried out only in Latvian.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

Statistical data on students in the reporting period in the academic Master's study programme "Environmental Engineering" are built on the enrolment indicators of the year of studies 2020/2021. In individual indicators the planned achieved indicators will be compared to the academic Master's study programme "Environmental Science", because it is built on the basis of this programme.

In year of studies 2020/2021, 40 students were enrolled in the study programme. If we evaluate the experience of the study programme "Environmental Science" in the reporting period, then the average number of students enrolled per year is 38.

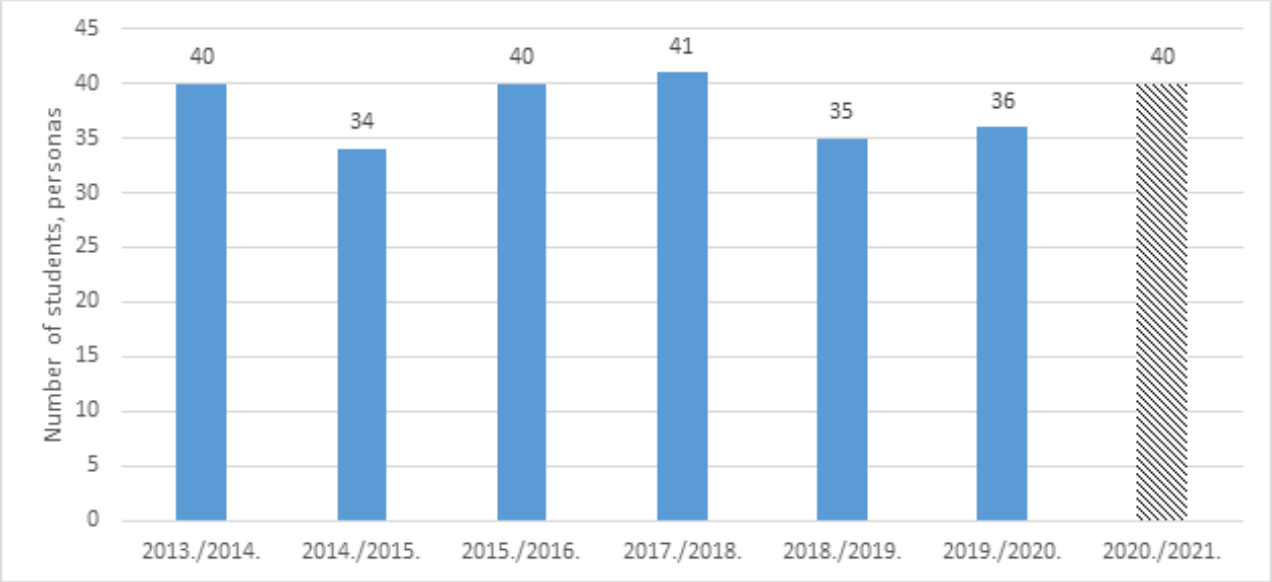

Figure: *Number of students (persons) enrolled in the Master's study programme "Environmental Science".*

Fluctuations in the number of students are related to:

- number of enrolled Bachelor students, who are potential Master students.
- Environmental engineering development trends in Latvia and global trends. In accordance with the information provided by cooperation companies of RTU IESE, lack of environmental protection specialists in observed in Latvia.
- Information and engineering sciences popularisation activities conducted in the specific year by RTU in general and specifically RTU FEEE and RTU IESE.
- Activities of foreign universities (outside Latvia) for attraction of foreign students in Latvia in the specific year.
- Socio-economic situation in the country, including employment, migration.

It should be noted that the study programme "Environmental Science" and "Environmental Engineering" attracts many external students, i.e. those who were graduated from other study programmes (for example, "Computer Sciences", "Electrical Engineering", "Energy", "Geodetics", "Quality management", "Construction", etc.), as well as those people, who already obtained a Master's degree in different sciences, but work actively in the field of environmental protection and feel the professional need to obtain the degree of a Master of Engineering in Environmental Engineering Sciences.

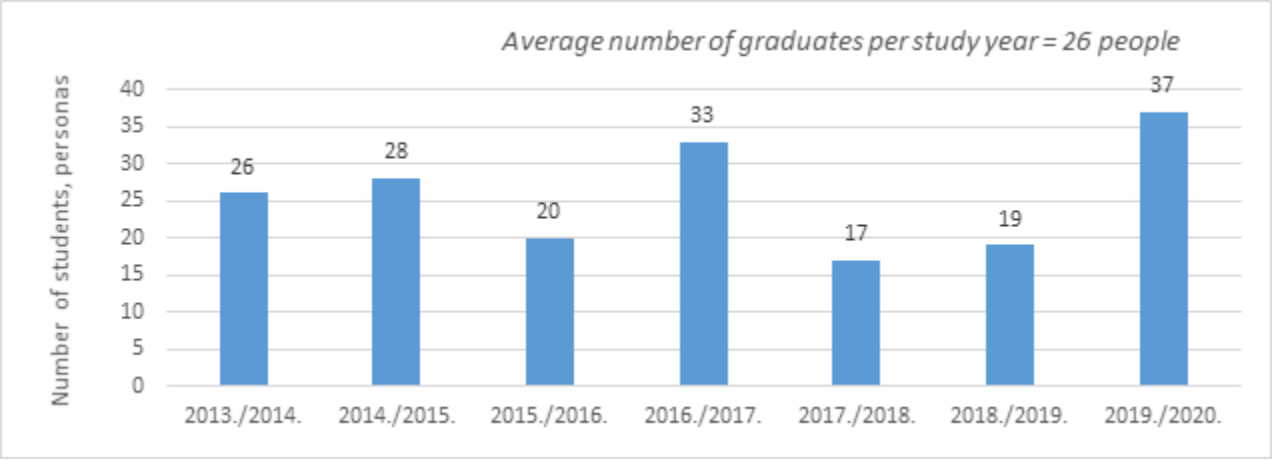

Figure: *Dynamics of enrolled students in the Master's study programme "Environmental Science" (Latvian and international students).*

Most of students (up to 100%) can study in state-funded budget study places.

Fluctuations in the number of students are related to environmental engineering development trends in Latvia and global trends. In accordance with the information provided by cooperation companies of RTU IESE, lack of environmental protection specialists in observed in Latvia.

Statistical data on the study programme "Environmental Science" evidence that up to 16% of students drop out every year in the reporting period. The calculation of dropouts does not include students, who dropped out due to not starting studies after enrolment or not concluding the study agreement. Most of students drop out after the first year, dropouts in other study years are lower.

When analysing the dynamics of the number of students together with industry development trends in the world and the situation in Latvia, a stable number of students and extensive development opportunities are expected in the Master's study programme "Environmental Engineering" in the future.

Table: *Forecasts of the number of students in the Master's study programme "Environmental Engineering"*

	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
Students					
Enrolled	30	45	60	75	80
% outside the EU	5%	15%	25%	40%	50%
Dropouts (year on year)	5%	5%	5%	5%	5%
Total number of students	29	72	129	200	276
Tuition fee per year					
EU	4400	4400	4620	4620	4851
Outside the EU	4400	4400	4620	4620	4851

During the academic year 2020/2021, studies in the program "Environmental Engineering" were implemented only in Latvian. The shortage of foreign students is due to the limitations of COVID-19 and the sharp decline in the number of incoming foreign students in all study programs.

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The title of the study program, its aim, tasks, learning outcomes, professional qualification and admission requirements are closely related. The content of the study programme complies with the labour market requirements.

The academic Master's study programme "Environmental Engineering" has been implemented at Riga Technical University from the year of studies 2020/2021. Graduates of the study programme obtain the **degree of a Master of Engineering in Environmental Engineering Sciences**. The amount and the duration of implementation of the study programme is 80 CP.

Today, protecting the environment and tackling climate change are the most important global challenges. The need for contemporary environmental solutions and, therefore, specialists is growing steadily, and higher education institutions play a key role, both in research and in the preparation of new specialists for economic sectors. In view of the diversity of environmental and

climate change themes and solutions, future environmental engineering study programmes should be directly oriented towards an interdisciplinary higher education model, combining engineering, natural and exact sciences, social sciences, political sciences, humanities, thereby providing the national economy with competitive cross-sectoral professionals ready to work locally globally and globally, building our common future. The interdisciplinary nature of environmental matters is also confirmed by the Latvian Smart Specialisation Strategy, defining a total of five specialisation areas: (1) knowledge-intensive bioeconomy; (2) biomedicine, medical technologies, biopharmacy and biotechnologies; (3) smart materials, technologies, and engineering systems; (4) smart energy; (5) information and communication technologies. For of them (knowledge-intensive bioeconomy; biomedicine, medical technologies, biopharmacy and biotechnologies; smart materials, technologies and engineering systems; smart energy) directly include the environmental protection (in particular, preventive environmental protection) approach.

The study programme provides knowledge and skills on the evaluation of the sustainability of existing technologies and systems (environmental, economic, social aspects); the development and optimisation of new environmental technologies and products (bio-resources, renewable energy sources, emissions prevention, etc.); the use of bio-resources for creation high added value developments and for long-term development of the economy through the bioeconomy prism; evaluation of existing environmental management models and development of new models at company and regional level; cross-disciplinary approach to resolution of environmental protection problems; conducting, evaluating, reporting and publishing original scientific studies.

The **objective** of the study programme is to prepare systemically thinking highly skilled specialists focusing on preventive environmental prevention activities and the development and implementation of innovative zero-pollution technologies with integrated academic education (Master's degree in engineering sciences) in two specialisations – "Environmental Engineering" and "Circular Bioeconomy". Students will multiply their understanding of environmental protection technologies, will learn how to assess environmental impact of processes on the local and global scale, and to use progressive methods and modelling tools to describe, quantitatively and qualitatively evacuate and solve environmental problems.

Tasks of the study programme:

- to provide competitive academic higher education of Master level meeting international standards in the field of environmental engineering in two specialisations – "Environmental Engineering" and "Circular Bioeconomy", thus ensuring continuous improvement of the quality of environmental education and preparing highly educated environmental engineering leaders for the private and public sector;
- to promote the capacity of students to develop environmental and climate technologies fitting local conditions and stimulating the national economy, as well as to develop the capacity of students to carry out research in the field of bioeconomy, climate and environmental technologies, who are capable of improving the processes of the environmental protection sector at national and international level;
- to achieve interaction between students and academic staff in the development of research papers and to demonstrate best practices for the practical implementation of the results obtained in environmental engineering companies at international level, as well as the disclosure of the scientific results obtained in high-impact international scientific journals;
- to encourage the interest of students and graduates in doctoral level study programmes, lifelong learning, as well as academic and scientific excellence.

Measurements of task performance **results** are learning outcomes of students, independently drafted Master's thesis, which has significant theoretical relevance and practical use potential and

includes original scientific research results, demonstrate the competence of independent mastering, selection and analysing information and using it make decision and address problems in the field of environmental science and engineering science.

As a result of mastering the study programme the graduate **(planned outcomes)**:

- demonstrates extended knowledge and understanding in the field of environmental protection and is able to create values, including intellectual values, in environmental engineering, and, using theoretical, methodical and problem-solving system thinking skills, to be able to critically analyse integrated solutions that match the latest findings to improve the environmental situation by focusing on long-term pollution evaluation methods;
- is able to conduct research and professional projects and develop comprehensive recommendations for the prevention of environmental pollution in the fields of bioresources, bioeconomy, environmental and climate technologies, environmental policy, cleaner production, smart energy, energy efficiency, climate adaptation and so on;
- is able to integrate knowledge into the implementation of environmental protection measures, to make a contribution to the creation of new knowledge, the development of environmental engineering research or professional activity methods, to formulate and collect scientific research results in scientific papers and present these results to industry professionals and society as a whole;
- using new learning approaches is able to independently develop improvement of own competences in environmental engineering and related interdisciplinary areas, driving innovation in the field of environmental research and their implementation in sectors of national economy.

The study programme focuses on preparing environmental protection specialists with profound knowledge in the field of bioeconomy and environmental engineering. The study programme can be well combined with engineering education previously acquired by students in other sectors, as it provides an integrated knowledge of the environmental impact assessment of different sectors and processes and the reduction of environmental pressure. Graduates of the “Environmental Engineering” study programme can work as leading specialists in the fields of environmental protection, bioeconomy, energy (thermal energy and smart energy), energy efficiency, environmental status modelling, resource management and related industries, are able to develop and implement innovative environmental and climate technologies in companies, re able to manage the development and implementation of environmental laws, as well as to manage environmental engineering development projects at local government level. Graduates of the programme are able to carry out research in the environmental engineering and energy sector, as well as to develop and implement environmental engineering projects.

Mastering of the skills and knowledge within the study programme is secured by European level academic and scientific staff (European Union experts in the fields of environmental engineering and energy, sustainable management of resources, environmental management), who are involved in the delivery of engineering solutions at national and European level on a daily basis. The curriculum and implementation of the study programme focuses on the creation of competences to adapt and respond to changes, following and even anticipating labour market demand. In order to achieve efficient functioning of such a model, in the curriculum and in the implementation development of the study programme special attention is paid to the establishment of the cooperation platform “Companies – University”.

The objectives, tasks and planned learning outcomes (knowledge, skills, competences) of the study programme “Environmental Engineering” are interlinked and the probability of reaching them is very high.

Admission to the RTU study direction “Environmental Protection” master's academic study program “Environmental Engineering” program, in addition to the general admission rules, for those students who obtained previous education (bachelor's level) in the field not related to environmental protection and engineering and technology to provide studies in the master's study program In “Environmental Engineering” the necessary understanding of environmental engineering and energy topics, in addition to the content of the study program “Environmental Engineering” must be acquired courses related to environmental engineering and energy, which are determined by RTU study direction “Environmental Protection” decision no. 19.06.2020-M2 and 19.06.2020-D2.

Recognition of previously acquired formal and non-formal education at RTU takes place in accordance with the Procedure for Recognition of Study Courses Acquired in Other Higher Education Institutions and Study Programs (RTU Vice-Rector for Studies Order No. 02000-1.1 / 29 of 4 April 2016) and Procedures for Recognition of Competences Acquired in Professional Experience and Study Results Achieved in Previous Education at Riga Technical University ”(approved by the RTU Senate on September 23, 2019, protocol No. 632).

Admission rules are published with RTU: https://www.rtu.lv/lv/studijas/uznemsana/uznemsanas-noteikumi ((Latvian only) for local students) and https://international.rtu.lv/ (for foreign and exchange students).

The possibility of recognizing the study period, professional experience, previously acquired formal and non-formal education within the study field is a convenient and relatively simple procedure for students. When a student submits an application accompanied by the necessary documents on the acquisition of previous similar study courses and / or professional experience, they are evaluated. In order to implement the equalization of professional experience, students must prepare and submit a description of their professional activity, which is evaluated by the commission and a decision is made on the compliance of professional activity with the requirements of the study program. If necessary, an additional interview is possible to clarify unclear issues.

Within the study “Environmental Protection” (especially during the last 2 years, which can be explained by the widely available availability of learning processes outside educational institutions in industry, associations, non-governmental organizations, etc.), professional experience is recognized regularly - every semester. For example, in 2017, five students of RTU bachelor's study program “Environmental Science” learned the basics of innovative entrepreneurship in the amount of 4 CP, which was obtained in the training cycle organized by the Latvian Technology Park. This knowledge was equated to the study course “Economics” of the bachelor study program “Environmental Science” (3 CP).

In the master's study programs “Environmental Science” and “Environmental Engineering” several student documents have been evaluated and previous education and / or experience in the professional field has been recognized.

Recognition of study courses acquired in formal education in all study programs of the field takes place almost every semester at the request of students.

An additional requirement for studies in English program is an English language certificate (requirements are specified in the RTU admission requirements https://apply.rtu.lv/courses/course/22-msc-environmental-engineering).

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of

Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation.

The academic Master's study programme "Environmental Engineering" is the only one in Latvia and there are only a small number of similar programmes in the international education space. This fact, jointly with the rapid increase in the importance of environmental engineering sciences, creates favourable competitive conditions for graduates to be in demand in Latvia and beyond. The European Union has one of the highest environmental standards. The current environmental policy focuses on reducing the impact of the EU economy, protecting natural resources and preserving the health and well-being of EU citizens. In light of cross-sectoral activities in research, innovation, education and training, universities are key drivers for the transition to low-carbon technologies. It is therefore vital right now – during the transition period (the programming periods defined in the EU Energy Strategy 2050) – to transform or create new study programmes and to introduce new learning approaches in order to prepare new specialists for a new era of change.

The developed study programme focuses on the improvement of environmental quality, because its objective is to prepare systemically thinking highly skilled specialists focusing on preventive environmental prevention activities and the development and implementation of innovative zero-pollution technologies with integrated academic education (Master's degree in engineering sciences) in two specialisations – "Environmental Engineering" and "Circular Bioeconomy".

Environmental engineering, including bioeconomy specialisation, direction studies are also offered at the 16 internationally recognised and strong universities of European Union Member States, Switzerland and Norway, and this, in addition to environmental policy trends, confirm topicality of the study programme direction.

During the development of the study programme, a confirmation has been obtained that the study process is different in each European country, taking into account national laws, regulations and national priority axes.

The competitiveness of the study programme is confirmed by the fact that according to the graduate survey data available to the RTU IESE administration, one year after graduation all graduates of the study programme "Environmental Science" are employed, most are working in the industry (around 86%) as environmental engineers, environmental specialists.

The study programme ensured topicality of curriculum of study courses and its compliance with the needs of the relevant industry, labour market and with the trends in science. Each year, study programme is improved, taking into account the results of student questionnaires, as well as recommendations of the employers. Environmental specialists working in different sectors are involved in the study programme "Environmental Engineering" (more examples are mentioned in section 5.1 of the description of the study direction "Environmental protection").

The curriculum of study programmes is updated in compliance with the needs of the industry, labour market and science development trends. Each year, study programme is improved, taking into account the results of student questionnaires, as well as recommendations of the employers. Environmental engineering specialists working in different sectors are involved in the study programme. All changes reflect external trends and certify compliance of the study programme with the industry and labour market situation. Changes in the study programme are based on the need to ensure compliance with industry, labour market and science development trends, to maximally strengthen mastering of professional competences and preparedness.

Close link to scientific trends is ensured in the implementation and development of the study programme (for more information see chapter 4 of the description of the study direction "Environmental protection").

Applied research also plays an important role. Students develop research works on topical issues in the field, studying and analysing scientific and professional literature in libraries and international databases. Students apply their knowledge and insights in practical research during internship in Latvian or foreign companies, analysing quality, process management, compliance and risk issues, developing and implementing solutions for business improvement. Students present their research results at the annual RTU Student Scientific Conference and summarize them in their bachelor's theses, which are presented at the conclusion of the studies. The results of individual studies are also summarized in scientific publications (for more information, see Section 2.5).

The master's degree awarded to the graduates of the study program is based on the achievements and findings in the field of environmental engineering.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The study programme ensures a link between the information included in the study courses, the learning outcomes, the objectives set, the methods, and the link between each study course and the objectives of the study programme and the learning outcomes. The objective of the programme has been set in line with the needs of the economy, different sectors and society, namely: to prepare environmental engineers in environmental engineering, as well as to create a basis for further studies at a higher level to acquire knowledge and competence. The tasks of the programme have been formed in such a way to educate students in accordance with the requirements of Level 7 of the Latvian Qualifications Framework (hereinafter referred to as LQF 7), as well as to promote the competitiveness of students in changeable socio-economic conditions and in the international labour market (see the parameters section of the programme).

The study programme is implemented through lectures, practical and laboratory classes (at universities and in field trips to companies), as well as in independent studies, mastering environmental engineering processes and models in detail. The courses offered within the study programme are based on a combination of theoretical and practical approaches – working in a laboratory/company, in a simulated environment (computer model) using modelling tools and decision marking methods. The content of the study programme complies with the requirements of

regulatory enactments and was designed in compliance with the provisions of the RTU Senate decision “On Uniform Requirements for Study Programmes”.

The duration of the Master’s is 2 years, broken down into 4 semesters, during which compulsory study courses, specialisation and elective courses are to be learned, and Master’s thesis should be drafted. **The amount of the study programme is 80 CP** (1 CP/week x 80 weeks). The programme can be mastered by applicants with an academic and professional Bachelor's degree in engineering, social sciences or equivalent education. If necessary (for example, applicants who have obtained Bachelor or professional Bachelor level education in a non-engineering science sector and who lack professional experience in the field of the study programme) should, on the order of the director of the study programme, master education equalisation courses (the director of the study programme defines the courses to be mastered by the student considering applicant’s prior education documents and knowledge obtained in professional activity) (see Annex "Master's admission rules with amendments").

The expected amount of **compulsory study courses** of the study programme is 36 CP (54 ECTS). The compulsory courses of the study programme provide students with knowledge of environmental engineering and develop knowledge of current problems in research engineering and energy industries, the description and its cross-sectoral importance, include knowledge on scientific research methodologies and their use.

The **restricted elective (specialised) study courses** (16 CP = 24 ECTS) of the study direction are designed to enable future specialists to deepen knowledge in the selected specialization. The study programme provides two specialisation areas: (1) specialisation “Environmental Engineering” and (2) specialisation “Circular Bioeconomy”. The “Environmental Engineering” specialisation is focused on in-depth knowledge of environmental and climate technologies, emission and waste reduction methods, an assessment of the sustainability of technologies throughout the product/service life cycle. In the “Circular Bioeconomy” specialisation, students master in-depth knowledge of renewable energy and biotechnology, bio-products to increase the added value of products/services, with the least possible impact on the environment. The “Circular Bioeconomy” specialisation can be well combined with the prior education of students in social and engineering fields, by integrating knowledge of the importance of bioresources in the development of national economy processes in terms of social, economic, environmental and climate aspects.

The study programme also includes **humanities and social study courses** (4 CP = 6 ECTS) and the **Master’s thesis** (20 CP=30 ECTS).

Table: *Study courses included in the study programme*

Code	Study course/module	CP
	Part A	**36.0**
VAS010	Sustainable Industrial Processes and Technologies	4.0
EAS703	Environmental Management	4.0
EAS722	Environmental Policy and Economics	5.0
IDA700	Basics of Labour Protection	1.0
EAS507	Environmental Impact Assessment	4.0

EVA705	Environmental Technologies	8.0
VAS011	Eco-design and Life Cycle Analysis	6.0
VAS012	Intersectoral and Interdisciplinary Research Methods	4.0
	Part B Restricted elective study courses	**20.0**
	B1 Professional specialisation study courses	**16.0**
	Specialisation "Environmental Engineering"	
EAS715	Experiment Planning and Simulation of Processes	4.0
EAS700	Energy Conversion and Efficiency	4.0
EAS723	Renewable Energy Sources	4.0
ĶNF503	Environmental Chemistry and Technology	2.0
VAS013	Circular Economy and Waste Management	4.0
VAS014	Geographic Information Systems	4.0
BŪK504	Water Treatment Technology	5.0
EVA709	Biotechnologies	4.0
EVA708	Energy Efficiency and Energy Audit of Buildings	4.0
VAS015	Strategic Planning. Innovations and Ecomanagement	4.0
VAS016	Adaptating to Climate Change	4.0
	Specialisation "Circular Economy"	
EAS744	Modelling and Simulation of Dynamic Processes	4.0
VAS017	Case Studies on Biobased products.	4.0
VAS018	Bioenergy Technologies	4.0
VAS019	Sustainable Rural and Urban Development	4.0
VAS020	Development and Analysis of Biotechonomy	4.0
VAS021	Production of Biobased Resources	4.0
VAS014	Geographic Information Systems	4.0

EVA708	Energy Efficiency and Energy Audit of Buildings	4.0
VAS016	Adaptation to Climate Change	4.0
	B2 Humanities and social study courses	**4.0**
EAS704	Socio-Economic Aspects of Energy Supply	4.0
HFL433	Presentation Skills	2.0
HSP488	Business Sociology	2.0
HSP485	Communication Psychology	2.0
HSP430	Social Psychology	2.0
VSL711	Latvian for Foreign Students	1.0
	Part C Elective study courses	**4.0**
	Part E Final / state examination	**20.0**
EAS002	Master Thesis	20.0
	Total:	**80.0**

The integrity of the study programme is achieved through the development of an inter-course learning approach – for study courses within one semester and between semesters. A Master's thesis (20 CP=30 ECTS) is a combining element of knowledge and skills acquired in the study programme, with an in-depth study on an environmental engineering topic (corresponding to the subject of Master's thesis). The implementation of the Master’s study programme at the level of study courses is implemented in close cooperation with the supervisors of the Master's thesis – practical and independent work at the level of study courses are focused on the subject of Master’s thesis, thereby reinforcing the student’s knowledge in the specific field of research with the Master’s thesis research topic. Such a mechanism of implementation of the study programme allows ensuring the successful achievement of learning outcomes.

The mastering of the programme ends with the drafting of a Master’s thesis and its public defence in the Master’s thesis defence committee of the Institute of Energy Systems and Environment of Riga Technical University. A reviewer is designated for assessment of the thesis. The content, assessment criteria and principles of the Master’s thesis are described in the “Regulations on Drafting and Defence of a Bachelor's and Master’s Thesis” in Study Programmes of the Study Direction “Environmental Protection”.

While drafting a Master’s thesis, interim tests on progress in drafting of the Master’s thesis are organised, in which students present their research to the responsible teaching staff. Interim tests include:

- regular meetings with the scientific supervisor of the Master’s thesis;
- quality control progress shows by responsible teaching staff in Master’s thesis quality control matters.
- Second year students report, at least once a month, on their progress in drafting of their

Master’s thesis: defending the topic of the Master’s thesis in the September in front of RTU IESE Bachelor’s and Master's Thesis Quality Monitoring Commission (teaching staff with a doctoral degree – Dr.sc.ing. Dace Lauka, as well as scientific assistants Zane Indzere and Ketija Bumbiere). During the meeting, the student should demonstrate performance (which is confirmed by a signed statement by the supervisor of the Master’s thesis) and has the possibility to ask unclear questions about drafting of the Master’s thesis to the representative of the committee. The drafting of a Master’s thesis and its quality assurance are closely linked to the compulsory study course “Intersectoral and Interdisciplinary Research Methods” and “Master’s Thesis”. Taking into account the results of the mapping of study courses, it can be stated that the content of study courses is mutually aligned and ensures that the achievement of the learning outcomes s of study courses and the study programme.

When implementing the study programme, its objective is “to prepare systemically thinking highly skilled specialists focusing on preventive environmental prevention activities and the development and implementation of innovative zero-pollution technologies with integrated academic education (Master’s degree in engineering sciences) in two specialisations – “Environmental Engineering” and “Circular Bioeconomy”, which corresponds to Level 7 of the European Qualifications Framework (EQF) and the Latvian Qualifications Framework (LQF), is achieved.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

For information on the evaluation of study results, final examinations and pedagogical methods, see the Bachelor's study program description in Part III, point 2.3.

The methods used in the study program contribute to the achievement of the aims and learning outcomes of the study courses and program, taking into account the principles of student-centered teaching and learning. One of the basic principles of RTU FEEE study programs is democracy and dialogue with students, their active involvement in the improvement of the study process. Students can realize their participation in the improvement of the study process directly – by expressing their wishes to the teacher, head of the department, study program director, or through the student selfgovernment, represented by its members in the FEEE Council, RTU Senate and RTU Senate commissions, as well as the RTU Academic Convention. FEEM relationships with students are characterized by mutual trust, respect and honesty. Conformity with the principles of student-centered education (hereinafter – SCL) is constantly ensured. As defined in the SCL Manual, student involvement in the study process and content development is assured thus creating additional responsibilities and authority for students. Students are provided with the opportunity to influence their own study process, exercise their autonomy, and provide feedback on the study process in line with their expectations. The FEEE Student self-government plays an important role in providing links between the students, academic staff and program administration, and it actively participates in all these processes and conducts annual evaluation of the academic staff.

Once every semester students evaluate the work of the academic staff by providing answers to a survey questions (in the ORTUS environment) (see description of Bachelor's study program point

no. 2.3.).

Pedagogical methods, the structure of study courses, as well as assessment methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. Courses and seminars on latest teaching, pedagogical methods are organised for academic staff, as well as attendance of courses to improve qualification is promoted at internal faculty activities, at RTU level and internationally. The Centre for Academic Excellence organises various events aimed at professional advancement of academic personnel at the University level.

The academic Master's study programme "Environmental Engineering" is implemented through lectures, practical and laboratory classes (at universities and in field trips to companies), as well as in independent studies, mastering environmental engineering processes and models in detail. The courses offered within the programme are based on a combination of theoretical and practical approaches – working in a laboratory/company, in a simulated environment (computer model) using modelling tools and decision marking methods. The content of the study programme complies with the requirements of regulatory enactments and was designed in compliance with the provisions of the RTU Senate decision "On Uniform Requirements for Study Programmes".

In order to ensure the interaction between the knowledge, competences and skills obtained by graduates, when developing and implementing study courses particular emphasis is given to:

- reflecting current challenges in the content of the study programme (at the level of lectures, practical works and laboratory works), including the analysis of actual problems faced by cooperation companies of the study programme and providing solutions within the limits of the content of the specific course;
- the use of modern teaching methods (solutions for specialised computer programmes in virtual laboratories, use of common solutions algorithm, solution-oriented methods, etc.);
- the integrity of study courses and the study programme, i.e. developing an inter-course learning approach (e.g. *Learning Technology Interoperability, Concept mapping, Mind mapping*, etc.);
- improvement of study methods in cooperation with foreign experts (e.g. University of Bergen) for distance learning form, using massive open online courses (MOOC) in the ORTUS e-study environment of Riga Technical University (RTU).

Independent studies of students play an important role. The description of independent studies is included as a compulsory part in the study course description. Students' ability to learn independently is purposefully developed in all study courses. **Students obtain skills in research work by working on regular basis with literature and internet resources to successfully develop different course papers and the Master's thesis.** Thus, scientific research work of students, work with the international scientific databases available at RTU library with electronic access from ORTUS environment is fostered.

- In the study process, the student should draft course papers in Part A in accordance with the study programme: "Environmental Impact Assessment", "Eco-design and Life Cycle Analysis" and "Intersectoral and Interdisciplinary Research Methods".
- In the "Environmental Engineering" specialisation course papers have to be drafted in the following study courses: "Experiment Planning and Simulation of Processes", "Renewable Energy Sources", "Circular Economy and Waste Management", "Water Treatment Technology" and "Energy Efficiency and Energy Audit of Buildings".
- In the "Bioeconomy" specialisation course papers have to be drafted in the following study courses: "Strategic Planning. Innovations and Ecomanagement", "Modelling of Environmental Processes and Technologies", "Case studies on Biobased products", "Sustainable Rural and

Urban Development", "Development and Analysis of Biotechonomy" and "Production of Biobased Resources".
- Only one course paper should be drafted in humanities and social study courses: "Socio-Economic Aspects of Energy Supply".

The study courses, in which course papers are drafted, were selected based on experience in the "Environmental Science" programme. Many of these study courses, which are included in this study programme, will be implemented in the "Environmental Science" programme. The above-mentioned study courses, where a course paper is necessary for the successful acquisition of knowledge and skills, have clearly crystallised following years of experience and repeated revisions to the study programme, as well as taking into account the results of polling of students and graduates on the above-mentioned courses. The implementation of course papers enables students to work independently with the scientific literature offered and to use in practice the knowledge acquired in lectures.

RTU IESE and RTU in general have in place a stringent and transparent system for competence development of the academic personnel. Several departments, including the personnel, research, international relations, studies and the Centre for Academic Excellence, inform staff on a regular basis about the possibilities of improving their competence in both scientific research and methodological and didactic skills and general competences (foreign languages, information technologies, speech and presentation skills, etc.) and in the field of specific professional activities. Information on scientific activity of academic staff is collected in the ORTUS environment. In order to perform teaching work at a high level, methodological seminars on the use of different teaching methods, experience, good practice and sharing success stories are organised for RTU teaching staff. The director of the study programme conducts individual interviews, and these matters are viewed at department meetings. Competence improvement activities are planned in the RTU IESE personnel development plan.

RTU IESE organises seminars for academic staff and students, explaining the principles and implementation solutions of student-centred education. This approach is implemented in daily work: teaching staff continuously improves the quality of study courses on the basis of both the latest trends and discoveries in the sector and the opinions of students. The study programme administration conducts interviews with students at least twice a year on their satisfaction, expectations and study quality assessment.

The academic staff members of the program regularly improve the content of the study; the best study organization methods and principles are introduced in the study process. Consistency with the strategy for the development of the European Higher Education Area enables both the academic staff and students to be mobile and enrich their knowledge and experience at foreign higher education institutions, and also provides job opportunities in the rapidly changing international work environment. IESE takes over good practices acquired by students and teaching staff during mobility in foreign universities. Foreign experience is integrated in the study process promoting the implementation and internationalisation of student-centred education. The experience and insights of the teaching staff are discussed both at department meetings and in informal communication in daily work. All teaching staff actively participates in the RTU IESE academic and scientific conference CONECT. For additional information on the improvement of qualifications of teaching staff and scientific activities see section 3.5 of the report on the study direction.

The faculty study environment and infrastructure are adapted to various needs of the student groups, while maintaining a consistent quality of study process. Proper infrastructure is provided for the students with special needs. There is differentiated support for different social groups of

students, which can be obtained by contacting the RTU Student Parliament.

Students can find all current information on studies, types and conditions of support, entertainment and sports activities, as well as communication with groupmates and teachers of the study courses, including the opportunity to apply for consultations in the ORTUS environment.

Several factors together create a favourable working and learning environment that fosters the study quality, incl. linking the aforementioned study content with the labour market situation, positive trends in the quality management profession in Latvia and a wide range of job opportunities, student participation in study quality improvement, opportunity to be heard, receive various types of support, gain international experience, FEEE administration's positive attitude and willingness to constantly improve the content and methods of the studies and the provision of facilities, equipment and software in the time, volume and quality required for the studies. For more information, see Section 3.1 and the Study Direction Report.

A lot of resources are invested in promoting RTU students' extracurricular activities and healthy lifestyle. RTU offers students a number of extracurricular activities – from various artistic groups and interest clubs, such as the choir "Vivere", orchestra "Bigbend", folk dance ensemble "Vektors", etc., to more than 20 kinds of sports where each student has an opportunity to be selected for the sports team of RTU. FEEE students most often join the choir "Vivere" and play in the women's basketball team.

The RTU Career Center very often hosts various seminars on personality development, education and global issues. Lectures are delivered by knowledgeable professionals from different spheres whom otherwise a limited number of students would be able to hear due to the high entry fees. However, RTU offers these lectures to students free of charge. According to the students, this is an opportunity for students to talk to and ask questions to people whom otherwise they would not be able to meet in the next few years.

Each RTU faculty offers its students an opportunity to participate in the Student Council, which represents and defends students' interests, organizes various educational seminars, sports games and cultural events. This is a great place for students to learn how to develop communication and work skills. Whereas, if a student wishes to become a student representative not only at the level of their faculty, but also at the level of the entire university, they have the opportunity to become involved in the RTU Student Parliament.

21 FEEE students were working in the RTU FEEE Student Self-Government in 2020/2021, of whom 10 are Bachelor students of "Environmental Science". Almost all them get involved also in RTU's extracurricular activities. On extracurricular activities see the RTU website https://www.rtu.lv/lv/ievf/studijas-ievf/arpusstudijas-1 (Latvian only)). Presently the board of RTU IESE does not have any RTU FEEE student of the Master's study programme, which is related to the fact that a domineering part of Master students are employed outside RTU and are unable to combine studies and work with active involvement in the RTU FEEE Student Self-Government.

Representatives of all study programs are active in the RTU FEEE Student Council. With each study year, students become more responsible for their future and, as a result, their collaboration with the student self-government becomes broader, not only in their studies but also in their extracurricular activities.

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education

institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

At the completion of the programme (20 CP), students must develop their Master's thesis devoted to environmental engineering problems. The Master's thesis is publicly defended before a committee. The committee operates in accordance with the regulation approved by the higher education institution's Senate.

The aim of the Master's thesis is to confirm student's skills to solve problems independently and to perform scientific research work in the environmental science sector and the ability to use analytical, mathematical, optimisation and modelling methods to address environmental problems, as well as to show readiness of the student for further studies in higher level programmes. **Topics of the Master's thesis are offered by RTU IESE and are based on the topics of ongoing scientific research projects at RTU IESE.** In addition, the student has the opportunity to offer his/her own topic for a graduation paper and defend it in the RTU IESE Scientific Council, which decides on compliance of the topic with the requirements for the graduation paper and the degree to be obtained.

Examples of topics of graduation papers in the Master's study programme "Environmental Science" are given below.

Year of studies 2013/2014

- *Development of the an energy efficiency model for state and local government buildings*
- *Integration of energy metabolism into urban flexibility assessment: methodological approach*
- *Analysis of a mechanical venting system provided with an counter-flow plate heat exchanger installed in a renovated building*
- *Assessment of biodegradable waste treatment scenarios in Latvia: life cycle approach*

Year of studies 2014/2015

- *Anaerobic digestion of Latvian macroalgal biomass. Evaluation of biogas production potential.*
- *Measurement and verification of energy savings measure under energy performance contracting*
- *Allocation of historical buildings in typology groups according to building construction solutions*
- *Environmental characterization of (bio)char derived from industrial sewage sludge*

Year of studies 2015/2016

- *Use of a system dynamics model and geospatial information systems (GIS) for bioeconomy modelling*
- *Connectivity of electric transport with existing energy supply systems and integrated use of the smart charging concept*

- *Science, innovation and education system dynamics model for the efficient use of bioresources*
- *Infrastructure and society resilience measurements: application of a holistic and probability method for the case of Latvia*

Year of studies 2016/2017

- *Biorafination approach to production of biogas from macro algae available in the Baltic Sea: effects of mechanical pre-treatment on BMP test*
- *Analytical and empirical modelling of flue-gas capacitors*
- *Feasibility study of marine macroalgae transformation systems: life cycle cost perspective*
- *Analysis of the potential of biotechonomics. Vegetable powder*

Year of studies 2017/2018

- *Analytical and experimental study of the mist flue-gas capacitor*
- *Sustainable municipal waste management in Latvia*
- *Role of energy management in the agricultural sector: key preconditions and impact*
- *Flexible energy consumption system dynamics model*
- *Strategic lines for Latvia's centralised district systems for switching to a 4th generation district heating system*
- *Extraction technologies for the use of biomass in accordance with the principles of bioeconomy*

Year of studies 2018/2019

- *Impact of decarbonisation on the Baltic Energy Supply System*
- *Life cycle analysis for processing of bioethanol into bioethylene*
- *Integrated sustainable bioenergy resources planning tool for local governments using geographical information systems (GIS) – case study in the Baltic States*
- *Sustainable assessment for the introduction of low temperature in district heating in Jurmala: life cycle analysis based study*
- *Assessment of the damage done by humidity sources and humidity on hygrothermal processes in outer walls with internal thermal insulation*

When evaluating the topics of Master's theses, their link to RTU IESE scientific research projects implemented in specific periods is clearly visible, such as: *"Accelerate SUNShINE: "Save your Building by Saving Energy. Advance Faster"" (2017 - 2020), "RIBuild: Improving Energy Efficiency of Historical Buildings" (2015-2020), "Knowledge on Biological Waste and Algae for Production of Second-Generation Biofuel (01.04.2010 - 31.03.2015)", "Disaster resilience academic network ANDROID" (2011-2014), "Developing Innovative Biomass Gasification Technology for Syngas Extraction – SYNGAS" (2015-2016), "Developing a Bioeconomy Model for Sustainable Use of Biological Resources for Climate Change Reduction and Adaptation For Capacity Building – BIOCLIMATE" (2015-2016), "Technological Solutions for the Development of Energy Systems of Nordic Countries TOP-NEST" (2011-2015), "BIOCM: Study of the Methane Oxidation Combination Reaction Process" (2017-2020)* and other. For more projects, see section 4.3 of the report – description of the study direction.

It should be noted that the choice of project-based graduation papers has several advantages. The main of them are:

- successful integration of students into scientific work and encouragement of interest in higher-level studies has been achieved;
- the interest of students in the work in scientific institutes following the drafting of graduation

papers;
- a successful symbiosis of Bachelor's, Master's and doctoral students is taking place, working sequentially on a single project topic.

The Master's thesis and its defence within the study programme "Environmental Engineering" demonstrates student's:

- theoretical knowledge, knowledge of concepts and methodologies, and the ability to focus on the selected field of research, the ability to use theoretical knowledge in practice;
- the skills to obtain, summarise, process and analyse data and capacity to use different research methods and tools for original solution of a problem, as well as to use analytical judgment skills and critical thinking;
- competence in areas related to environmental engineering and bioeconomy;
- understanding of important and topical aspects of the inherent functions of environmental engineering and bioeconomy;
- systematic and logical approaches to the development of Master's thesis, the ability to use appropriate information sources and available information processing technologies;
- the ability to draw reasoned conclusions and make realistic and reasonable proposals, present them and justify their personal professional opinions.

The transversal approach with the entire study programme is ensured when drafting of a Master's thesis. The implementation of the Master's study programme at the level of study courses is implemented in close cooperation with the scientific supervisors of the Master's thesis and teaching staff of study courses – practical and independent work at the level of study courses are focused on the subject of Master's thesis, thereby reinforcing the student's knowledge in the specific field of research with the Master's thesis research topic. For example, technological solutions for innovative industrial processes in cleaner production developed in the study course "Environmental Technologies" will be developed on a topic related to the Master's thesis. Such a mechanism of implementation of the study programme allows ensuring the successful achievement of learning outcomes and integrity of the study programme.

Topics of the Master's thesis are offered by RTU IESE and are based on the topics of ongoing scientific research projects at RTU IESE. In addition, the student has the opportunity to offer his/her own topic for a graduation paper and defend it in the RTU IESE Scientific Council, which decides on compliance of the topic with the requirements for the graduation paper and the degree to be obtained.

The Master's thesis is made of three parts. The task of the theoretical part is to provide a theoretical rationale for the solution for the topic of the Master's thesis, an evaluation of scientific publications, materials and literature. This part studies published opinions of different authors, the author of the Master's thesis compares and evaluates different theoretical concepts and provides his/her opinion and evaluation of them. The task of the analytical part or research is to collect and analyse information, reflect author's research, identify and explain problems to be solved. The practical or solution part of the Master's thesis is justification of problem solutions and alternatives, the choice of best alternatives and proof of their efficiency supported by specific facts and calculations.

Students present the results of Master's theses at student conferences and at the international scientific conference CONECT (for more information on CONECT and student engagement read section 4.5 of the self-evaluation report of the study direction). The Student scientific technical conference is an event, during which students have the possibility to present their scientific activity to a wider range of people, the possibility to get their first publication, by submitting their work after the conference to any RTU journals. The event is usually held in April and May. Participation in

the Student Scientific Technical Conference for Master students of the 2nd year is a mandatory part of the study process. When developing scientific skills during studies, increasingly more students are ready to participate also in international scientific conferences. For example, in 2019 students of the 2nd year of the RTU Master's study programme "Environmental Science" participated in the CONECT conference with scientific reports presenting scientific insights from their Master's thesis:

- *Z. Indzere. The benchmarking of coffee substitute's production.*
- *L. Rozentale. Accelerating power generation with solar panels. Case in Latvia.*
- *M. Aleknaite. Assessment and evaluation of railway noise spread dependence on different types of sleepers.*
- *E. Anuzyte. Natural oil sorbents modification methods for hydrophobicity improvement*
- *G. Vitkauskaite. Perforated sound-absorbing constructions acoustic performance test and noise modelling.*
- *A. Tukulis. Methodology of system dynamic approach for solar energy integration in district heating.*

In 2020, within the scope of the double diploma cooperation programme with the Vilnius Gediminas Technical University, 11 2nd year students of the RTU Master's study programme "Environmental Science" (S. Kalna, V. Kosteviča, V. Balodis, A. Krastiņš, K. Dreimanis, E. Kudurs). Participation in this conference is mandatory and is the annual component of the double diploma cooperation programme. K. Bumbiere, A. Dzalbs, A. Piščika, E. Račko, R. Kaķis) participated in the VGTU student conference "11th International Conference on "Environmental Engineering"" with scientific reports.

The results of assessment of the final examination of students of the Master's study programme "Environmental Engineering" are discussed at RTU IESE meetings twice a year. The results are summarised and evaluated also by the administration of the programme, and they serve as a basis for further improvement of the study process.

In the reporting period from the year of studies 2013/2014 to 2018/2019 assessments for drafted Master's theses on a 10-point scale in 92% of cases were not lower than 7 (good).

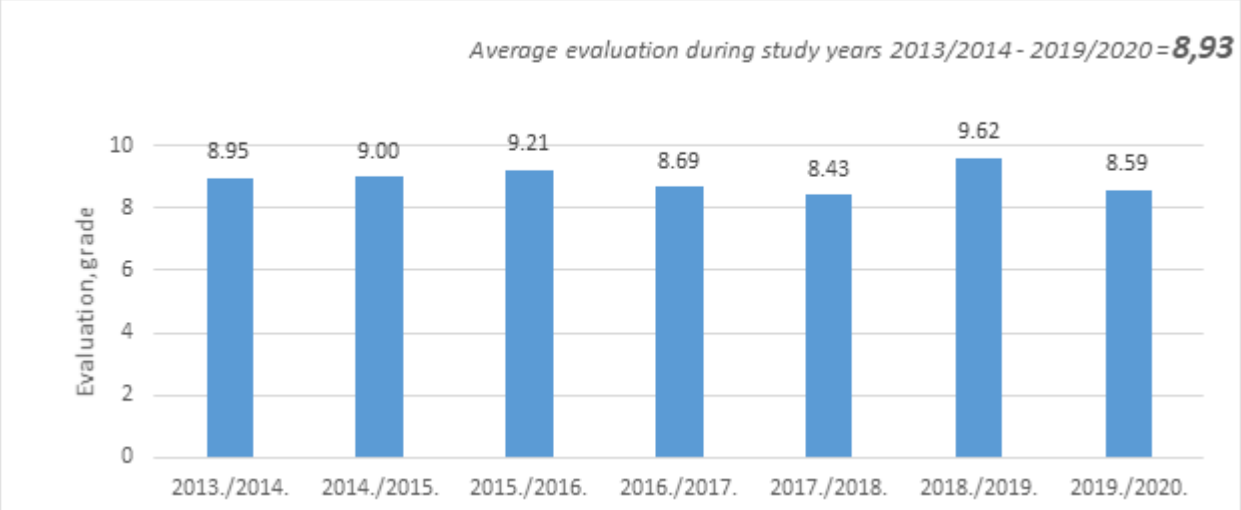

Figure: *Average assessments of graduation papers of students from Latvia in the reporting period in the Master's study programme "Environmental Science".*

There is a similar trend also with regard to assessments of international students for graduation papers in the study programme "Environmental Science", where the weighted average assessment in the reporting period is 8.50 (see Figure "Average assessments of graduation papers of foreign students in the reporting period in the Master's study programme "Environmental Science"). It should be noted that in terms of individual foreign students, the level of knowledge, with which the

student starts studies in the study programme 'Environmental Science" varies. It is observed that students from Nigeria, India, Pakistan start their studies in the study programme "Environmental Science" with considerably lower performance and preliminary knowledge from undergraduate studies. Meanwhile, students from Europe have rather similar achievements and preliminary knowledge from undergraduate studies.

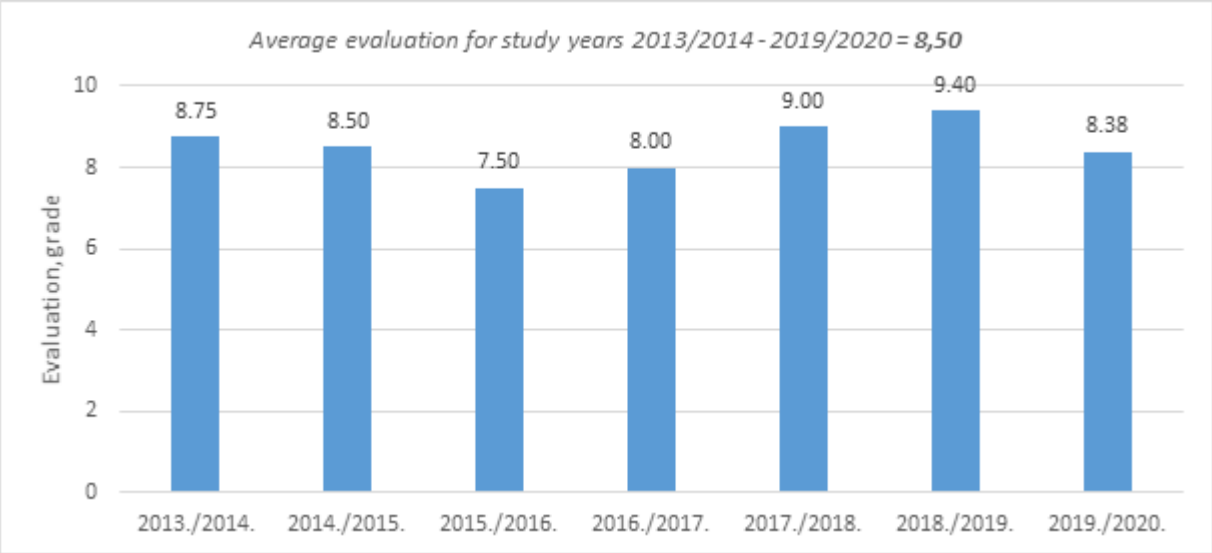

Figure: *Average assessments of graduation papers of foreign students in the reporting period in the Master's study programme "Environmental Science".*

Assessment of 10 (with distinction) is granted by the State Examination Committee only to those students which have summarised in their work studies beyond the requirements of the programme, or the outcomes of their studies have resulted in a scientific publication.

The Master's theses defended within the Master's programme "Environmental Science" of the study direction "Environmental protection" are internationally oriented and include examples of case studies on Latvia – 89% in the period from year of studies 2013/2014 to 2019/2020 (see Figure).

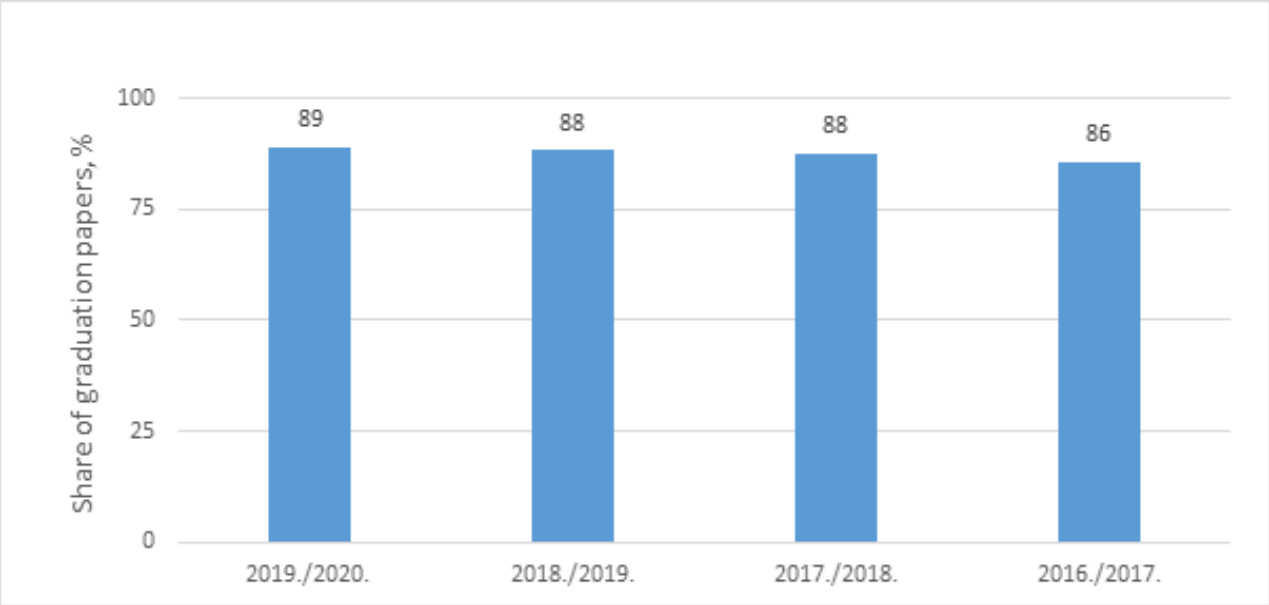

Figure: *Share of graduation papers of the Master's study programme "Environmental Science", which include examples of case studies on Latvia (years of studies 2016/2017-2019/2020).*

The drafted Master's theses has high added value in the development of national economy confirmed by the interest of industry companies in them and winning of students in graduation

paper contests organised by companies. For instance,

- In 2013, students of the Master's study programme "Environmental Science" received the *Werner von Siemens* Excellence Award in the category of Master's theses: A. Beloborodko "Application of industrial symbiosis principles to evaluation of timber flows" (scientific supervisor of the thesis RTU IESE professor, *sc.ing.* Marika Rošā), A. Fridrihsone "Rapeseed oil – renewable raw material" (scientific supervisor of the thesis RTU IESE Assistant Professor, *Dr.chem.* Sarma Valtere), A. Barisa "Impact assessment of policy instruments for increasing the proportion of energy wood in district heating systems" (scientific supervisor of the thesis RTU IESE professor, *Dr.sc.ing.* Marika Rošā), V. Kirsanovs "Study of low capacity pellet boiler combustion process (scientific supervisor of the thesis RTU IESE professor, *Dr.sc.ing.* Ivars Veidenbergs).
- In 2015, students of the Master's study programme "Environmental Science" received the Werner von Siemens Excellence Award in the category of Master's theses: D. Lauka "Low carbon energy production waste. physical properties" (scientific supervisor of the thesis RTU IESE professor, *hab.sc.ing*. Dagnija Blumberga) and L. Pastare "Multiple-criteria analysis for sustainable production of biogas from microalgae in Latvian conditions" (scientific supervisor of the thesis RTU IESE professor, *Dr.sc.ing.* Francesco Romagnoli).
- In 2016, students of the Master's study programme "Environmental Science" received the Werner von Siemens Excellence Award in the category of Master's theses: A. Skujevska "Evaluation of heat energy consumption: from municipal buildings to energy supply companies" (scientific supervisor of the thesis RTU IESE professor, *sc.ing.* Marika Rošā, RTU IESE Associate Professor, Dr.sc.ing. Agris Kamenders), M. Miezis "Anticipating Management of Heat Supply of a Building" (scientific supervisor of the thesis RTU IESE Assistant Professor, *Dr.sc.ing.* Dzintars Jaunzems).
- G. Valdmanis, a student of the Master's study programme "Environmental Science" received the Latvenergo Annual Award in 2019 for his Master's thesis "Modelling of Renewable Energy Sources and Flexibility in Energy Systems" (scientific supervisor of the thesis RTU IESE Professor *sc.ing.* Gatis Bažbauers).

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

The results of student, employer and graduate surveys are used to improve the quality of the study program. The study quality monitoring and implementation system introduced by RTU in 2008 envisages regular electronic surveys of students on the content of studies and the quality of the academic staff through the ORTUS environment.

Student surveys are conducted every year after the autumn and spring semesters (see the description of Bachleor's study program point no. 2.6.).

Every year **a survey of program graduates** is also conducted. The results of the surveys reflect the positive and negative aspects of the program implementation (see the description of Bachleor's study program point no. 2.6.).

In order to analyse study directions and to receive feedback, RTU has developed a polling cycle (see the description of Bachleor's study program point no. 2.6.)

The involvement of **students** in the development of the new study programme “Environmental Engineering” started during the existing study programme “Environmental Science”, when **student survey** result pointed to the need to create several specialisations in the Master level study programme and to put more emphasis on bioeconomy matters in the study programme.

In order to receive feedback from RTU graduates, RTU Alumni Association has been established. It actively operates at the University http://alumni.rtu.lv/ (Latvian only), https://www.facebook.com/RTUAlumni/ (Latvian only) and runs an online community platform https://rtuconnect.net/ (Latvian only), which aims at developing alumni traditions.

The student survey results are analysed during the audit of the study programme and used in the development of the process of organisation and implementation the study programme in the next academic year. At the meetings of the Programme Council, as well as at the meetings of responsible departments of each higher education institution. The Study Direction Committee analyses recommendations from employers and external experts, which are used as the basis for improvement of the study programmes.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

The study program provides both incoming and outgoing mobility opportunities. To promote mobility, the RTU International Mobility Unit and the RTU Student Parliament organize information events on the mobility program in September and February (see the description of Bachleor's study program point no. 2.7.).

Outgoing mobility

The courses acquired during mobility are fully recognized – it is ensured by being careful in choosing a foreign university, study program and courses to study in collaboration with the program director and the office manager of the program.

Master level students use the opportunity to complement their knowledge in foreign higher education institutions, the Vilnius Gediminas Technology University and universities of Scandinavian countries (Technical University of Denmark), see also Figure “*Student mobility in the Master’s study programme “Environmental Science”*”.

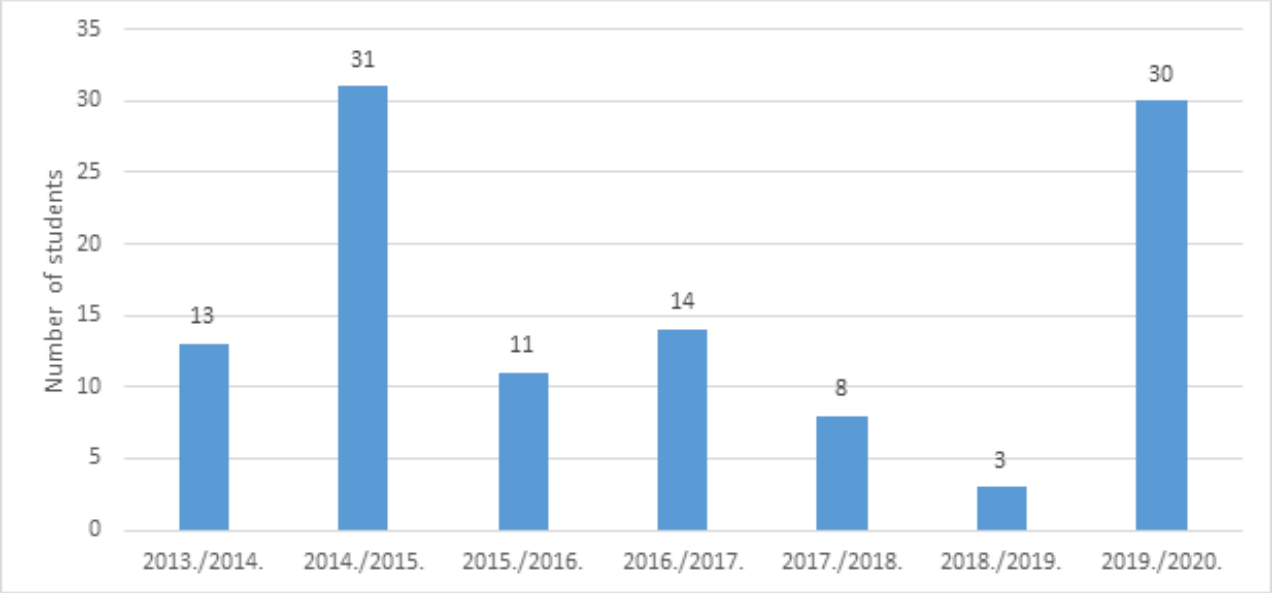

Figure: *Student mobility in the Master's study programme "Environmental Science".*

However, the dynamics of Master students in the use of student mobility programmes vary greatly over the years. The reasons for insufficient mobility are related to the fact that (1) nearly all Master students are employed at the beginning of their studies and therefore mobility is difficult to combine with their work in Latvia. (2) their family status prevents them from using long-term mobility opportunities. The complicating factor in mobility trips is also a different semester start and end periods in universities: they often starts later than at RTU and students need to delay the beginning of their studies at RTU in the context of mobility.

Being aware of the importance of student mobility in the development of students' skills and competences, RTU IESE is currently analysing opportunities and drawing up an action plan to improve student mobility dynamics during the next reporting period.

Incoming mobility

The study program is a popular opportunity for incoming mobility. Between 2019 and 2021, 44 people used the incoming mobility opportunities. These have been students who took advantage of Erasmus + study and internship opportunities and students of a double degree program from Vilnius Gediminas Technical University.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

Full information on these issues is provided in the Study Direction Report, Part II, Section 3, Criteria 3.1 to 3.3. This paragraph contains only additional separately highlighted information about the study program.

RTU has a decentralized budget, so each university unit has its own budget. A budget in general is a plan of revenue and expenditure for a specific period of time, work, event or function (see the description of Bachleor's study program point nr. 3.1.).

The sources of funding of the Master's study programme "Environmental Engineering" are both state budget funds and the tuition fee paid by natural persons for studies. For the year of studies 2020/2021, **40 state-funded study places are available for the programme** (1st year).

The **tuition fee** for the academic Master's study programme "Environmental Engineering" is **EUR 4400** (in both Latvian and English).

Calculation of the study place costs for the Master's study program "Environmental Engineering" see in the appendix "Study_progam_Environmental_Engineering_mast".

For data on the amount and dynamics of funding of the study programme, see Figure "Study program funding" and in Table "Table: Study program funding" in Annex "Statistical data_masters".

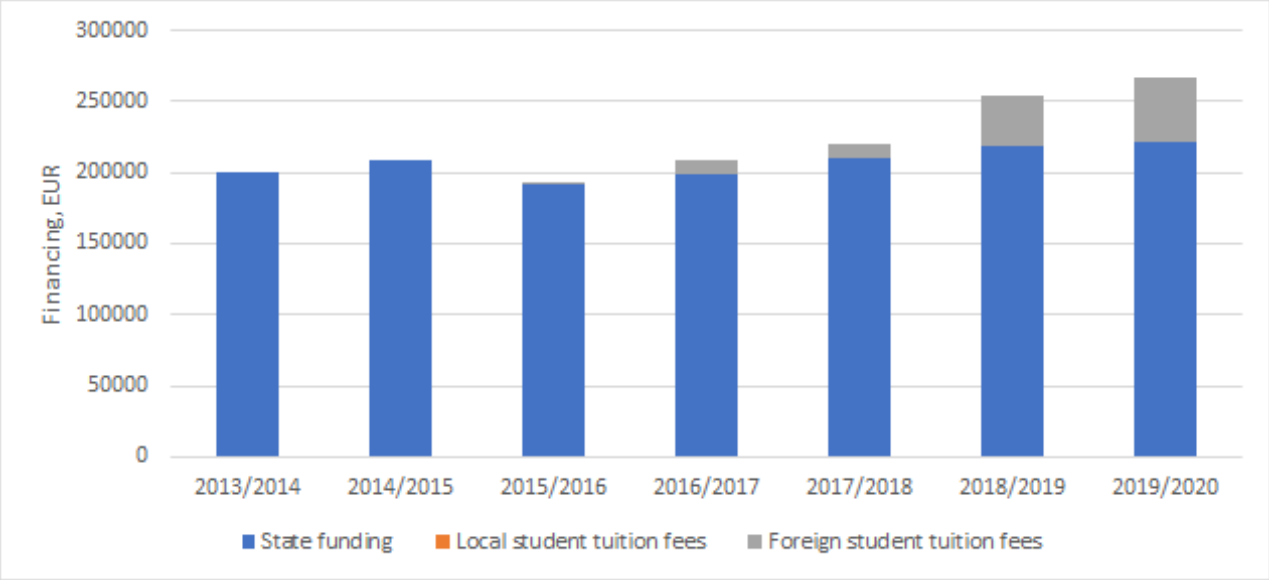

Figure: *Breakdown of funding of the Master's programme "Environmental Science" by years.*

The study process is mainly ensured by staff of RTU FEEE Institute of Energy Systems and Environment (11500). In addition, other organisational units are involved in the professional specialisation part (part B1), humanities and social study courses part (part B2). In addition, RTU organisational units ensuring the implementation of Part C ("Elective study courses") are also involved. Annex "Study programme planning_masters" contains the planning of the study programme for all forms of implementation of the study programme and Annex "Study course descriptions_masters" contains study course descriptions.

RTU IESE ensures teaching and methodological work: creates and updates study course descriptions, ensures appropriate teaching of study courses (including practical laboratory and seminar classes), supervision and defence of graduation papers and performs other activities related to teaching, methodological and scientific work.

Students of the study programme "Environmental Engineering" conduct their scientific research for their Master's thesis, as well as laboratory works in one of five RTU IESE laboratories: *Environmental Monitoring Laboratory, Biosystem Laboratory, Combustion Research Laboratory, Solar Energy*

Systems Laboratory or Building Energy Efficiency Laboratory.

RTU IESE **Environmental Monitoring Laboratory** obtained accreditation for solid energy source (including biofuel) testing services – ash content, moisture content, thermal heat capacity (higher and lower) and other services. The Environmental Monitoring Laboratory was accredited in the Latvian National Accreditation Bureau as a testing laboratory (reg. No. LATAK-T-559-00-2017).

The **Biosystem Laboratory** does research in several directions, which are related to research and development of biosystems. Research conducted at the Biosystem Laboratory: study of algae as a resource, production and study of innovative materials, study of biogas, study of electrolysis and methanation processes. The purpose of the laboratory is to provide students with an environment for research and development of biosystems in the academic study process and scientific research.

Main research directions of the **Combustion Research Laboratory** are study and optimisation of the combustion process. The laboratory is equipped with modern equipment, allowing to determine the performance efficiency of and created emissions generated by heating units. The efficiency of boilers and furnaces, as well as amounts of emissions are determined based on the methods of the Latvian national standard (LVS NE 303-5 and LVS NE 13240/AC). In addition, the laboratory is working on the research of methods for the reduction of harmful emissions generated as a result of the combustion process. Some of the methods developed are patented and are used on real sites in Latvia. Services provided by the laboratory: testing of heating equipment; measurements of energy efficiency and emissions in boiler houses, plants and other sites; boiler house audits, including full or partial boiler balance. The laboratory is planning to start a study of the biomass gasification process, which includes both theoretical and experimental research.

The purpose of work of the **Solar Energy Systems Laboratory** is to study, simulate and develop solar heat systems. Studies performed in the laboratory are related to studies of solar collectors; study of heat storage systems and their control systems; modelling and improvement of systems using modelling programmes; study of phase change materials. The laboratory studies and develops the use of phase change materials in heat storage systems and the use of computerised dynamic flow programmes to optimise system elements.

The **Building Energy Efficiency Laboratory** studies both the quality of construction materials and rooms and the possibilities to improve their energy efficiency. As part of several projects, the identification of construction materials of Latvian historic buildings and the determination of their hygrothermal properties is taking place in order to facilitate forecasts regarding the impact of internal heat insulation on the outer wall. In the laboratory, it is possible to perform the determination of the hygrothermal properties of construction materials; assessment of the energy performance of buildings; energy modelling of buildings.

For RTU IESE to be able to manage and improve performance in the field of environment, as well as to demonstrate the importance of environmental management in governance of higher education institutions to students, an RTU IESE Environmental Management System was created in 2007 and is still maintained. The environmental management system has been developed in accordance with the basic principles of the environmental management system in accordance with the conditions of LVS EN ISO 14001:2017. The Environment Management System of RTU IESE has been documented, is implemented and maintained in accordance with the requirements of the standard, reviewed annually and updated as needed. The administration of RTU IESE, laboratory administration, teaching staff and the Master's level students of the study course "Environmental Management Systems" as experts participate the self-monitoring procedure of the system. The environmental management system contributes to the rational use of resources and the improvement of the Institute's activities.

The study, science, informative (including the library), material, technical and financial basis of FEEE in general and also specifically of the Department of Energy Systems and Environment creates the preconditions for achieving the results of studies and demonstrate the possibility of providing a high-quality study process for the new study programme “Environmental Engineering”. For the effective implementation of the study programme, teachers and students at the faculty have access to auditoriums equipped with the latest generation visual and audio equipment, as well as highly certified and evaluated laboratories that meet the specifics and implementing conditions of the study programme.

Funding per study place has increased by 12% in the year of studies 2019/2020 compared to year of studies 2013/2014 (see Figure *Dynamics of study funding of the Master’s programme “Environmental Science” over the reporting period per 1 student*).

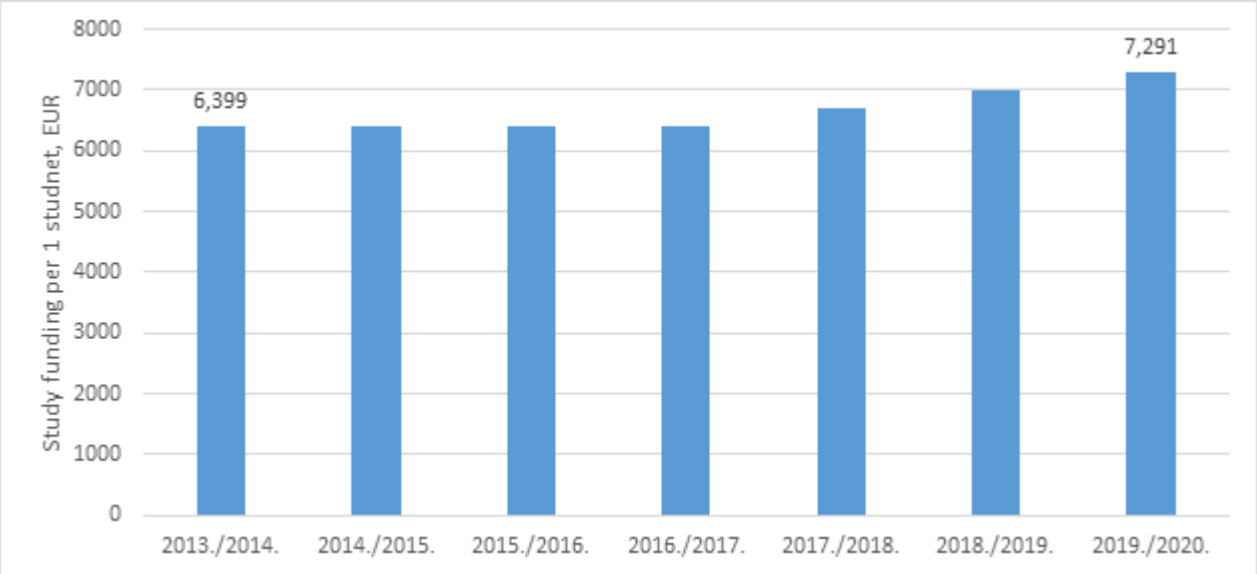

Figure: *Dynamics of study funding of the Master’s programme “Environmental Science” over the reporting period per 1 student.*

In the period from 2013 to 2019 RTU IESE purchased infrastructure for laboratories, practical classes (e.g. modelling software) and lectures (e.g. Scientific literature, databases of scientific articles), computer equipment (monitors, computers, presentation lasers), laboratory equipment (data loggers, barometers, air humidifiers, gas analyser, set of cold cameras, climate station, weights, muffle furnace, drying cabinet, detector, gas sensor adapter, etc.) for the needs of the study direction “Environmental protection” to ensure the study process.

Students of the study programme “Environmental Engineering” have access to the library of the Institute of Energy Systems and Environment, which has about 400 books in the field of environmental engineering, including doctoral theses and their abstracts in the field of environmental engineering and energy sciences, as well as methodological materials for students of the study direction “Environmental protection”. RTU IESE library provides students with access to professional educational literature, which is supplemented every year. In the reporting period, several books were purchased for the needs of the programme in addition to other library resources.

In the RTU ORTUS environment, students can access international databases: Web of Science, EBSCO, SCOPUS, SCIENCE DIRECT, SpringerLink full-text journals and books, several databases and other information resources. At the RTU library students have access to the database of “Latvian Standard”.

The RTU Design Factory includes an open-type laboratory “theLAB” in which the students can

materialise their inventions by using technological possibilities offered by 3D printing, laser cutting and engraving, plottering, large-format printing and other tools. In turn, FEEE has created a LATVENERGO student creative laboratory, where students can use latest technologies to develop their products. This is the possibility of students to act and use the obtained theoretical knowledge in practice.

As already mentioned, the overall assessment of resources is reflected in the information provided in Study Direction Report Part II, Section 3, Criteria 3.1 to 3.3.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

Overall assessment of the academic staff is shown in the information provided in the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff. This section will highlight changes in the academic staff involved in the program and their competence in teaching specific courses.

Teaching staff of the Department of Energy Systems and Environment and teaching staff of other RTU departments and industry visiting lecturers are involved in the implementation of the Master's study programme "Environmental Engineering". RTU IESE scientific and academic staff are involved in the implementation of the study programme: with a doctoral degree – 27 doctors of science, of which 23 are experts of the Latvian Council of Science (LCS) in environmental engineering or environmental science and 15 European exerts (CORDIS); teaching staff without a doctoral degree (doctoral students) – 9 persons. The scientists and young scientists involved in the implementation of the study programme specialise in environmental engineering and energy. The justification of selection of teaching staff is related to experience of scientists, scientific research interests, scientific performance, etc., taking into account the specifics of the study programme and study courses. Measures are taken on a regular basis within the study programme "Environmental Engineering" to make changes in teaching staff have a positive impact on the development and the quality of implementation of the study programme, and to ensure compliance of the study programme with the requirements specified in regulatory enactments.

See table with list of teaching staff responsible for the study course in the Master's study programme "Environmental Engineering" in Annex "List of responsible teaching staff_masters".

Measures are taken on a regular basis within the study programme "Environmental Engineering" to make changes in teaching staff have a positive impact on the development and the quality of

implementation of the study programme, and to ensure compliance of the study programme with the requirements specified in regulatory enactments.

In the implementation of the study program "Environmental Engineering" are involved lecturers from the "Environmental Science" program and other lecturers. This is due to the fact that the study program has been supplemented with new study subjects. The choice of teaching staff, taking into account their experience, research interests and scientific performance, allows us to offer a high-quality study program.

Other RTU faculty organisational units are involved in the implementation of the study programme "Environmental Engineering".

The general education study course in Part A "Intersectoral and Interdisciplinary Research Methods Study Field" is implemented by the teaching staff of RTU IESE.

Industry-specific theoretical study courses (Part A)and professional specialisation study courses (Part B1 of Part B) are implemented by RTU IESE teaching staff and other RTU organisational units, for example,

- the study source "Foundations of Civil Protection" is implemented by the teaching staff of the Department of Occupational Safety and Civil Defence of the RTU Faculty of Engineering Economics and Management;
- the study source "Water Purification Technology" is implemented by the teaching staff of the Department of Water Engineering and Technology of the RTU Faculty of Civil Engineering.
- the study source "Environmental Chemistry and Technologies" is implemented by the teaching staff of the Department of Chemistry of the RTU Faculty of Material Science and Applied Chemistry.

Part B of the programme include study courses, the implementation of which in the respective year of studies is determined by previously obtained education of students and student's interests. One of two specialisations in Part B of the study programme – "Environmental Engineering" specialisation or "Circular Bioeconomy" specialisation.

In order to provide students with the necessary skills, which will be required while working in the areas related to environmental engineering and circular bioeconomy, students are offered to choose

Humanities and social study courses in **section B.2 of Part B**. They are read by teaching staff and other organisational units. For instance,

- the study course "Socio-Economic Aspects of Energy Supply" is implemented by the teaching staff of RTU IESE;
- the study courses "Presentation Skills", "Business Sociology", "Communication Psychology", "Social Psychology" are implemented by the teaching staff of the Department of Social Sciences of RTU Faculty of E-Learning Technologies and Humanities.

In section B.6 of Part B "Languages" foreign students must learn the study course "Latvian Language for Foreign Students" of 1 CP, which will be implemented by the teaching staff of the Department of Technical Translation of the RTU Faculty of E-Learning Technologies and Humanities.

In Part C students have the opportunity to freely select study courses for 4 CP.

In Part E, the process of drafting of the Master's thesis, the study course "Master's Thesis" (20 CP) is coordinated by the responsible teaching staff of RTU IESE – Assistant Professor *Dr.sc.ing.* Dace Lauka and assistants (students of doctoral studies) Zane Indzere, Ketija Bumbiere and Vivita Priedniece.

Until now, no teaching staff of several study courses, which are the responsibility of RTU IESE and ensure mastering of exactly engineering matters in the study programme “Environmental Science” and since September 2020 also in the study programme "Environmental Engineering”, was changed due to complaints of students, which is an evidence of satisfaction of students with the work of the teaching staff and regular improvement of the study course. Teachers improve and change the content and methods of study courses every year on the basis of the recommendations received in the previous study year and the students’ involvement in class and independent work activities. There have been no complaints about academic staff and visiting academic staff from other departments over the past two years, and students have positively evaluated the work of the academic staff. For additional information on the academic staff, see the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

Overall assessment of the academic staff is reflected in the information provided in the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff. This section will highlight relevance of the qualifications and competences of the academic staff involved in the study program to teaching particular courses.

The qualification of teaching staff involved in the implementation of the study programme fully corresponds to the conditions of implementation of the study programme and the requirements of regulatory enactments, as well as ensures the achievement of aims and learning outcomes of the study programme and respective study courses (see CVs of teaching staff). RTU’s elected teaching staff, visiting teaching staff and leading industry specialists are involved in the implementation of the Master’s study programme “Environmental Engineering”. The elected academic staff of RTU is responsible for the content and creation of study courses. A team of teaching staff usually works on the implementation of the study course under the leadership of the director of the study programme and responsible teaching staff, and industry professionals, doctoral students, visiting lecturers may be included into it. Teaching staff holding a doctor’s degree are responsible teaching staff in the Master’s study programme. RTU’s elected academic staff and industry visiting lecturers with a Master’s degree and 7 years of experience in the sector participate in the implementation of the programme.

RTU IESE scientific and academic staff are involved in the implementation of the Master’s study programme “Environmental Engineering”: with a doctoral degree – 27 doctors of science, of which 23 are experts of the Latvian Council of Science (LCS) in environmental engineering or energy/environmental science or other field of science and 15 European exerts (CORDIS). The scientists and young scientists involved in the implementation of the study programme specialise in environmental engineering and energy.

9 professors of RTU IESE participate in the implementation of the study programme (see the description of Bachleor's study program point no. 4.5).

Summaries about the **qualification** of **RTU IESE professors** (as mentioned before, teaching staff of RTU IESE forms 86 % of all the teaching staff in the study programme "Environmental Engineering", teaching staff of other organisational units – 14 %) are provided below:

*Professor, **Dr.hab.sc.ing. Dagnija Blumberga.** Dagnija Blumberga, habilitated doctor of engineering sciences and RTU professor, founder of the RTU study direction "Environmental protection", Director of RTU IESE. Is the Director of the RTU study direction "Environmental protection", Director of Bachelor's, Master's and doctoral study programmes "Environmental Engineering" and "Environmental Science". Her total service record in energy and environmental protection is over 50 years. She has extensive experience by leading and participating many national and international projects in the field of energy and environment, for example, bioeconomy, renewable sources, climate change, energy and other environmental engineering related topics. She is on editorial boards of international scientific journals and conference organising committee. Dagnija Blumberga is the author of more than 300 publications, which were mainly published in scientifically reviewed with a high citation rate. The total number of scientific publications is over 400, of which 389 are published in Scopus. Co-author of 14 patents. Experience in more than 50 scientific projects and research, of which more than 30 as project manager. Hirsch index 22. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Environmental Technologies", "Production of Biobased Resources", "Bioenergy Technologies", as well as participates in drafting of Master's theses as a scientific supervisor.*

***Professor Dr.sc.ing. Andra Blumberga.** Professor Andra Blumberga is an expert with large experience in the field of energy performance of buildings and system dynamics. She has more than 25 years of professional experience. She works as the head of the Ventilation Department at ABB Latvia, then as Managing Director and the Energy Consultant and in the last 20 years she has been RTU academic staff and since 2012 she has been the RTU FEEE Vice-Dean for Research. She has extensive experience by leading and participating many national and international projects in the field of energy and environment. A.Blumberga is a co-author of 115 scientific publications, which are available in SCOPUS, and her H-index is 17. She is a co-author of 4 patents. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Environmental Policy and Economy", "Energy Efficiency and Energy Audit of Buildings", "Sustainable Rural and Urban Development", as well as participates in drafting of Master's theses as a scientific supervisor.*

***Professor Dr.sc.ing. Francesco Romagnoli.** Professor Francesco Romagnoli was graduated from the Faculty of Georesources and Geotechnology of the Polytechnic University of Turin, obtaining the degree of an environmental engineer in 2001. In 2002-2008, Francesco Romagnoli worked as an engineering for geotechnical and tunnelling projects in Rocksoil, Italian design company (Milan, Italy). In 2012, he was graduated from Riga Technical University defending the doctoral degree "Model for Sustainable Production and Use of Bioenergy". The main action direction include teaching of courses at the university, supervision of Bachelor's and Master's theses, conducting of scientific research and project management. The main topics of research of Francesco Romagnoli are: biogas, alternative types of biomass for the production of biogas (e.g. seaweed and microalgae), growing of microalgae in a laboratory and their initial cultivation conditions, life cycle analysis and system dynamics modelling with technically provided and sustainably evaluated bioenergy capabilities, provision of cities with anti-flood resilience with a focus on significant infrastructure systems. In the Master's study programme "Environmental Engineering" she is*

responsible for supervision of graduation papers and implementation of the following courses: "Adapting to Climate Change", "Eco-design and Life Cycle Analysis", as well as participates in drafting of Master's theses as a scientific supervisor.

Professor Dr.sc.ing. Gatis Bažbaeurs. *In 1995, Gatis Bažbauers was graduated from the Massachusetts Institute of Technology, obtaining a Master's degree in Mechanical Engineering, and in 1999 obtained a doctoral degree in Environmental Engineering. Since 2009, he has been working at the RTU Faculty of Energy and Environmental Engineering as a professor. Since 2012, Gatis Bažbauers is a RTU Vice-Rector for Research, whose direct job duties include management of the research system and research policy making. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Socio-Economic Aspects of Energy Supply", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor Dr.sc.ing. Ivars Veidenbergs. *Ivars Veidenbergs obtained the degree of a habilitated doctor in 1992. His total service record in thermal energy is 60 years, during which Ivars Veidenbergs work as an engineer in the Latvian Academy of Sciences and in the Diesel Train Laboratory of the Scientific Research Institute for Railway Cars. He continues his professional development at the RTU Institute of Energy Systems and Environment as a professor, project manager and expert in thermal energy and heat and mass exchange processes. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Energy Conversion and Efficiency", as well as participates in drafting of Master's theses as a scientific supervisor.*

Professor Dr.sc.ing. Jeļena Pubule. *In 2014, Jeļena Pubule obtained a doctoral degree in Environmental Engineering. In the last 10 years, she has been working in the field of environmental impact assessment, renewable energy sources, climate change, reading study courses and participating in the implementation of scientific research projects. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Environmental Impact Assessment", "Production of Biobased Resources", "Circular Economy and Waste Management", as well as participates in drafting of Master's theses as a scientific supervisor.*

Professor Dr.sc.ing. Jūlija Gušča. *In 2011, she obtained a doctoral degree in Environmental Engineering, doctoral thesis "Development of Latvian energy sources, Study of the impact of carbon dioxide storage processes". Since 2014, she led the RTU Department of Energy Systems and Environment. Research and project management in climate technologies, resource and waste management, environmental performance assessment of products and processes. In 2004-2012, work experience in international companies and organisations in the field of environmental protection and energy – AS Ramboll, United National Development Programme. Since 2011, she has been on the board of the environmental education society "Dabas koncertzāle". Participates in several advisory councils of ministries as RTU representative. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Circular Economy and Waste Management", "Strategic Planning. Innovations and Ecomanagement", "Eco-design and Life Cycle Analysis", as well as participates in drafting of Master's theses as a scientific supervisor.*

Professor, Dr.sc.ing. Claudio Rochas. *He obtained the Master's degree in the Polytechnic University of Turin, but in 2008 RTU obtained a doctoral degree in energy and continue*

working at RTU. Specialises in solar heat systems, combustion processes, optimisation of heat and mass exchange processes, combi-systems for renewable energy sources, planning of energy performance of buildings, energy planning and cost optimisation, and quantitative assessment of resilience of cities. In parallel to academic work, he has been actively working on boards of companies (Renesco, SIA Ekodoma) and in professional organisations (Solar Energy Association). Actively participates in drafting and implementation of scientific projects. He is the author of more than 70 scientific publications, which can be studied in detail in the research gateway profile or in his ortus.rtu.lv profile. quantitative assessment of resilience of cities. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Experiment Planning and Simulation of Processes", as well as participates in drafting of Master's theses as a scientific supervisor.

Professor, Dr.sc.ing. Marika Rošā. *Marika Rošā is an author of 57 scientific articles, which are indexed in the Scopus database, and her Hirsch index is 13. M.Rošā focuses on study of climate technologies in her scientific activity. In recent years, there was also research on energy efficiency from different aspects – her publications and activity in projects includes energy studies at local government level, in the fields of transport, industry, household and agriculture, as well as environmental impact assessment and assessment of climate change related aspects. She is a project coordinator in three Horizon 2020 projects (whether RTU IESE is the leading partner of the project), project manager or coordinator in six other projects (ERDF, IIE, EEA, Nordic Energy Research, etc.) and worked as an expert in another 12 international projects and 19 national level projects (both as participant and manager). In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Geographic Information Systems", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

For the scientific achievements of the above-mentioned professors, see the description of the Bachelor's study program in Part III, point 4.2

4 elected associate professors of RTU IESE participate in the implementation of the study programme (see the description of Bachleor's study program point no. 4.5).

Summaries about the **qualification** of **RTU IESE associate professors** (as mentioned before, teaching staff of RTU IESE forms 86 % of all the teaching staff in the study programme "Environmental Engineering", teaching staff of other organisational units – 14 %) are provided below:

Associate Professor Dr.sc.ing. Agris Kamenders. *A. Kamenders is an Associate Professor at Riga Technical University and he obtained a doctoral degree in engineering sciences. Specialises in energy performance of buildings and industry, district heating systems, renewable energy sources, energy planning and cost optimisation. A. Kamenders is currently actively working in the management of SIA "Ekodoma", where he is the project manager of several energy efficiency projects. Job duties of A. Kamenders include leading of study courses, supervision and implementation of energy projects using latest energy saving technologies and renewable energy systems. In general, A. Kamenders participated in many scientific research projects and research. During his career, Agris has proven his ability to work in a multicultural environment. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Sustainable Rural and Urban Development", "Energy Efficiency and Energy Audit of Buildings".*

Associate Professor Dr.sc.ing. Anna Kubule. *Obtained a doctoral degree in*

Environmental Engineering. While working at IESE, during 10 years he has obtained experience in direct work with students and scientific research. Participation in over 5 European and global and more than 5 Latvian scientific projects provided her with significant experience. Hirsch index 7. She has experience in reading of lectures to up to 200 people, as well as preparation of seminars and other individual works for smaller audiences, as well as conducting of practical experiments in fuel research and testing laboratory, as well as field trips to companies. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Case Studies on Biobased Products", "Development and Analysis of Biotechonomy", "Production of Biobased Resources", "Environmental Technologies".

Associate Professor Dr.sc.ing. Aiga Barisa. *Obtained a doctoral degree in Environmental Engineering. Dr.sc.ing. Aiga Barisa is the author of 21 SCOPUS indexed scientific publications, cited 206 times in total, her Hirsch index is 8. She is a co-author of 9 scientific monographs and textbooks. Her scientific activity is related to research topics line sustainable transport systems, energy efficiency in the transport sector, system dynamics modelling software "PowerSim". She has experience as a participant of 8 international and national level projects as a scientific manager and as a participant. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Biotechnologies", "Development and Analysis of Biotechonomy".*

Associate Professor Dr.sc.ing. Edgars Vīgants. *Scientific activity of Dr.sc. ing. Edgars Vīgants is related to sustainable heat supply, development of energy technologies and combustion technologies. Scientific abilities have been confirmed by more than 20 scientific articles, which have been published in local and international scientific editions in the last 5 years. Experience of participation in EU projects as a manager and participant. He is a co-author of several state patents. Extensive practical experience in generation of energy from renewable sources. Actively participates in the work of the Latvian Association of Heating Companies, as well as in the Latvian Renewable Energy Federation. In the Master's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Sustainable Industrial Processes and Technologies", "Bioenergy Technologies".*

For the scientific achievements of the above-mentioned associate professors and the rationale for the selection of lecturers, see the description of the Bachelor's study program in Part III, point 4.2.

The teaching staff responsible for the implementation of study courses (practical work, laboratory works) also invites visiting lecturers (industry experts, company directors) and candidates for a doctoral degree. For instance,

- from academic year 2014/2015 to academic year 2019/2020 Rozenblate Māra from the Patent Office of the Republic of Latvia "Innovative Energy Supply Technologies" read visiting lectures within the Master's study programme "Environmental Science".
- in academic year 2016/2017, Andis Kārkliņš, a representative of the Latvian Biogas Association participated read a lecture and practical work on biogas production technologies in the study course "Renewable Energy Sources" of the Master's study programme "Environmental Science".
- in academic year 2016/2017, Rolands Irklis, a representative of the Public Utilities Commission read a lecture and practical work on thermal energy pricing in the study course "Energy Technologies" of the Master's study programme "Environmental Science".
- in academic year 2020/2021, *phil.* Artis Svece, an Assistant Professor of the University of

Latvia participated read a lecture and practical work on scientific philosophy in the study course “Intersectoral and Interdisciplinary Research Methods” of the Master’s study programme “Environmental Science”.

- in academic year 2020/2021, Elīna Karaseva, a representative of the RTU Department of Public Affairs read a lecture and practical work on transfer of scientific information in the study course “Intersectoral and Interdisciplinary Research Methods” of the Master’s study programme “Environmental Science”.
- in academic year 2020/2021, *pol.* Ivars Ījabs, the Associate Professor of the University of Latvia was involved in the implementation of the study course “Environmental Policy and Economy” of the Master’s study programme “Environmental Engineering”.

Teaching staff of the Master’s study programme “Environmental Engineering” participate on a regular basis in the upskilling activities organised by the RTU Trade Union Organisation, the Student Parliament, the Study Department, as well as RTU IESE organises own upskilling activities for its employees.

For example, on 31 May 2017, there was a lecture on psychological burnout and its evaluation tools for all teaching staff of RTU IESE, as well as Bachelor, Master and doctoral students. The lecture was intentionally organised at the end of the academic year, because this was the time when students (in particular 3rd year Bachelor students, and 2nd year Master students, who draft their graduation papers) and teaching staff feel increased stress.

The RTU IESE academic staff involved in the implementation of the Master’s study programme “Environmental Engineering” is highly qualified and has extensive scientific experience.

Table: *Summary of scientific specialisations of responsible teaching staff involved in the implementation of the Master’s study programme “Environmental Engineering”.*

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
1.	Andra Blumberga	*Dr.sc.ing.*	Professor	System dynamics analysis, modelling of policy instruments, energy performance of buildings, energy performance of historical buildings, low and zero energy buildings, biomimicry, modelling of bioeconomy, smart air exchange systems	17
2.	*Francesco Romagnoli*	*Dr.sc.ing.*	Professor	Bioresources, biogas and biomethane, life cycle analysis, biogas from microalgae, risk assessment, resilience to climate change	13

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
3.	Marika Rošā	*Dr.sc.ing.*	Professor	Energy management, sustainable transport, sustainable industry, GHG emissions reduction technologies, modelling of GHG emissions	13
4.	Dagnija Blumberga	*Dr.hab. sc.ing.*	Professor	Climate technologies, renewable energy, cleaner production, bioeconomy, sustainable heat and cold supply, energy end-user management, energy sector modelling	22
5.	Jūlija Gušča	*Dr.sc.ing.*	Professor	Circular economy, recovery of resources from waste, sustainability assessment, ecodesign, CO_2 capture and storage	8
6.	Anna Kubule	*Dr.sc.ing.*	Associate Professor	Environmental pollution prevention technologies, cleaner production, industrial symbiosis, environmental sustainability assessment of manufacturing companies	7
7.	Kārlis Valters	*Dr.sc.ing.*	Assistant professor	Scientific research principles, prevention of water pollution, evaluation of chemical processes in enterprises	4
8	Gatis Žogla	*Dr.sc.ing.*	Assistant professor	Energy performance of buildings, energy audit	6
9.	Dzintars Jaunzems	*Dr.sc.ing.*	Assistant professor	Management of solar combi-systems, solar energy end-user management	2

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
10.	*Claudio Rochas*	*Dr.sc.ing.*	Professor	Energy management, energy end-user management, solar combi-systems, feasibility study of energy processes, biogasification	7
11.	Gatis Bažbauers	*Dr.sc.ing.*	Professor	Socio-economic assessment of energy supply, modelling of energy systems, heat supply processes	10
12.	Ivars Veidenbergs	*Dr.sc.ing.*	Professor	Mathematical modelling of energy technologies, sustainable heat supply and cold supply, exergy analysis	9
13	Jeļena Pubule	*Dr.sc.ing.*	Professor	Environmental impact assessment, resource management	5
14.	Vladimirs Kirsanovs	*Dr.sc.ing.*	Assistant professor	Biogasification, sustainable heat supply	7
15.	Dace Lauka	*Dr.sc.ing.*	Assistant Professor	Solar heat supply systems, modelling of renewable energy, cleaner production in enterprises, recovery of resources	9
16.	Silvija Nora Kalniņš	*Dr.sc.ing.*	Assistant Professor	Environmental management, sustainability assessment, ecomanagement	5
17.	Aiga Barisa	*Dr.sc.ing.*	Associate Professor	Sustainable transport, biogas, bioresources	8
18.	Edgars Vīgants	*Dr.sc.ing.*	Associate Professor	District heating, biomass combustion technologies, quality of biofuel	7
19.	Ruta Vanaga	*Dr.sc.ing.*	Assistant Professor	Biomimicry, passive buildings, energy performance of buildings	5

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
20.	Ģirts Vīgants	*Dr.sc.ing.*	Assistant professor	District heating, biomass combustion technologies, quality of biofuel	5
21.	Agris Kamenders	*Dr.sc.ing.*	Associate Professor	Energy performance of buildings, energy planning, low-energy, zero-energy buildings	5
22.	Sarma Valtere	*Dr.chem.*	Assistant professor	Environmental management, sustainability assessment	4
23.	Miķelis Dzikēvičs	*Dr.sc.ing.*	Assistant professor	Combined energy systems, solar energy systems	4
24.	Lauma Balode	*M.sc.*	Researcher	Assessment of sustainability of resources, environmental impact	0
25.	Kristiāna Dolge	*M.sc.*	Scientific assistant	Modelling of energy systems, energy independence	0
26.	*Fabian Diaz Sanchez*	*M.sc.*	Researcher	Life cycle assessment, life cycle cost assessment, bioresources, cold supply chains	1
27.	Ilze Vamža	*M.sc.*	Researcher	Biotechnology, processing of low quality resources into high value added products, microbiology	1
28.	Zane Indzere	*M.sc.*	Researcher	Bioresources, fish processing waste valorisation, bioeconomy	3
29.	Ketija Bumbiere	*M.sc.*	Researcher	Assessment of environmental aspects, bioresources	0
30.	Ieva Pakere	*PhD.*	Assistant professor	Sustainable heat supply, renewable energy sources	7

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
31.	Krišs Spalviņš	*PhD.*	Researcher	Biotechnology, processing of low quality resources into high value added products, microbiology	5
32.	Maksims Feofilovs	*M.sc.*	Researcher	Assessment of resilience of systems and infrastructure to natural disasters, environmental risk analysis	2
33.	Lauma Žihare	*PhD.*	Researcher	Bioeconomy, production of high value added products from agricultural and forestry waste, multiple-criteria analysis of bioeconomy processes	5
34.	Signe Allena – Ozoliņa	*M.sc.*	Researcher	Modelling of technical, environmental, socio-economic processes of energy systems, energy independence	1
35.	Vivita Priedniece	*M.sc.*	Researcher	Combustion processes, technology for prevention of gaseous emission pollution	4
36.	Valentīna Urbāne	*Dr.oec.*	Associate Professor	Labour safety aspects	0
37.	Gerda Gaidukova	*Dr.chem.*	Assistant Professor	Biocomposite research	6
38.	Tālis Juhna	*Dr.sc.ing.*	Professor	Sustainable management of water resources, water purification methods	13
39.	Gunārs Ozolzīle	*Dr. paed.*	Associate Professor	Analysis of political systems	-
40.	Airisa Šteinberga	*Dr. psych.*	Associate Professor	Pedagogical methods	-
41.	Larisa Iļinska	*Dr. philol.*	Professor	Analysis of technical texts	-

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
42.	Daina Kalniņa	*Dr.chem.*	Associate Professor	Water chemistry and microbiology	6
43.	Baiba Ieviņa	*M.sc.biol.*	Researcher	Biobased products. Case study	3
44.	Sandra Gudzuka	*Dr.psych.*	Assistant Professor	Social psychology	0
45.	Ritvars Freimanis	*M.sc.*	Researcher	Energy efficiency of buildings	3

Scientific excellence of all the teaching staff involved in the implementation of academic Master's study programme "Environmental Engineering" in 2015-2020 (data on 2020 are incomplete) is summarised in the Figure. Since 3 teaching staff members (Gunārs Ozolzīle, Larisa Iļinska, Airisa Šteinberga) represent the humanities and social sciences sector, data of this teaching staff are not available in the S*ciVal* database and are not included in the information summarised in the Figures.

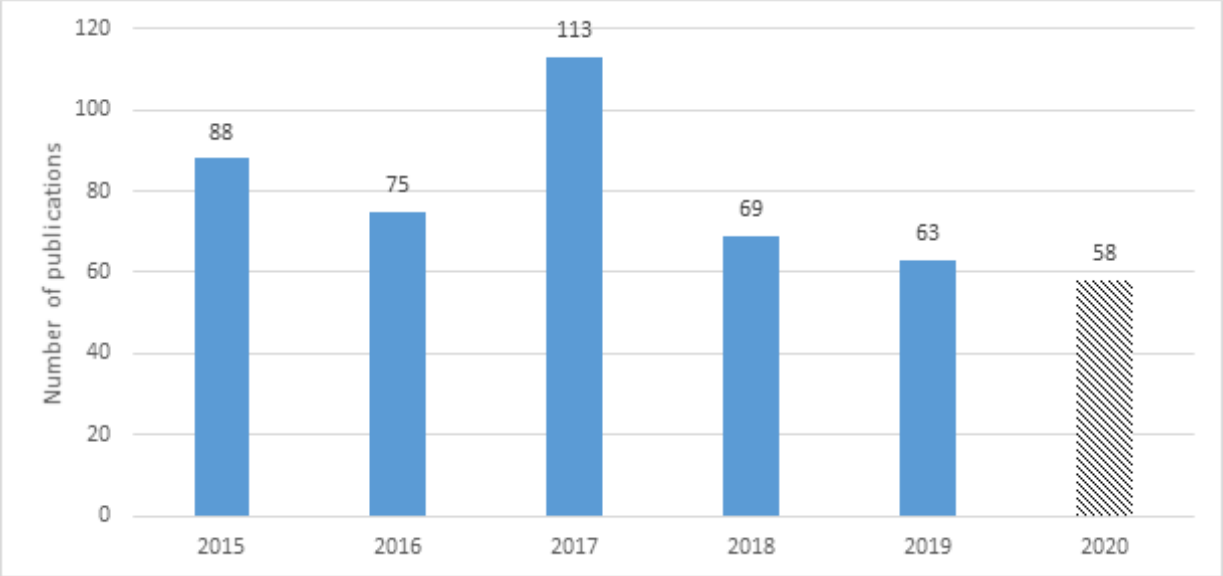

***Figure: Dynamics of SCOPUS publications** of the **teaching staff involved** in the implementation of the RTU **academic Master's** study programme "Environmental Engineering" in 2015-2020 (data from the SciVal Tool).*

In 2015-2020, the teaching staff involved in the implementation of the RTU academic Master's study programme "Environmental Engineering" **published 466 SCOPUS indexed scientific publications,** which were **cited 2750 times.** The teaching staff published SCOPUS-indexed articles in 2015-2020 and made a contribution to the development of fields of science in the following fields of science: Engineering (7.6 %), Environmental science (21.3 %), Energy (52.2 %), Agriculture and biology (5.5 %), business and management (2.2 %) and other sectors (11.2 %). The Figure below shows the breakdown of publications by research areas (188 areas in total).

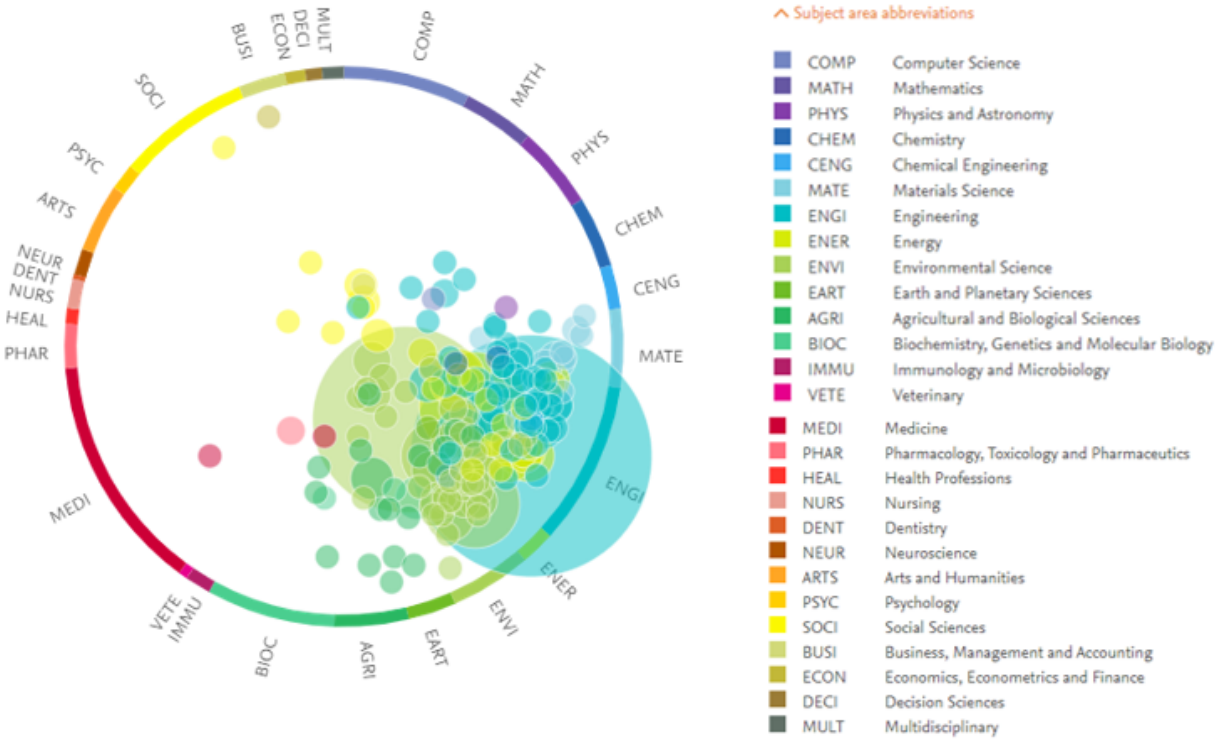

Figure: *Contribution of SCOPUS-indexed publications of the* ***teaching staff involved*** *in the implementation of* ***academic Master's*** *study programme "Environmental Engineering" (in 2015-2020) in the development of thematic areas (data from the SciVal Tool).*

In the reporting period from 2015-2020, SCOPUS indexed publications of the teaching staff involved in the implementation of academic Bachelor's study programme "Environmental Engineering (466 publications) were cited 2750 times, 5.9 citations per 1 publication on average.

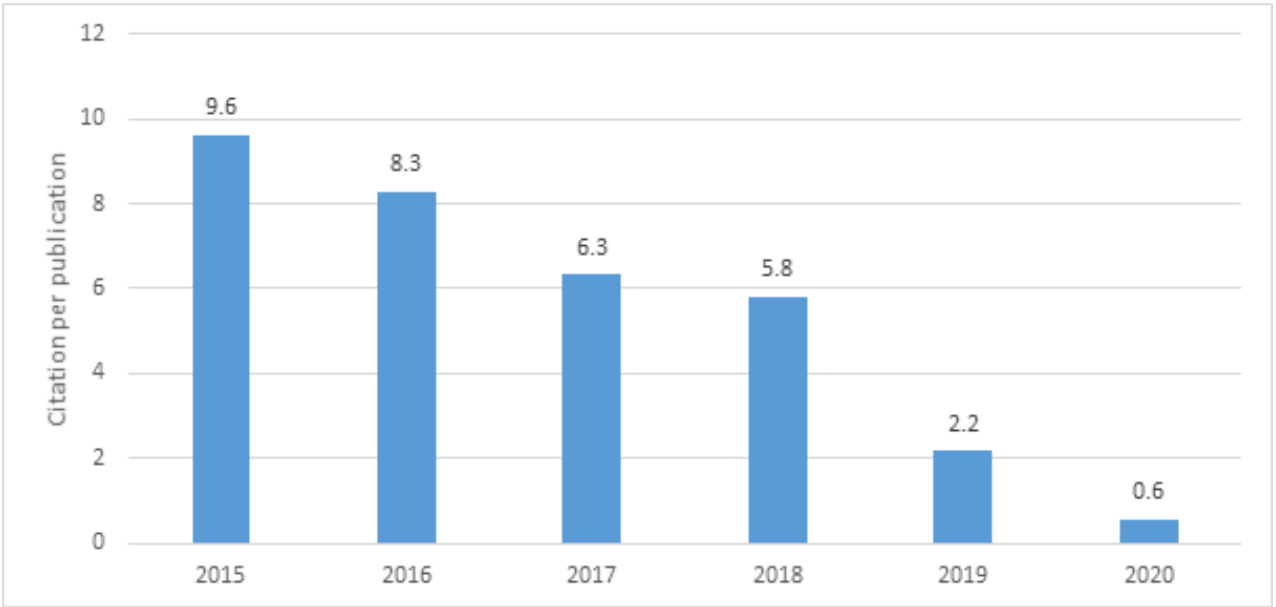

Figure: Citation *of publications of the* ***teaching staff involved*** *in the implementation of the RTU* ***academic Master's*** *study programme "Environmental Engineering"* ***per 1 publication*** *in 2015-2020 (data from the SciVal Tool).*

As it has already been mentioned, for individual achievements of teaching staff members also see CVs, for publications of teaching staff see the report on the Study Direction.

Every year, visiting lectures of foreign teaching staff are organised as a compulsory components of the study process. Some examples of foreign teaching staff involved in the implementation of the

study programme as visiting teaching staff:

- *In academic year 2013/2014 Associate Professor Baziene Kristina from the Vilnius Gediminas Technical University (Lithuania) supervised a Master's thesis of several students of the RTU programme "Environmental Science";*
- *In academic year 2013/2014 professor Andreeva Natallia from Vladimir State University named after A.G. and N.G. Stoletov (Russia) read lectures in the study course "Environmental Technologies';*
- *In academic year 2014/2015 Assistant Professor Kan Elena from Urgench State University (Uzbekistan) read a lecture on the topic "Development and implementation of environmental projects. Example of Uzbekistan" in the study course "Innovative Energy Supply Technologies".*
- *In academic year 2016/2017 the leading researcher Laukkanen Timo Pekka from Aalto University (Finland) read lectures of integration of industrial processes, optimisation and industrial sector energy efficiency, as well as the use of the Pinch analysis in optimisation of industrial processes in the study course "Environmental Technologies";*
- *In academic year 2015/2016 Associate Professor Vaiškūnaite Rasa from the Vilnius Gediminas Technical University (Lithuania) supervised a Master's thesis of several students of the RTU programme "Environmental Science".*
- *In academic year 2015/2016 professor Mada Kannan Arunachala Nadar from Arizon State university (United States) read a cycle of lectures on the topic "Renewable Energy Sources and Energy Security" in the study course "Renewable Energy Sources". In the same academic year RTU was visited by one teaching staff member from the United States – Majumdar Arun – from Stenford University, who read visiting lectures to students.*
- *In academic year 2015/2016 Schwarz Therese from the University of Leoben (Austria) read a lecture "LCA as practicable tool for waste management systems" in the study course "Life Cycle Analysis".*
- *In academic year 2016/2017 RTU IESE was visited by Associate Professor Grubliauskas Raimondas from the Vilnius Gediminas Technical University (Lithuania) supervised a Master's thesis of several students of the RTU programme "Environmental Science".*
- *In academic year 2017/2018 Professor Weidlich Ingo from Hafen City University Hamburg (Germany) read lectures on mechanical ageing processing in interaction with pipelines with soil within ERASMUS + programme in the study course "Heat Supply Optimisation".*
- *In academic year 2017/2018 RTU IESE was visited by Professor Vasarevičus Saulius from the Vilnius Gediminas Technical University (Lithuania) supervised a Master's thesis of several students of the RTU programme "Environmental Science".*
- *In academic year 2018/2019 RTU IESE was visited by Professor Davidsen Paal Ingebrigt from the University of Bergen as part of scientific work and read a lecture in the study course "Environmental Policy and Economy".*
- *In academic year 2018/2019 Andres Siirde, professor of the Tallinn University of Technology (Estonia) specialising in modelling of heat processes, worked at RTU IESE as a visiting professor for 12 months within a project and read visiting lectures in the Master's study course "Energy Technologies".*

Annual cooperation for the attraction of visiting teaching staff in the implementation of the study programme has established between RTU IESE and Vilnius Gediminas Technical University (Lithuania).

4.3. Information on the number of the scientific publications of the academic staff

members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

Overall assessment of the academic staff is reflected in the information provided in the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff. For more information about the study process and student involvement in research, see Section 2.5.

The academic staff members of the study program, both at national and international level, are engaged in scientific research in the field of quality management and conformity assessment, and the acquired information and experience are integrated into the study process.

RTU IESE research directions mainly focus on environmental protection, environmental and climate technologies and energy. Research in the following areas was conducted within RTU IESE: energy change modelling, renewable energy sources, sustainable use of resources, biotechnologies, infrastructure resilience to disasters and risk analysis, energy efficiency, bioeconomy, fuel technology, energy and environmental policy, environmental management and other (see the description of Bachleor's study program point no. 4.5.). Research results and conclusions are integrated in the study process (Lectures are supplemented with examples from research projects. The results of scientific research are used in laboratory and practical work, for example, as developed methodologies, models, stands).

Students obtain skills in research work by working with literature, different scientific databases and internet resources to successfully develop study papers and the Master’s thesis. The Master’s thesis will be a serious research, which is developed as a feasible solution to the current problem based on a research in a specific company or area. As it has been mentioned in Paragraph 2.5, students will present the results of their research paper at student conferences.

Research is integrated in the study process. This interaction is supplemented and updated by labour market research and consultations with employers and practicing specialists. Changes focus

mainly on modern and applied research. The research and study process is organised in a way that study and research work topics of students would include pressing environmental protection matters.

Personnel of RTU IESE is working actively in industry research. Research results and achievements are confirmed by participation in international conferences and acknowledgement for achievements.

Every year, RTU IESE academic staff participates in international and local scientific conferences (see sections 4.4 and 4.5 of the Report).

RTU IESE faculty's lecturers' participation in conferences in the period from 2016 to 2020 are described in the description of the Bachelor's study program in Chapter III, ponint no. 4.5.

RTU IESE not only participates in scientific conferences, but also organises them. Every year, in May, an international environmental and climate technology scientific conference CONECT is organised, where industry scientists and researchers and doctoral students share their research and research results (see description of Bachleor's study program point no. 4.5.).

Publications prepared and presented by RTU IESE representatives at the international environment and climate conference CONECT in the period from 2014 to 2020 are detailed in the the description of the Bachelor's study program in Chapter III, point no. 4.5.

When we evaluate the development of the scientific environmental and climate technologies CONECT conference, it is clear that participants from increasingly more countries of the worlds participate in it every year. This contributes to visibility of RTU IESE and promotes international academic cooperation. The increase in publications of RTU IESE representatives is evident and confirms the development at international level.

RTU IESE lecturers and doctoral students who have participated in the 2019 and 2020 "RTUCON" conferences are recounted in Chapter III, point no. 4.5 of the Bachelor's study program description.

RTU IESE academic staff actively participates in research work of the faculty and promotion of international cooperation (see Chapter 4 of the report). RTU IESE participates in the implementation of different European Union projects in cooperation with other institutes of the faculty (see description of Bachleor's study program point no. 4.5.).

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study program has a mechanism for teachers to cooperate with each other, which facilitates the improvement and interconnection of study courses. The improvement of courses takes place on a regular basis, based on the suggestions made by the students and the trends of the development of the industry.

During the implementation of the courses, there are regular meetings of the teachers, where they exchange experience on the topics of the courses, as well as develop and improve the study content by mutually agreeing on the topics, focuses, responsibilities and compliance with

regulatory requirements (see the description of Bachleor's study program point nr. 4.6.).

The Master's study programme "Environmental Engineering" has been created with two specialisations – Environmental Engineering and Circular Bioeconomy. Study courses and their development and implementation were also planned considering the thematic belonging of the specialisations.

Cooperation of teachers in ensuring the interconnection of study courses is based on understanding of the thematic structure of the study program. Mechanisms for promoting collaboration are selected based on the individual workload of the academic staff members, the thematic relationship (coherence, continuity, complementarity) of the study courses, and the experience of the teachers (see the description of Bachleor's study program point nr. 4.6.).

The student to teaching staff ratio is 1 teaching staff member per 4.5 students (in the 1st and 2nd years of studies together) in the academic staff elected to RTU and doing independent work (within the study direction "Environmental Protection").

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	Statistical data_masters.pdf	Statistikas dati_maģistri.pdf
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	Compilance with national standart_masters.docx	Studiju progrmmas atbilstība valsts standartam_maģistri_JP.docx
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Mapping of the study courses_masters.pdf	Studiju moduļu kartējums_maģistri.pdf
Curriculum of the study programme (for each type and form of the implementation of the study programme)	Study programme planning_masters.docx	Studiju programmas plānojums_maģistri.docx
Descriptions of the study courses/ modules	Study course descr_masters.pdf	Studiju kursu apraksti_magistri.pdf
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	Diploma, diploma supplement.zip	Diploms, dilpoma pielikums.zip
Description of the Study Programme - Other mandatory attachments		
Document confirming that the higher education institution/ college will provide the students with the options to continue the acquisition of education in another study programme or at another higher education institution/ college (a contract with another accredited higher education institution/ college), in case the implementation of the study programme is discontinued	Agreement for possibility to continue studies_masters.zip	Vienošanās par studiju turpināšanu_maģistri.pdf
Document confirming that the higher education institution/ college guarantees to the students a compensation for losses if the study programme is not accredited or the licence of the study programme is revoked due to the actions of the higher education institution/ college (actions or failure to act) and the student does not wish to continue the studies in another study programme	01000-2.2.1-e_178.edoc	01000-2.2.1-e_178.edoc
Confirmation of the higher education institution/ college that the teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language according to European language levels (see the levels under www.europass.lv), if the study programme or any part thereof is to be implemented in a foreign language.	02000-2.2.1-e_22.edoc	02000-2.2.1-e_22.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education	02000-2.2.1-e_24.edoc	02000-2.2.1-e_24.edoc
Sample (or samples) of the study agreement	Study agreement sample_masters.doc	Studiju liguma paraugi_magistri.zip
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.	AIP conclusion_55th Article_masters.zip	AIP Atzinums 55.pants_maģistri.pdf

Environmental Engineering (43529)

Study field	*Environmental Protection*
ProcedureStudyProgram.Name	*Environmental Engineering*
Education classification code	*43529*
Type of the study programme	*Academic bachelor study programme*
Name of the study programme director	*Dagnija*
Surname of the study programme director	*Blumberga*
E-mail of the study programme director	*dagnija.blumberga@rtu.lv*
Title of the study programme director	*Dr.habil.sc.ing.*
Phone of the study programme director	*29419783*
Goal of the study programme	*The objective of the study programme is to prepare high-profile and high-quality professionals with integrated first level academic education, inherent of systemic thinking and understanding capable of following the development of environmental technologies and contributing successfully to the implementation of environmental and climate technologies.*
Tasks of the study programme	*- to ensure continuous improvement of the quality of environmental education by preparing highly educated professionals for the private and public sector in the field of environmental engineering;* *- to develop the ability of students to carry out studies in the field of climate and environmental technologies as a basis for the review of the regulatory framework for the environment and the introduction of new requirements;* *- to develop the ability to adapt technologies and systems developed abroad to local conditions through pilot projects;* *- to develop the ability of students to develop innovative projects aimed at using sustainable use of resource and reducing environmental pollution;* *- to promote interaction between students and academic staff in the development of research papers and to demonstrate best practices for the practical implementation of the results obtained in environmental engineering companies, as well as the disclosure of the scientific results obtained;* *- to encourage the interest of students and graduates in higher-level study programmes, lifelong learning, as well as academic and scientific excellence.*

Results of the study programme	*The graduate of study programme:* *- is able to demonstrate specialised knowledge of environmental protection systems, the nature of their elements, and the causal relationship between factors affecting the quality of the environment;* *- using theoretical knowledge and acquired skills is able to analytically explain causation and debate in a reasoned manner on challenges in environmental protection and to offer environmental pollution prevention solutions, integrating modern environmental and climate technologies and evaluating them in the engineering, economic, environmental, climate change and social aspects;* *- is able to independently obtain, select and analyse information, including scientific, on environmental and climate technologies, sustainable management of resources, energy production, energy efficiency, etc. in the fields of environmental engineering, and to use a scientific approach to decision-making, problem-solving and the development of national economy projects;* *- is able to organise its own professional development in environmental engineering and related interdisciplinary areas, to take responsibility and initiative in the implementation of environmental projects individually or in a team.*
Final examination upon the completion of the study programme	*Bachelor Thesis*

Study programme forms

Full time studies - 3 years - latvian

Study type and form	*Full time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*latvian*
Amount (CP)	*120*
Admission requirements (in English)	*General or vocational secondary education*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Environmental Engineering*
Qualification to be obtained (in english)	-

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

Full time studies - 3 years - english

Study type and form	*Full time studies*
Duration in full years	*3*
Duration in month	*0*
Language	*english*
Amount (CP)	*120*

Admission requirements (in English)	*General or vocational secondary education. Proof of English language knowledge is required.*
Degree to be acquired or professional qualification, or degree to be acquired and professional qualification (in english)	*Bachelor of Engineering in Environmental Engineering*
Qualification to be obtained (in english)	-

Places of implementation

Place name	City	Address
Riga Technical University	RĪGA	KAĻĶU IELA 1, CENTRA RAJONS, RĪGA, LV-1050

III - DESCRIPTION OF THE STUDY PROGRAMME (1. Indicators Describing the Study Programme)

1.1. Description and analysis of changes in study programme parameters that have taken place since the issue of the previous accreditation certificate of study direction or the license of study programme if study programme is not included in the accreditation page of the study direction

The Bachelor's academic study programme "Environmental Engineering" was created on 28 October 2019 (RTU Senate decision No.633). The programme was licenced on 27.04.2020 (licence No.04051-181) and is now advanced for accreditation to obtain accreditation for six years.

In September 2020, the implementation of the study program "Environmental Engineering" was started. The study program is offered in Latvian and English. In September 2020 students did not apply for programme on English language.

The amount of the study programme is 120 CP. General secondary education or 4-year vocational secondary education is required to start the studies. As a result of successful mastering of the study programme student obtains the degree of a Bachelor of Engineering Sciences in Environmental Engineering.

The forms of implementation are only full-time intramural studies (3 years). Full-time studies in the programme are implemented according to RTU's standard planning, where there are 2 semesters in each year of studies, the duration of each semester is 20 weeks – 16 weeks of studies and 4 weeks of the examination period.

Adapting to the students' demand, the programme is implemented as full-time intramural studies. There has been an evident trend in the Bachelor's study programme "Environmental Science" in the reporting period that students choose full-time studies and therefore the study programme "Environmental Engineering" will follow this example. This has positive impact on study results, because the number of contact hours is higher compared to part-time studies, and full-time students usually get more involved un study quality improvement measured and extracurricular activities.

The place of implementation of the study program is Riga. The study program is not implemented in the RTU affiliations.

The study programme is implemented in Latvian and English.

1.2. Analysis and assessment of the statistical data on the students of the respective study programme, the dynamics of the number of the students, and the factors affecting the changes to the number of the students. The analysis shall be broken down in the different study forms, types, and languages.

Statistical data on students in the reporting period in the academic Bachelor's study programme "Environmental Engineering" are built on the enrolment indicators of the year of studies 2020/2021.

In individual indicators the planned achieved indicators will be compared to the academic Bachelor's study programme "Environmental Science", because it is built on the basis of this programme.

35 students were enrolled in the study programme in the year of studies 2020/2021, but 33 student concluded study agreements (it should be noted that 1 student resumed studies within the study programme "Environmental Science").

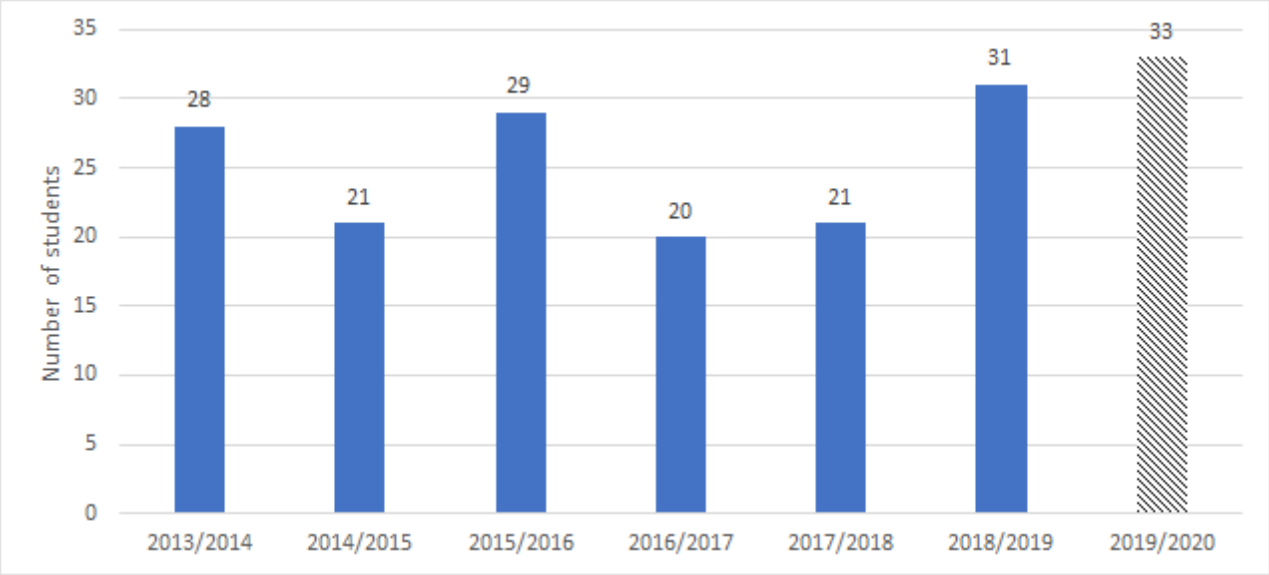

Figure: *Number of students (persons) enrolled to the Bachelor's study programme "Environmental Science" (years of studies 2013/2014-2019/2020) and Bachelor's study programme "Environmental Engineering" (year of studies 2020/2021)*

Fluctuations in the number of students are related to:

- Information and engineering sciences popularisation activities conducted in the specific year by RTU in general and specifically RTU FEEE and RTU IESE;
- Achievements of graduates of schools in centralised examinations, in particular in exact sciences.
- Environmental engineering development trends in Latvia and global trends. In accordance with the information provided by cooperation companies of RTU IESE, lack of environmental protection specialists in observed in Latvia.
- Activities of foreign universities (outside Latvia) for attraction of foreign students in Latvia in the specific year.
- Socio-economic situation in the country, including employment, migration.

If we evaluate the experience of the study programme "Environmental Science" in the reporting period, 12-19 students are enrolled per year on average (see Annex "Statistical data_bachelors").

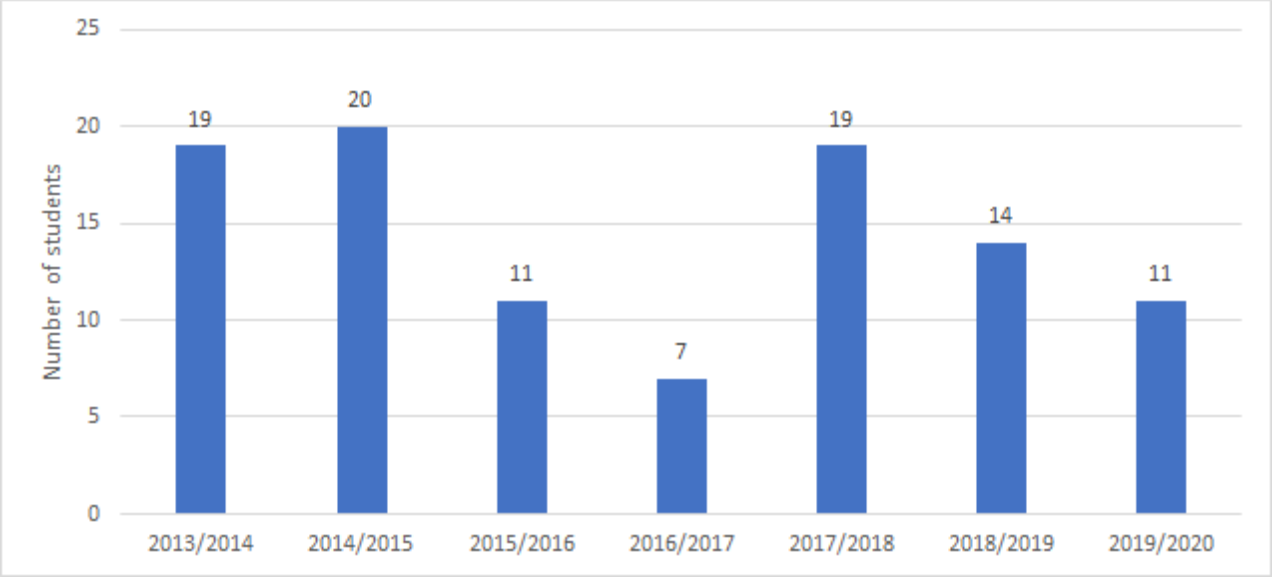

Figure: *Dynamics of enrolled students in the Bachelor's study programme "Environmental Science".*

Most of students (up to 100%) can study in state-funded budget study places.

Fluctuations in the number of students are related to environmental engineering development trends in Latvia and global trends. In accordance with the information provided by cooperation companies of RTU IESE, lack of environmental protection specialists in observed in Latvia.

Statistical data on the study programme "Environmental Science" evidence that up to 25% of students drop out every year in the reporting period. The calculation of dropouts does not include students, who dropped out due to not starting studies after enrolment or not concluding the study agreement. Most of students drop out after the first year, dropouts in other study years are lower. Comparatively high dropouts are related to the fact that general education and industry study courses are mainly included in the first year. Study courses "Mathematics", "Physics" cause most problems for part of students of the 1st and 2nd year.

When analysing the dynamics of the number of students together with industry development trends in the world and the situation in Latvia, a stable number of students and extensive development opportunities are expected in the Bachelor's study programme "Environmental Engineering" in the future.

Table: *Forecasts of the number of students in the Bachelor's study programme "Environmental Engineering"*

	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
Students					
Enrolled	30	45	60	75	80
% outside the EU	5%	15%	25%	40%	50%
Dropouts (year on year)	5%	5%	5%	5%	5%
Total number of students	29	72	129	200	276
Tuition fee per year					
EU	3000	3000	3150	3150	3308
Outside the EU	3000	3000	3150	3150	3308

1.3. Analysis and assessment of the interrelation between the name of the study programme, the degree or professional qualification to be acquired or the degree and professional qualification to be acquired, the aims, objectives, learning outcomes, and the admission requirements.

The title, aim, tasks, learning outcomes to be achieved and enrolment requirements are closely interlinked. The content of the study programme complies with the labour market requirements.

The programme is built in such a way that graduates obtain competences formulated in a standard way. In order to ensure the interlinking between the Bachelor level study requirements, the study content and the learning outcome, the programme ensures the acquisition of both professional and general competence. Professional competence is acquired in industry-specific theoretical study courses, industry-specific professional specialisation courses as well as in the drafting and defence of a Bachelor's thesis. On the other hand, the acquisition of general competence is ensured in general education and humanities courses, as well as in elective study courses (for details see section 2.2). The study programme is implemented in Latvian and English.

The academic Bachelor's study programme "Environmental Engineering" (hereinafter referred to as the Study Programme) at Riga Technical University have been implemented from the year of studies 2020/2021. Graduates of the study programme will obtain the **degree of a Bachelor of Engineering in Environmental Engineering Sciences**. The amount and the duration of implementation of the study programme is 120 CP.

The volume of the study program is 120 CP. General secondary education or 4-year professional secondary education is required to start studies. As a result of successful acquisition of the study program, the student is awarded a bachelor's degree in environmental engineering.

Today, protecting the environment and tackling climate change are the most important global challenges. The need for contemporary environmental solutions and, therefore, specialists is growing steadily, and higher education institutions play a key role, both in research and in the preparation of new specialists for economic sectors. In view of the diversity of environmental and climate change themes and solutions, future environmental engineering study programmes should be directly oriented towards an interdisciplinary higher education model, combining engineering, natural and exact sciences, social sciences, political sciences and humanities, thereby providing the national economy with competitive cross-sectoral professionals ready to work locally globally and globally, building our common future. The interdisciplinary nature of environmental matters is also confirmed by the Latvian Smart Specialisation Strategy, defining a total of five specialisation areas: (1) knowledge-intensive bioeconomy; (2) biomedicine, medical technologies, biopharmacy and biotechnologies; (3) smart materials, technologies, and engineering systems; (4) smart energy; (5) information and communication technologies). Four of them (knowledge-intensive bioeconomy; biomedicine, medical technologies, biopharmacy and biotechnologies; smart materials, technologies and engineering systems; smart energy) directly include the environmental protection (in particular, preventive environmental protection) approach.

The study programme "Environmental Engineering" focuses on preparing environmental protection specialists with extensive competences in engineering matters for work in companies and public administrations in different fields. Mastering of the skills and knowledge within the study programme is secured by European level academic and scientific staff (EU experts in the fields of environmental engineering and energy, sustainable management of resources, environmental management), who are involved in the delivery of engineering solutions at national and European

level on a daily basis.

The **objective** of the study programme is to prepare high-profile and high-quality professionals with integrated first level academic education, inherent of systemic thinking and understanding capable of following the development of environmental technologies and contributing successfully to the implementation of environmental and climate technologies.

Tasks of the study programme:

- to ensure continuous improvement of the quality of environmental education by preparing highly educated professionals for the private and public sector in the field of environmental engineering;
- to develop the ability of students to carry out studies in the field of climate and environmental technologies as a basis for the review of the regulatory framework for the environment and the introduction of new requirements;
- to develop the ability to adapt technologies and systems developed abroad to local conditions through pilot projects;
- to develop the ability of students to develop innovative projects aimed at using sustainable use of resource and reducing environmental pollution;
- to promote interaction between students and academic staff in the development of research papers and to demonstrate best practices for the practical implementation of the results obtained in environmental engineering companies, as well as the disclosure of the scientific results obtained;
- to encourage the interest of students and graduates in higher-level study programmes, lifelong learning, as well as academic and scientific excellence.

Measurements of task performance **results** are learning outcomes of students, independently drafted Bachelor's thesis, which has significant theoretical relevance and practical use features and includes original scientific results, demonstrate the competence of independent mastering, selection and analysing information and using it to address environmental problems.

As a result of mastering the study programme the graduate **(planned outcomes)**:

- is able to demonstrate specialised knowledge of environmental protection systems, the nature of their elements, and the causal relationship between factors affecting the quality of the environment;
- using theoretical knowledge and acquired skills is able to analytically explain causation and debate in a reasoned manner on challenges in environmental protection and to offer environmental pollution prevention solutions, integrating modern environmental and climate technologies and evaluating them in the engineering, economic, environmental, climate change and social aspects;
- is able to independently obtain, select and analyse information, including scientific, on environmental and climate technologies, sustainable management of resources, energy production, energy efficiency, etc. in the fields of environmental engineering, and to use a scientific approach to decision-making, problem-solving and the development of national economy projects;
- is able to organise its own professional development in environmental engineering and related interdisciplinary areas, to take responsibility and initiative in the implementation of environmental projects individually or in a team.

The **interdisciplinary** and **multisectoral approach** used in the implementation of the study programme enables students to use the knowledge learned in the theoretical part of classes in practice for the analysis and resolution of current problems of specific companies/institutions

making it possible for students to integrate in the real work environment. The implementation of the study programme focuses on the use of innovative pollution prevention technologies and their comprehensive evaluation for sustainable economic development.

The demand for the study programme is justified by the increased demand for environmental protection specialists with interdisciplinary knowledge in the fields of resource management and energy. With the obtained interdisciplinary knowledge in the field of environmental engineering graduates of the study programme can work in the fields of environmental protection, energy (thermal energy and smart energy), energy efficiency, resource management and related industries, will be able to integrate and evaluate innovative environmental and climate technologies in companies, will be able to work on drafting and introduction of environmental regulations in public authorities, as well as participate in at local government level for the development of the field of environmental engineering. Graduates of the programme will be able to carry out research in the environmental engineering and energy sector, as well as to develop and implement environmental engineering projects.

Mastering of the skills and knowledge within the study programme is secured by European level academic and scientific staff (European Union experts in the fields of environmental engineering and energy, sustainable management of resources, environmental management), who are involved in the delivery of engineering solutions at national and European level on a daily basis. The curriculum and implementation of the study programme focuses on the creation of competences to adapt and respond to changes, following and even anticipating labour market demand. In order to achieve efficient functioning of such a model, in the curriculum and in the implementation of the study programme special attention is paid to the establishment of the cooperation platform “Companies – University”.

The objectives, tasks and planned learning outcomes (knowledge, skills, competences) of the study programme are interlinked and the probability of reaching them is very high.

The programme is in line with the basic setting of the Strategy and Development Programme of Riga Technical University (RTU) for 2021-2025: to ensure the fulfilment of the core motif included in the National Development Plan 2021 – 2027 – to implement “economic breakthrough” of Latvia. RTU positions itself as one of cornerstones of development of Latvia, which prepares specialists necessary for the Latvian national economy, as well as creates new products and services, serving as a foundation for sustainable growth of Latvia. The RTU Strategy includes the most important settings for RTU development in the period until 2025, as well as sets out the activities to be performed and the allocation of responsibility for the fulfilment of the tasks to be carried out.

In order to achieve the RTU vision to become the leading science and innovation university in the Baltic States by 2025, the strategy defines four objectives of the University – excellence in science, high quality study process, sustainable valorisation and institutional excellence. Specific performance indicators have been defined for these purposes.

The purpose of a quality study process is internationally competitive, analytically and creatively thinking specialists prepared in prestigious, internationally recognised high-quality studies, who ensure the development of the Latvian economy and who have the capacity to learn all their lives. The purpose of excellent research is high-quality scientific research that meets the needs of Latvian and international economy, are widely involved in international, national and sectoral research programmes and are integrated into the study process. The purpose of sustainable valorisation is an efficient technology transfer and innovation development environment that promotes the creation of new technological companies and products.

The RTU Strategy for 2021-2025 can be read at https://files.rtu.lv/public/ortus/Strategija_RTU.pdf

(Latvian only). The strategy of RTU's new planning period is a successor to the previous University Strategy for years 2014-2020

The study programme fully complies with the goal of the strategy of the RTU Faculty of Electrical and Environmental Engineering for 2014-2020 – by 2020 to become Latvia's leading internationally recognised study, science and innovation institution in the fields of energy, electrical engineering and environmental science, ensuring a high quality study process, internationally recognised scientific research and sustainable innovation, commercialisation and knowledge transfer in the economy.

The RTU Institute of Energy Systems and Environment (IESE) has developed a development concept of the Department of Energy Systems and Environment (2016-2020), which includes four strategic goals with regard to the quality of the study process and awareness of the nature and high quality of the programme, awareness of IESE as an international and local brand, development of IESE as the leading institution in Latvia, which offers scientific services in the fields of environmental protection and energy to the private sector and improvement of scientific quality of IESE. The implementation of the study programme helps to achieve these goals, because it prepares intersectoral specialists in the fields of environmental engineering, energy, bioeconomy and environmental management.

For more information on compliance of the study programme with RTU, RTU FEEE and RTU IESE strategies see section 1.2 of the self-evaluation report of the study direction.

III - DESCRIPTION OF THE STUDY PROGRAMME (2. The Content of Studies and Implementation Thereof)

2.1. Assessment of the relevance of the content of the study course/ module and the compliance with the needs of the relevant industry and labour market and with the trends in science. Provide information on how and whether the content of the study course/ module is updated in line with the development trends of the relevant industry, labour market, and science. In case of master's and doctoral study programmes, specify and provide the justification as to whether the degrees are awarded in view of the developments and findings in the field of science or artistic creation.

The interdisciplinary academic Bachelor's study programme "Environmental Engineering" is the only one in Latvia and there are only a small number of similar Bachelor level programmes in the international education space, so the competitiveness of graduates is evaluated as very high. The curriculum of the study programme reflects development trends in the sector and ensures the preparedness of specialists.

The Paris climate conference highlighted that climate change and related environmental problems are emerging more rapidly than previously anticipated. Therefore, in order to reduce the pace of climate change and irreversible environmental degradation, cardinally new technological solutions are needed, which are based on new education models, an interdisciplinary approach and inclusive cooperation (government – business – universities and schools - society) (Paris Agreement, United Nations, 2015). In response to climate change, the green energy and environmental engineering sector is rapidly developing, creating new job opportunities while requiring new skills and

knowledge. The challenges are significant: the growing number of low and zero-emission technologies in coming years will require education or retraining of many employees. In the renewable energy sector, the workforce has increased from 230,000 to 550,000 people just in 5 years (Source: "*A Roadmap for moving to a competitive low carbon economy in 2050*"). At the same time, green innovation creates a huge need for young talent able to cope with the transition period of the energy sector, based on a systemic approach.

The Sustainable Development Strategy of Latvia for 2030 and the strategic objectives set out therein require Latvia's development to be based on sustainable development foundations in the future and will also require specialists with interdisciplinary knowledge in the fields of environmental engineering.

Research, innovation and education should be based on cross-sectoral activities, therefore universities are key drivers for the transition to low carbon dioxide emission technologies. It is vital right now – during the transition period (the programming periods defined in the European Union Energy Strategy 2050) – to transform or create new study programmes and to introduce new learning approaches in order to prepare specialists for an era of change. The analysis of labour markets and societal needs leads to the conclusion that there is a growing demand for environmental protection professionals with deep and extensive knowledge not only in fundamental and technical sciences but also in the areas related to social sciences, legal and economic matin situations where a flexible and cross-sectoral approach is needed.

The newly created Study Programme is in line with the current and future labour market demand. It is important that the RTU implements an integrated approach to modernising and internationalising the study direction "Environmental protection". The implementation of the new research programmes "Environmental Engineering" at all levels (Bachelor, Master and doctoral) at the same time provides high added value, as this ensures the integrity of the qualification to be obtained from the Bachelor's level to the doctoral level, avoiding duplication of study content and risks of non-fulfilment of competences, as well as ensuring the sustainability of Master and doctoral programmes.

In order to ensure continued updating of the study programme in line with labour market demand, it is planned to establish the Employers' Board of the Programme. The Employers' Board will participate in the definition of the vision for strategic development of the study programme, the definition of the necessary competencies and the initiation of new study courses in accordance with the requirements of the requirements of employers and labour market situation.

RTU IESE wanted to start the implementation of an international Bachelor level environmental engineering programme in Latvia as soon as possible for the following reasons:

1. Latvia has a high potential to become a European green technology superstate, which is based on both available bioresources and socio-economic factors. The implementation of the programme and the preparation of high-level experts will be a prerequisite for the development of the green economy at both national and regional levels;
2. in the long term, it will be possible to develop new specialisations in the study programme, taking into account its structure, in response to changes in demand from different sectors;
3. as it is recently started the implementation of the Bachelor, Master and doctoral level study programmes "Environmental Engineering" at RTU, the Bachelor's study programme will be a cornerstone of succession and sustainability in higher education in the field of environmental engineering.

Therefore studies in new study program were started in September 2020.

The competitiveness of the study programme is confirmed by the fact that according to the

graduate survey data available to the RTU IESE administration, one year after graduation graduates of the study programme “Environmental Science” are employed, most are working in the industry (around 68%) as environmental engineers, environmental specialists.

The curriculum of study programmes is updated in compliance with the needs of the industry, labour market and research development trends. Each year, study programme is improved, taking into account the results of student questionnaires, as well as recommendations of the employers. Environmental specialists working in different sectors are involved in the study programme “Environmental Engineering” (more examples are mentioned in section 5.1 of the description of the study direction “Environmental protection”).

All changes to the curriculum and implementation methods of the study programme reflect external trends and certify compliance of the study programme with the industry and labour market situation. Changes in the study programme are based on the need to ensure compliance with industry, labour market and science development trends, to maximally strengthen mastering of professional competences and preparedness.

Close link to scientific trends is ensured in the implementation and development of the study programme (for more information see chapter 4 of the description of the study direction “Environmental protection”).

Applied research also plays an important role. Students draft study papers on topical issues in the sector, studying and analysing scientific and professional literature in libraries and international databases. Students use the acquired knowledge and insights in practical research in Latvian or foreign companies, analysing issues related to environmental engineering and environmental protection, developing and implementing solutions for improving business activities. Students present the results of their research at the RTU’s annual scientific conference for students and the most prominent students in the Bachelor's study programme also present them at the international scientific conference CONECT. The results of individual research are also summarised in scientific publications (in addition see paragraph 2.5 of the report on the programme and section 4.5 of the report on the study direction).

The courses acquired in the study process and their content testify to the compliance of the study program with the current and future market demand. For example, the study course “Intelligent Energy Systems” introduces students to the basic principles of engineering of the main renewable energy sources, including a detailed understanding of its conversion into electricity and further distribution. The knowledge gained in the study course on the engineering challenges of renewable energy production is essential in the labour market. When developing the bioeconomy, employers want employees with prior knowledge of the bioeconomy. The study course “Introduction to Biotechnology” provides an understanding of the use of local bioresources and approaches to of creating high value-added products.

2.2. Assessment of the interrelation between the information included in the study courses/ modules, the intended learning outcomes, the set aims and other indicators, the relation between the aims of the study course/ module and the aims and intended outcomes of the study programme. In case of a doctoral study programme, provide a description of the main research roadmaps and the impact of the study programme on research and other education levels.

The study programme ensures a link between the information included in the study courses, the learning outcomes, the objectives set, the methods, and the link between each study course and the objectives of the study programme and the learning outcomes. The objective of the programme has been set in line with the needs of the economy, different sectors and society, namely: to prepare environmental specialists in the field of environmental engineering with the degree of a Bachelor of Engineering in Environmental Engineering, as well as to create a basis for further studies at a higher level to acquire knowledge and competence. The tasks of the programme have been formed in such a way to educate students in accordance with the requirements of Level 6 of the Latvian Qualifications Framework (hereinafter referred to as LQF 6), as well as to promote the competitiveness of students in changeable socio-economic conditions and in the international labour market (see the parameters section of the programme).

The structure of the study courses is organized on three levels. In the general education, humanities, social sciences and elective courses students mostly acquire general knowledge, personal and social competences. Professional competences are developed in the field-specific and professional study courses, there more emphasis is placed on the development of skills and professional preparedness, whereas in the elaboration of the bachelor's thesis students demonstrate the acquired skills and competences. The content of the Bachelor's programme consists of compulsory study courses, restricted elective courses (specialised) study courses, humanities and social study courses, elective study courses and graduation paper. The degree of the Bachelor of Engineering in Environmental Engineering Sciences is awarded after completing theoretical courses and defending the Bachelor's thesis.

The expected amount of **compulsory study courses** of the study programme is 70 CP (105 ECTS). The compulsory courses of the study programme provide students with knowledge of environmental engineering guidelines and links with natural sciences study courses (mathematics, environmental physics, engineering chemistry), the structure of the sector and historical facts, principles, sector developments and problems, current problems in research engineering and energy industries, the description and its cross-sectoral importance, include knowledge on scientific research methodologies and their use. The **restricted elective (specialised) study courses** (24 CP = 36 ECTS) of the study programme are designed to enable future specialists to deepen knowledge in the selected study direction. The restricted elective study courses of the study programme are conditionally divided into four thematic areas: air, energy, water and resources/waste. The student may choose study courses corresponding to a given thematic area, thereby gaining in-depth knowledge and competence, or choosing a horizontal course learning approach – to study restricted elective study courses in each of the thematic areas, gaining extended knowledge and competence in the field of environmental protection. Such an approach (without directly distinguishing specialisations in the study programme) has been borrowed from the developers of the academic Bachelor's higher education study programme "Environmental Engineering" (43529), when visiting the Swiss Federal Institute of Technology in Zurich (ETH Zurich). The implementation of the approach in the Bachelor-level environmental protection studies programmes ensures flexibility of the study programme. Thus, study courses in any specialisation are not distinguished in the planning of the academic Bachelor's higher education study programme "Environmental Engineering" (43529). The study programme also includes humanities and social study courses (4 CP = 6 ECTS), as well as **elective study courses** (4 CP). The student completes mastering of the programme with the Bachelor's thesis (15 CP = 22.5 ECTS).

Table: *Study courses included in the Bachelor's academic study programme "Environmental Engineering"*

Code	Study course	CP
	Part A	**70.0**
DIM708	Environmental Mathematics	11.0
DMS212	Probability Theory and Mathematical Statistics	2.0
MFT702	Physics	8.0
ĶTM101	Environmental Engineering Chemistry and Material Sciences	4.0
ICA301	Civil Defence	1.0
SDD701	Innovative Product Development and Entrepreneurship	4.0
EVA703	Introduction to Study Field	2.0
VAS003	Introduction to Environmental Research Methods and Theory	4.0
VAS005	Introduction to Environmental System Dynamics Modeling	5.0
VAS027	Sustainable Development	2.0
VAS037	Geographic Information Systems	3.0
VAS006	Introduction to Biotechonomics	6.0
VAS030	Air Quality Engineering	6.0
BŪK712	Water Treatment Technology	6.0
VAS028	Smart Energy Systems	6.0
	Part B	**31.0**
	B1 Professional specialisation study courses	**24.0**
EVA702	Thermal energy systems. Basic course	6.0
VAS007	Combustion Processes	2.0
EAS501	Demand Side Management	4.0
EAS714	Basics of Systems Simulation	4.0
VAS032	Energy Audit	4.0
VAS036	Heating and Cooling Supply Systems	4.0

Code	Study course	CP
EAS756	Practice	4.0
VAS004	Concepts and Technologies of Waste Management	6.0
VAS034	Raw Materials and Resources	6.0
VAS029	Environmental Monitoring	4.0
VAS033	Carbon Dioxide Capture, Storage and Utilisation	4.0
VAS001	Metrology	4.0
EAS705	Theoretical Aspects of Climate Technologies	4.0
VAS031	Air Pollution Control	4.0
BŪK316	Microbiology of Engineering Systems	2.0
BŪK320	Wastewater Treatment	4.0
EAS718	Gas and Fluid Mechanics	4.0
BŪK705	Hydrological Processes and Modelling	2.0
BŪK713	Artificial Recharge of Groundwater	4.0
BŪK706	Water Resources Risk Analysis	4.0
BŪK704	Basics in Biology	2.0
	B2 Humanities and social study courses	**4.0**
HSP377	General Sociology	2.0
HSP375	Sociology of Management	2.0
HSP376	Sociology of Personalities and Small Groups	2.0
HSP378	Politology	2.0
HSP379	Political System of Latvia	2.0
HSP380	United Europe and Latvia	2.0
	B6 Languages	**3.0**
HVD153	The terminology minimum in English	3.0

Code	Study course	CP
HVD149	The terminology minimum in German	3.0
VSL711	Latvian for Foreign Students	1.0
	Part C Elective study courses	**4.0**
	Part E Final / state examination	**15.0**
VAS035	Bachelor Thesis	15.0
	Total:	**120.0**

The integrity of the study programme is achieved through the development of an inter-course learning approach – for study courses within one semester and between semesters. A Bachelor's thesis (15 CP = 22.5 ECTS) is a combining element of knowledge and skills acquired in the study programme, with an in-depth study on an environmental engineering topic (corresponding to the subject of Bachelor's thesis). The implementation of the Bachelor's study programme at the level of study courses is implemented in close cooperation with the supervisors of the Bachelor's thesis – from the 3rd semester, practical and independent work at the level of study courses are focused on the subject of Bachelor's thesis, thereby reinforcing the student's knowledge in the specific field of research with the Bachelor's thesis research topic. Such a mechanism of implementation of the study programme allows ensuring the achievement of successful learning outcomes – perfectly drafted Bachelor's thesis and successfully mastered study courses.

To obtain the degree of the Bachelor of Engineering in Environmental Engineering Sciences the requirements of the Bachelor's study programme should be fulfilled and the Bachelor's thesis should be defended. The mastering of the programme ends with the drafting of a Bachelor's thesis and its public defence in the Bachelor's thesis defence committee of the Institute of Energy Systems and Environment of Riga Technical University. The content, assessment criteria and principles of the Bachelor's thesis are described in the "Regulations on Drafting and Defence of a Bachelor's and Master's Thesis" in Study Programmes of the Study Direction "Environmental Protection".

While drafting a Bachelor's thesis, interim tests on progress in drafting of the Bachelor's thesis are organised, in which students present their research to the responsible teaching staff. Interim tests include:

- regular meetings with the scientific supervisor of the Bachelor's thesis;
- students of the last (third) year report, at least once a month, on their progress in drafting of their Bachelor's thesis: defending the topic of the Bachelor's thesis in the autumn semester at the RTU IESE Scientific Council and in the other months (December to May) – meeting individually with the representative of the RTU IESE Bachelor's and Master's Thesis Quality Monitoring Commission (teaching staff with a doctoral degree – *sc.ing.* Dace Lauka, as well as scientific assistants Zane Indzere and Ketija Bumbiere). During the meeting, the student should demonstrate performance (which is confirmed by a signed statement by the scientific supervisor of the Bachelor's thesis) and has the possibility to ask unclear questions about drafting of the Bachelor's thesis to the representative of the committee. The drafting of a Bachelor's thesis and its quality assurance are closely linked to the compulsory study course

"Introduction to Environmental Research Methods and Theory" and "Bachelor's Thesis". Taking into account the results of the mapping of study courses, it can be stated that the content of study courses is mutually aligned and ensures that the achievement of the learning outcomes s of study courses and the study programme.

Study plan is formed in compliance with successiveness of the study content (see Annex "Study programme planning_bachelors"). All conditions for acquisition of the credit points are described in the description of each study course (see Annex "Study course descriptions_bachelors"). Content and volume of examinations corresponds to content specified in the subject programmes and makes it possible to check the level of achievement of acquired skills, knowledge and competence.

The requirements for environmental education specified in Article 42 of the Environmental Protection Law, taking into account the specifics of the study program, are covered in most study program study courses, for example, study course "Sustainable Development", "Introduction to Study Field", "Introduction to Environmental Research Methods and Theory" etc.

2.3. Assessment of the study implementation methods (including the evaluation methods) by providing the analysis of how the study implementation methods (including the evaluation methods) used in the study courses/ modules are selected, what they are, and how they contribute to the achievement of the learning outcomes of the study courses and the aims of the study programme. Provide an explanation of how the student-centred principles are taken into account in the implementation of the study process.

Assessment of learning outcomes is carried out in accordance with the Regulation on the Assessment of Learning Outcomes (https://www.rtu.lv/writable/public_files/RTU_1_studiju_rezultatu_vertesanas_nolikums.pdf (Latvian only)) and the Regulation on Final Examinations at Riga Technical University (https://www.rtu.lv/writable/public_files/RTU_nolikums_par_noslguma_prbaudjumiem_.pdf (Latvian only)). Pedagogical methods, the structure of study courses, as well as assessment methods are selected by the instructors responsible for the study courses in compliance with course curriculum and specifics of the programme, as well as student needs. Courses and seminars on latest teaching, pedagogical methods are organised for academic staff, as well as attendance of courses to improve qualification is promoted at internal faculty activities, at RTU level and internationally. The Centre for Academic Excellence organises various events aimed at professional advancement of academic personnel at the University level.

A member of academic staff should inform students about particular assessment criteria of each study course at the fist lecture/practical class, and they are published in the e-studies environment of the course in the RTU intranet ORTUS.

The methods used in the study program contribute to the achievement of the aims and learning outcomes of the study courses and program, taking into account the principles of student-centered teaching and learning. Conformity with the principles of student-centered education (hereinafter – SCL) is constantly ensured. As defined in the SCL Manual, student involvement in the study process and content development is assured thus creating additional responsibilities and authority for students. Students are provided with the opportunity to influence their own study process, exercise their autonomy, and provide feedback on the study process in line with their expectations. The FEEE Student self-government plays an important role in providing links between the students, academic staff and program administration, and it actively participates in all these processes and

conducts annual evaluation of the academic staff. In several documents – the Code of Academic Integrity, Regulation of the Evaluation of Learning Outcomes, Methodological Guidelines for the Development of Study and Final Theses, etc. – the teaching and learning guidelines are defined.

Once every semester students evaluate the work of the academic staff by providing answers to a survey questions (in the ORTUS environment). Students evaluate the work of the academic staff, the content of the study courses, the sufficiency of theoretical knowledge for understanding and acquiring the material, individual tasks, the acquired practical skills, the attitude of the academic staff and cooperation with the students, the assessment methods and criteria, and other indicators. The questionnaires are anonymous. At the beginning of each study course, the teacher informs the students what changes have been made to the study course based on the recommendations and comments of the students of previous years, as well as the results of the survey. Each semester the study program director discusses with the students the factors that influence their opinion about the quality of studies; this procedure is described in the RTU Regulations for Academic Group Leaders. As a result of the discussions, the study program director proposes changes in the content and methods of the study courses.

Full achievement of learning outcomes is ensured in the study program. The learning outcomes are formulated at the level of the study program and study courses. At the beginning of each study course the learning outcomes to be achieved are discussed with the students and they can also read them in the ORTUS. As mentioned above, a link between the study program and the learning outcomes to be achieved is ensured. The interconnection of study courses and their succession in the study content acquisition is evaluated at least once a year and additionally in cases when suggestions are received from students. According to the learning outcomes of the study program, the content and volume of the study courses in credit points are formed, while according to the learning outcomes of the study course, the topics and their volume in hours are formed. The learning outcomes in all study courses are tested using appropriate assessment methods. Students have the opportunity to challenge the assessment of their study results – it is stipulated in the Regulations on the Assessment of Study Results (29/05/2017 Senate Decision, Minutes No.610).

The study program is supplemented and updated in the process of its implementation on the basis of labour market research and consultations with employers and practitioners. Recommendations from alumni, students and academic staff play an important role in improving the study process.

Many and diverse study methods are used in the pedagogical process: individual and group work; individual and group tutorials; presentations of results, project work, simulations of situations (for instance, business games), case studies, tests, oral and written examinations, practical and laboratory work, discussions, etc. At the beginning of each study course, the teacher explains the purpose of the course, identifies the students' level of knowledge, their previous experience, expectations, and other relevant information. The academic staff and the students agree, as far as possible, on the study process, methods, assessment, etc. By combining teaching and learning methods, their relevance to different groups of students is ensured, and students with different needs are given the opportunity to acquire knowledge, skills and attitudes in the most appropriate way.

The study process is developed as an active, engaging process for the students and includes lectures, seminars, discussions, case studies and practical problem solving, individual and group work, including research work, company visits and field trips, internship, guest lectures by employer representatives. The pedagogical process uses the methods of acquiring knowledge, developing skills and abilities, as well as methods of applying knowledge and creativity. These methods are usually applied both when providing information and testing. This principle is reflected in the work of the academic staff in individual topics and throughout the whole course.

The academic staff organise students' cognitive activity in various ways – inductive (from individual to general), deductive (from general to individual), reproductive (formulating ready-made facts, evidence, putting emphasis on the main ideas), and often use the problem-finding method. Both monological approach is used – a student's independent activity and presentation of their point of view, as well as dialogical – student collaboration, and research – literature studies, case studies, simulations, seminars etc.

The academic staff use several ways of presenting information – verbal, visual and practical methods are used in the study process. Narration, presentation, brainstorming, discussions, roleplays are often used to present and consolidate theoretical knowledge. They combine elements of verbal and visual methods, whereas practical methods – case studies, exercises with a specific purpose, as well as intermediate tests – are more often used to enhance what has been learned. At the end of topics and study courses, knowledge-testing methods are used: tests, presentations as a synthesis of the acquired material, which allows the student to demonstrate the ability to focus on the goal (topic), select information, systematise it, explain it clearly and justify their opinion by answering questions.

Within the study courses, methods are chosen depending on the aim, content and learning outcomes. Many study courses use problem-based learning using brainstorming, group work, discussions, project work, etc. Active learning methods such as discussions, problem solving, case studies, online tests (http://www.kahoot.com/, http://www.mentimeter.com/), , and field trips to companies are used to engage students in the study process.

Independent studies of students play an important role. The description of independent studies is included as a compulsory part in the study course description. Students' ability to learn independently is purposefully developed in all study courses. Students acquire research skills by regularly working with literature and internet resources in order to successfully develop a variety of study projects, internship reports and master's theses. In this way, students' research work and work with international scientific databases available in the RTU library with electronic access from the ORTUS environment is also promoted. In the study process, the student should draft a course paper in accordance with the study programme in the study, which usually is a summary of practical works. For example, "Introduction to study field", "Introduction to environmental research methods and theory", "Introduction to modelling of environmental systems dynamics", "Introduction to biotechonomy", "Demand Side Management", "Basics of Systems Simulation", which provide an opportunity to obtain research work skills.

There is a strong focus on interactive learning methods, the main purpose of which is learning to learn, find information, use different sources of information, make judgements, work with others, make decisions and undertake responsibility. The cooperation here is both ways: student-teacher and teacher-student. For more information, see about teaching and learning methods in Section 4.5 and study course descriptions. Practical and laboratory work in companies and use of laboratories of companies play an important role in this programme. This is also practiced in the study programme "Environmental Science" with several examples in the reporting period of how performance of practical and laboratory works in production facilities of different companies are integrated in the study process and provide students with an insight in how theory looks in practice (for example, study course "Combustion processes", "Concepts and technologies of waste management", "Demand side management", etc.).

For the evaluation of the knowledge acquired during the study courses, a summative assessment approach is used, determining the weight of each test. Attendance of classes is also taken into account to evaluate how much time students devoted to learning by participating in lectures of lecturers and practical classes. Evaluating all the works together, including the examination,

provides an understanding of each student's knowledge stability and understanding of the use of methods in data acquisition, processing, in statistical 504 analysis, visualization and interpretation of results. For more information, see about teaching and learning methods in Section 4.5 and in study course descriptions, on the assessment system – section 1.6 of the self-evaluation report of the study direction.

Examination, group work, presentation, independent work and examination are chosen as the main assessment methods for achievement of the learning outcomes and aims of the study program. Tests provide an opportunity to gain confidence that the students understand the theoretical concepts discussed in the course and their applications. Group work enables students to demonstrate their comprehensive knowledge of the topics covered within the study program and to apply their knowledge in practice, to develop research skills, ability to work in a team, use correct terminology, and define and defend their views. Presentations give an opportunity to ascertain the students' ability to gather and present the necessary information. Independent work gives an opportunity to ascertain the students' ability to independently evaluate the obtained information, to systematize it and to carry out the necessary analysis, reflects the students' level of knowledge and ability to work and analyse literature, it also facilitates academic writing. Examination gives the opportunity to verify the students' acquired knowledge within the course.

Student achievements and course assessment results are discussed twice a year (after session results) at the department meeting. The results are summarised and evaluated by the program administration and serve as a basis for further improvement of the study process.

RTU FEEE and RTU in general have in place a stringent and transparent system for competence development of the academic staff.. Several departments, including the HR, Science, International Relations, Studies, and Academic Excellence Centre regularly inform the staff about opportunities to develop their competencies in research, methodological and didactic skills, as well as general competencies (foreign languages, information technology, public speaking and presentation skills, etc.) and specific competencies in the professional sphere. Information on the scientific activities of the academic staff is stored in the ORTUS environment. In order to carry out pedagogical work at a high level, methodological seminars are organized for RTU academic staff members on the possibilities of using different teaching methods, experience, good practice and sharing success stories. The head of the department conducts individual talks and these issues are discussed at the meetings of the department. Competence improvement activities are planned in the RTU IESE personnel development plan. For more information see section 3.5 of the report – description of the study direction.

RTU IESE organizes seminars for the academic staff and students, explaining the principles and implementation solutions of student-centered learning. The student-centered approach is implemented in everyday work: the academic staff members constantly improve the quality of study courses based on the latest trends and findings in the industry, and students' opinions, and at least twice a year the program administration consults with students on their satisfaction, expectations and evaluation of the quality of studies.

The academic staff members of the program regularly improve the content of the study; the best study organization methods and principles are introduced in the study process. Consistency with the strategy for the development of the European Higher Education Area enables both the academic staff and students to be mobile and enrich their knowledge and experience at foreign higher education institutions, and also provides job opportunities in the rapidly changing international work environment. IESE takes over the best practice that students and academic staff members have gained during their mobility abroad. Foreign experience is integrated into the pedagogical process, facilitating the implementation and internationalization of student-centered

education. The experience and insights of the academic staff are discussed both at the department meetings and in informal communication during daily work. All teaching staff actively participates in the RTU IESE academic and scientific conference CONECT. For additional information on the improvement of qualifications of teaching staff and scientific activities see section 3.5 of the report on the study direction.

The faculty study environment and infrastructure are adapted to various needs of the student groups, while maintaining a consistent quality of study process. The infrastructure is adjusted to fit the needs of disabled students. There is also differentiated support for various social groups of students, which can be received upon applying to RTU Student Parliament.

Students can find all current information on studies, types and conditions of support, entertainment and sports activities, as well as communication with groupmates and teachers of the study courses, including the opportunity to apply for consultations in the ORTUS environment.

Several factors jointly create a favourable working and learning environment for promoting the quality of studies, including linking the above-mentioned study content to the labour market situation, growing demand for highly qualified environmental specialists in the labour market, positive development trends in Latvia and a wide range of job opportunities, participation of students in improving the quality of studies, opportunity to be heard, to receive different kinds of support, to gain international experience, encouraging attitudes and readiness of faculty administration and teaching staff to continuously improve the study content and methods, as well as provision of room, equipment and software at the time, amount and quality needed for studies. For more information, see Section 3.1 and the Study Direction Report.

A lot of resources are invested in promoting RTU students' extracurricular activities and healthy lifestyle. RTU offers students a number of extracurricular activities – from various artistic groups and interest clubs, such as the choir "Vivere", orchestra "Bigbend", folk dance ensemble "Vektors", etc., to more than 20 kinds of sports where each student has an opportunity to be selected for the sports team of RTU. FEEE students most often join the choir "Vivere" and play in the women's basketball team.

The RTU Career Center very often hosts various seminars on personality development, education and global issues. Lectures are led by knowledgeable and professional specialists in different areas, whose lectures would otherwise be available to a limited number of students, due to their high participation fee. However, RTU offers these lectures to its students free of charge. According to the students, this is an opportunity for students to talk to and ask questions to people whom otherwise they would not be able to meet in 506 the next few years.

Each RTU faculty offers its students an opportunity to participate in the Student Council, which represents and defends students' interests, organizes various educational seminars, sports games and cultural events. This is a great place for students to learn how to develop communication and work skills. Whereas, if a student wishes to become a student representative not only at the level of their faculty, but also at the level of the entire university, they have the opportunity to become involved in the RTU Student Parliament.

21 FEEE students were working in the RTU FEEE Student Self-Government in 2020/2021, of whom 10 are Bachelor students of "Environmental Science"/"Environmental Engineering". Representatives of all study programmes are working in the RTU FEEE Student Self-Government. Every year students become increasingly more responsible for their future, and therefore cooperation with the self-government also becomes closer not only in studies, but also in the extracurricular area.

The current board of RTU FEEE Student Self-Government (SSG) was elected on 25 May 2020. It

consists of:

- L. Puzule, head of FEEE SSG, student of the 3rd year of the Bachelor's study programme "Environmental Science".
- E. Norenberga. Deputy head of FEEE SSG, student of the 2nd year of the Bachelor's study programme "Adaptronics".
- A. Černiševs, head of study and science direction of FEEE SSG, student of the 2nd year of the Bachelor's study programme "Environmental Science".
- A. A. Stīpniece, head of internal direction of FEEE SSG, student of the 2nd year of the Bachelor's study programme "Environmental Science".
- K. Rožkova, head of public relations direction of FEEE SSG, student of the 2nd year of the Bachelor's study programme "Environmental Science".
- M. Bataitis, head of sports and cultural direction of FEEE SSG, student of the 2nd year of the Bachelor's study programme "Environmental Science".
- Z. Čipāne, head of external direction of FEEE SSG, student of the 2nd year of the Bachelor's study programme "Adaptronics".

Almost all members of the RTU FEEE Student Self-Government get involved also in RTU's extracurricular activities. On extracurricular activities see the RTU website (https://www.rtu.lv/en/studies/student-life).

2.4. If the study programme entails a traineeship, provide the analysis and assessment of the relation between the tasks of the traineeship included in the study programme and the learning outcomes of the study programme. Specify how the higher education institution/ college supports the students within the study programme regarding the fulfilment of the tasks set for students during the traineeship.

The study programme "Environmental Engineering", as one of the courses in the block of elective study courses, also offers the "Internship" course (2 or 4 CP). Annex "Internship management procedure at RTU" contains a revised Senate decision of 2019 on the Internship Organisation Procedure at RTU. The internship organisation procedure provides that the internship coordinator in the organisational unit helps to provide students with an internship. If additional help is necessary, it is possible to go to Career Support and Services Division, where a career adviser and a project manager helps students to search and contact internship places, as well as promotes the development of career skills, which may provide successful results in the process of internship, using different events. Once a year, the Career Support and Services Division organises the RTU Career Day, when students can meet company representatives in person and communicate in future opportunities. More information about the event and participants of the previous years is available at: https://www.rtu.lv/en/studentservice/career-centre/career-day.

An additional resource developed in 2015 is a website that invites companies to post vacancies that are relevant to RTU students (https://ekarjera.rtu.lv/ (Latvian only)). Students have the opportunity to log in with the University username and keep abreast of current internships and job opportunities in their field.

RTU Development Fund provides additional support for practical skills promotion (https://www.rtu.lv/en/developmentfund). Several hundred competitions were held for promotion of practical skills over the year which were organised in cooperation with companies offering students

an opportunity to learn practical skills.

In the study program “Environmental Engineering” the course “Practice” is an optional study course. Internship in companies related to environmental engineering allows students to gain real work experience in the field of environmental protection and engineering and allows to achieve the goals and objectives of the study program "Environmental Engineering".

Latvian and foreign students are offered equal opportunities in providing internships. RTU Career Days and RTU Development Fund are one of the ways students receive information about internship opportunities.

2.5. Analysis and assessment of the topics of the final theses of the students, their relevance in the respective field, including the labour market, and the evaluations of the final theses.

At the completion of the programme (15 CP), students must develop their Bachelor thesis devoted to environmental engineering problems. The Bachelor thesis is publicly defended before a committee. The committee operates in accordance with the regulation approved by the higher education institution’s Senate.

A Bachelor’s thesis is drafted in the field of science represented by the study programme on a specific topic (energy efficiency, reducing environmental pollution, eco-design, renewable energy sources, climate technologies, environmental policy, cleaner production, etc.). The aim of the Bachelor’s thesis is to confirm student’s skills to perform scientific research work in the environmental science sector and the ability to use analytical, mathematical, optimisation and modelling methods to address environmental problems, based on an overview of scientific literature. **Topics of the Bachelor’s thesis are offered by RTU IESE and are based on the topics of ongoing scientific research projects at RTU IESE.** In addition, the student has the opportunity to offer his/her own topic for a graduation paper and defend it in the RTU IESE Scientific Council, which decides on compliance of the topic with the requirements for the graduation paper and the degree to be obtained.

Examples of topics of graduation papers in the Bachelor’s study programme “Environmental Science” are given below.

Year of studies 2013/2014

- *Methods and potential for the acquisition of synthetic biofuels Latvia*
- *Development of a calculation methodology for a column grain dryer for the extraction of hydrogen through electrolysis*
- *Sustainable transport planning in a municipality*
- *Industrial symbiosis of cheese and biogas plants*
- *Application of the energy management system (ISO 50001) to municipalities in order to achieve the energy consumption reduction targets*
- *Use of phase change materials to reduce heating energy consumption in buildings*

Year of studies 2014/2015

- *Use of recycled materials to improve thermodynamic properties of encapsulated phase change materials in active solar systems*
- *Humidity of the outer walls of historic brick buildings*

- *Hybrid heat pump systems. Increasing the fraction of renewable energy sources*
- *Electromobility assessment in Latvian municipalities following the CCFI competition*
- *Analysis of the possibilities for improvement of the composition and quality of fuel produced from waste in Latvia*
- *System dynamics model for developing a support policy for biomethane supply systems*

Year of studies 2015/2016

- *Testing of a macroalgae growing laboratory*
- *Innovative solar thermal energy systems in district heating systems*
- *Biomass co-incineration laboratory plant*
- *Opportunities for the development of bioeconomy in Latvia. System dynamics model for high value added products in the fisheries sector*
- *Determination of the physical properties of organic material in the pyrolysis process*

Year of studies 2016/2017

- *Study of local government energy planning development trends*
- *Assessment of the potential for industrial heat surplus for integration into the 4th generation district heating system*
- *Studying hygrothermal processes in the outer walls of historic buildings with internal heat insulation*
- *Analysis of possibilities of environmental laboratory services*
- *Use of mushroom resources to increase the added value of Latvian forests*

Year of studies 2017/2018

- *Study of the performance of a mist condenser in reducing particulate matter in the flue-gases from low-capacity energy sources*
- *Analysis of the system dynamics model of energy efficiency policy instruments and proposals for its improvement*
- *Obtaining fibres from pine needles*
- *Impact of various biodegradable waste products on the outcome of single cell oil in the microbiological cultures of Yarrowia lipolytica and Umbelopsis isabellina*

Year of studies 2018/2019

- *Testing of hydrothermal properties of historical bricks in laboratory conditions*
- *Evaluation performance of a fog apparatus*
- *Assessment of the potential for the use of biomethane in transport in Latvia*
- *Solar wall with aerogel and phase change materials*
- *Anaerobic co-fermentation of seaweed and lignocellulose substrate: testing of biomethane potential in laboratory conditions*
- *Possibilities for the use of invasive plant species for protein extraction*

When evaluating the topics of Bachelor's theses, their link to RTU IESE scientific research projects implemented in specific periods is clearly visible, such as: *"RIBuild: Improving Energy Efficiency of Historical Buildings" (2015-2020), "Developing Innovative Biomass Gasification Technology for Syngas Extraction – SYNGAS" (2015-2016), "Developing a Bioeconomy Model for Sustainable Use of Biological Resources for Climate Change Reduction and Adaptation For Capacity Building – BIOCLIMATE" (2015-2016), Improving Energy Efficiency of Historical Buildings" (2010-2013), "BIOCM: Study of the Methane Oxidation Combination Reaction Process" (2017-2020)* and other. For more projects, see section 4.3 of the report – description of the study direction.

It should be noted that the choice of project-based graduation papers has several advantages. The

main of them are:

- successful integration of students into scientific work and encouragement of interest in higher-level studies has been achieved;
- the interest of students in the work in scientific institutes following the drafting of graduation papers;
- a successful symbiosis of Bachelor's, Master's and doctoral students is taking place, working sequentially on a single project topic.

The transversal approach with the entire study programme is ensured when drafting of a Bachelor's thesis. The implementation of the Bachelor's study programme at the level of study courses is implemented in close cooperation with the supervisors of the Bachelor's thesis and teaching staff of study courses – practical and independent work at the level of study courses are focused on the subject of Bachelor's thesis, thereby reinforcing the student's knowledge in the specific field of research with the Bachelor's thesis research topic. For example, students of the study course "English" should write an abstract of publications on the topic of their Bachelor's thesis, while in the study course "Introduction to environmental research methods and theory" concepts of scientific novelty are analysed in conjunction with each student's Bachelor's thesis topic. Such a mechanism of implementation of the study programme allows ensuring the successful achievement of learning outcomes and integrity of the study programme.

Students present the results of Bachelor's theses at student conferences and at the international scientific conference CONECT (for more information on CONECT and student engagement read section 4.5 of the self-evaluation report of the study direction). The Student scientific technical conference is an event, during which students have the possibility to present their scientific activity to a wider range of people, the possibility to get their first publication, by submitting their work after the conference to any RTU journals. The event is usually held in April and May. Participation in the Student Scientific Technical Conference for Bachelor students of the 3rd year is a mandatory part of the study process. When developing scientific skills during studies, increasingly more students are ready to participate also in international scientific conferences. For example, Z. Ozola, a 3rd year student of RTU "Environmental Science" participated in the CONECT conference in 2019 with a report in English "Paper Waste Recycling. Circular Economy Aspects" presenting scientific insights of her Bachelor's thesis. In continuation, research results were also published in the scientific journal "Environmental and Climate Technologies", which is indexed in SCOPUS and Web of Science (Ozola, Z., Vesere, R., Kalniņš, S., Blumberga, D. Paper Waste Recycling. Circular Economy Aspects. Environmental and Climate Technologies, 2019, Vol. 23, No. 3, pp. 260-273. ISSN 1691-5208. e-ISSN 2255-8837. Available from: doi:10.2478/rtuect-2019-0094). D. Freidenfelds, a 3rd year student of RTU "Environmental Science" participated in the conference in 2018 with a report "Sustainability analysis framework for universities" on scientific results of his Bachelor's thesis, which was created in cooperation with I. Pētersone, a 4th year student of the professional Bachelor's study programme "Regional Development and Urban Economy Engineering" of the RTU Faculty of Engineering Economics and Management, who also drafted her diploma paper. In turn, the results of his Bachelor's thesis were published in the journal "Energy Procedia" in the article "What does Environmentally Sustainable Higher Education Institution Mean?" (Freidenfelds, D., Kalniņš, S., Gušča, J. What does Environmentally Sustainable Higher Education Institution Mean?. Energy Procedia, 2018, Vol.147, pp.42-47. ISSN 1876-6102. Available from: doi:10.1016/j.egypro.2018.07.031).

The results of assessment of the final examination of students of the Bachelor's study programme "Environmental Engineering" are discussed at RTU IESE meetings twice a year. The results are summarised and evaluated also by the administration of the programme, and they serve as a basis for further improvement of the study process.

In the reporting period from the year of studies 2013/2014 to 2018/2019 assessments for drafted Master's theses on a 10-point scale in 90% of cases were not lower than 7 (good).

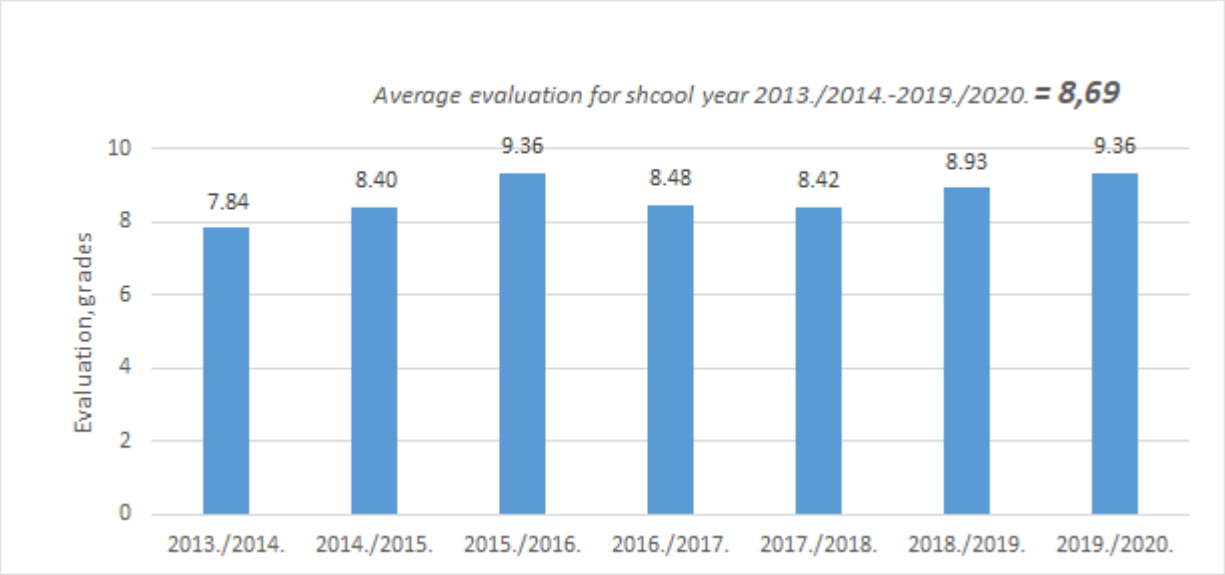

Figure: *Average assessments of Bachelor's theses in the reporting period in the Bachelor's study programme "Environmental Science".*

The RTU IESE Graduation Paper Committee particularly appreciates participation of students in scientific research activities (conferences, publications) awarding higher assessment at that.

The Bachelor's theses defended within the Bachelor's programme "Environmental Science" of the study direction "Environmental protection" are internationally oriented and include examples of case studies on Latvia – 97% in the period from year of studies 2013/2014 to 2019/2020 (see Figure).

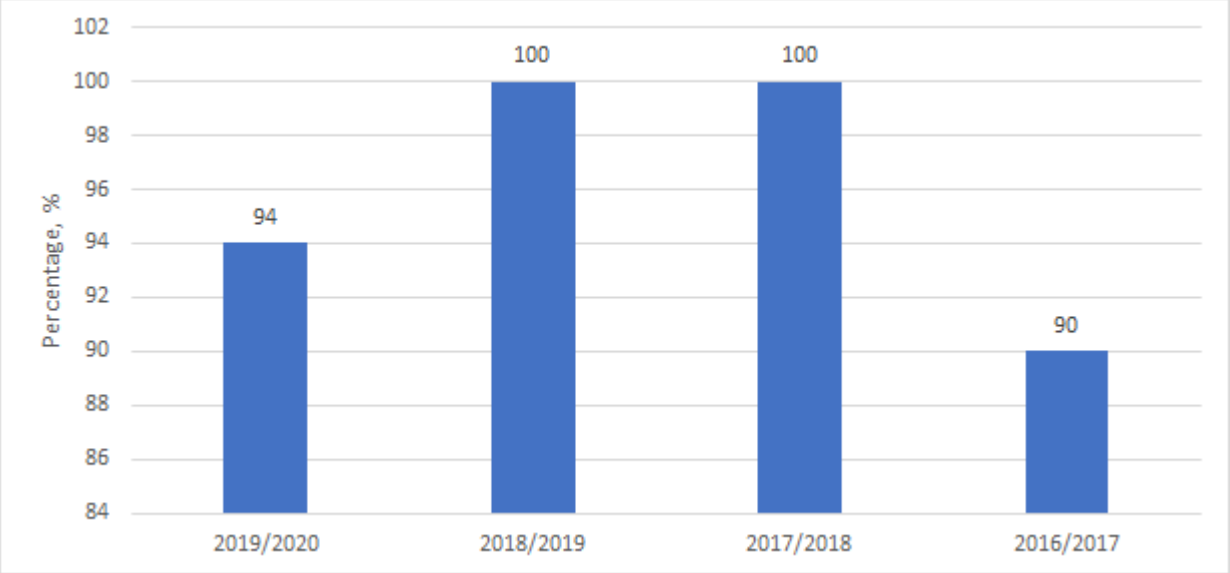

Figure: *Share of graduation papers of the Bachelor's study programme "Environmental Science", which include examples of case studies on Latvia (years of studies 2016/2017-2019/2020).*

The drafted Bachelor's theses has high added value in the development of national economy confirmed by the interest of industry companies in them and winning of students in graduation paper contests organised by companies.

2.6. Analysis and assessment of the outcomes of the surveys conducted among the students, graduates, and employers, and the use of these outcomes for the improvement of the content and quality of studies by providing the respective examples.

The results of student, employer and graduate surveys are used to improve the quality of the study program. The study quality monitoring and implementation system introduced by RTU in 2008 envisages regular electronic surveys of students on the content of studies and the quality of the academic staff through the ORTUS environment.

Student surveys are conducted every year after the autumn and spring semesters. The surveys include questions about the availability of study literature for each particular course, the teacher's criteria for student assessment, work culture and quality, respect for student rights during classes, time spent on student independent work and class discipline. The final part of the questionnaire is intended for students' suggestions and recommendations for the improvement of the course and the teacher's work quality. Questionnaires are filled in anonymously so that the answers given do not influence the attitude of the teacher to the particular student or group of students, and the target of obtaining an objective evaluation of students is achieved. The results of the questionnaire on the particular program are analysed and used to improve the quality of the program. The students themselves and the FEEE student council are actively involved in the processes of surveying and result analysis.

The student questionnaires are designed so that the students' answers help to evaluate the quality of the study courses and the academic staff, and also give the students an opportunity to express their opinion and make suggestions for improvement of the teacher's work and development of the course curriculum. Thus, each teacher has an opportunity to evaluate the results of their work and take measures to improve the quality of studies.

In general, the results of the student surveys on the work of the academic staff have been very positive, as from the maximum possible 5.0 points the average was above 4.0, in most cases it was above 4.2.

Students have highly valued the teachers who prepare their own teaching materials and / or handouts for the study courses. The main recommendations for the improvement of the study program from the students' point of view are to bring the contents of the lectures closer to the actual situation and developments, and to increase the number of study literature. Different numbers of students take part in surveys in the ORTUS environment on various study courses, so the obtained data should be evaluated with caution. The results of the students' questionnaires are analysed at the meetings of the study program administration, departments and institutes, involving, if necessary, representatives of the student self-government. Then the necessary improvements are made.

Every year a **survey of program graduates** is also conducted. The results of the surveys reflect the positive and negative aspects of the program implementation. The study program, its content, internship and benefits gained by the graduates are evaluated. Papildus absolventu anketēšanai, RTU Feedback at IESE is ensured through cooperation with graduates in academic and scientific research areas of RTU IESE; organisation of the reunion of graduates, communication of employees of IESE (former IESE graduates) with course maters (for more detailed information see section 2.2 of the report – description of the study direction).

As it was mentioned above, all the results of the surveys are used by the program administration to improve the study process. If we make a comparison by years, the evaluation by students of the

study process, obtained knowledge and practical skills shows that all the results obtained in surveys of previous years of studies, which were used for the improvement of the study process and content, have been very highly evaluated.

In order to analyse study directions and to receive feedback, RTU has developed a polling cycle:

- every semester there is polling of students on the quality of teaching work and the evaluation of the study programme, which is governed by the Regulation "On Student Surveys in the Evaluation of the Study Process". The polling is conducted electronically on the ORTUS portal, the results are received by each instructor personally and the head of the organisational unit. In addition, each instructor can complement questions of the semesterly polling with questions specific to his/her course.
- after each graduation round, polling of the graduates of Bachelor and Master programmes is conducted, regular polling of employers is planned. The results are (will be) taken into consideration in the improvement of the study programmes within the study direction.
- RTU IESE has a study process quality assurance system in place: after each class, students should make their comments on the course in writing in specially created individual notebooks. After each class, the notebooks are collected and the comments are read by the teaching staff (they sign for reading them). This approach allows for timely elimination of shortcomings in the topics of study courses, the attitudes and competences of teaching staff, as well as other issues related to studies, such as infrastructure, study planning, etc.). The continuous feedback between teaching staff, students and study programme administration is ensured by discussing student opinions at the monthly meeting of the RTU IESE Council.

The involvement of **students** in the development of the new Bachelor's study programme "Environmental Engineering" started during the existing study programme "Environmental Science", when **student survey** result pointed to the need to ensure an integrated, transversal approach in general education study courses (e.g. "Mathematics", "Physics", "Chemistry", etc.). Failures of students in these courses are the most frequent cause of stopping studies in the Bachelor's study programme "Environmental Science". In order to prevent this and to follow the recommendations from student surveys, special attention to the content of these courses and the link of these courses to industry-specific study courses of the study programme was paid when developing the Bachelor's study programme "Environmental Engineering".

In order to receive feedback from RTU graduates, RTU Alumni Association has been established. It actively operates at the University http://alumni.rtu.lv/ (Latvian only), https://www.facebook.com/RTUAlumni/ (Latvian only) and runs an online community platform https://rtuconnect.net/ (Latvian only), which aims at developing alumni traditions.

The student survey results are analysed during the audit of the study programme and used in the development of the process of organisation and implementation the study programme in the next academic year. At the meetings of the Programme Council, as well as at the meetings of responsible departments of each higher education institution. The Study Direction Committee analyses recommendations from employers and external experts, which are used as the basis for improvement of the study programmes.

2.7. Provide the assessment of the options of the incoming and outgoing mobility of the students, the dynamics of the number of the used opportunities, and the recognition of the study courses acquired during the mobility.

The study program provides both incoming and outgoing mobility opportunities. To promote mobility, the RTU International Mobility Unit and the RTU Student Parliament organize information events on the mobility program in September and February. There the issues of scholarship competitions and other aspects to consider when planning mobility are explained in detail. Students are also supported by the office manager of the program, who introduces them with the planned study courses and advises on the choice of the most suitable university.

Students share their experiences of mobility in the RTU student self-government events and are encouraged to motivate others who have not yet tried mobility to use this opportunity. They tell them about the benefits, experiences in intercultural communication not available in your own country, about new learning and assessment experiences. At such events, students are happy to ask questions about extracurricular activities and daily life abroad.

The courses acquired during mobility are fully recognized – it is ensured by being careful in choosing a foreign university, study program and courses to study in collaboration with the program director and the office manager of the program.

In the reporting period, bachelor's study programmes of the study programme "Environmental Science" used mobility opportunities **very sluggishly** (only 1 students was in mobility at the Polytechnic Institute of Porto (Instituto Politécnico do Porto), Portugal, in 18.02.2016 - 15.07.2016. Reasons for insufficient mobility are related to the fact that this is a three-year programme and in the first year of studies students settle in the university environment, in the second year many students start working in parallel to studies, but in the third year, starting from the 5th semester they start drafting their Bachelor's thesis, including start to act in scientific research laboratories. Thus, in order to complete studies within 3 years, students would have to go to mobility in the 2nd year of studies. The complicating factor in mobility trips is also a different semester start and end periods in universities: they often starts later than at RTU and students need to delay the beginning of their studies at RTU in the context of mobility.

During the reporting period, there were no participants in the inbound mobility of students in the bachelor's study program. RTU VASSI academic staff is working on closer development of cooperation between universities in the field of student mobility. Future work is expected to be successful.

Being aware of the importance of student mobility in the development of students' skills and competences, RTU IESE is currently analysing opportunities and drawing up an action plan to improve student mobility during the next reporting period.

III - DESCRIPTION OF THE STUDY PROGRAMME (3. Resources and Provision of the Study Programme)

3.1. Assessment of the compliance of the resources and provision (study provision, scientific support (if applicable), informative provision (including libraries), material and technical provision, and financial provision) with the conditions for the implementation of the study programme and the learning outcomes to be achieved by providing the respective examples. Whilst carrying out the assessment, it is possible to refer to the information provided for in the criteria set forth in Part II, Chapter 3, sub-paragraphs 3.1 to 3.3.

Full information on these issues is provided in the Study Direction Report, Part II, Section 3, Criteria 3.1 to 3.3. This paragraph contains only additional separately highlighted information about the study program.

RTU has a decentralized budget, so each university unit has its own budget. A budget in general is a plan of revenue and expenditure for a specific period of time, work, event or function. The revenue and expenditure of RTU are administered in accordance with principles approved by the Senate or with the powers granted by Vice-Rector for Finance. Revenue may be divided into means allocated to the university unit for carrying out certain tasks for which it is responsible, such as consultancy services or organization of training, and means allocated to the unit as a result of calculations based on expected workload and / or performance indicators of previous periods (e.g., scientific support). RTU provides each head of unit with remote access to operational financial information on the unit's budget, including planned workload and funding to be allocated in subsequent periods for the implementation of the study programs and courses. The head of the unit plans the work of the unit at the beginning of each financial or budget year, including salaries for the academic staff who are subordinates to the particular head of the unit, and develops a procurement plan for the following year appropriate to the operation and development of the study program or course, etc.

The sources of funding of the Bachelor's study programme "Environmental Engineering" are both state budget funds and the tuition fee paid by natural persons for studies.

For the year of studies 2020/2021, **35 state-funded study places for first-year students were available for the program.**

The **tuition fee** for the academic bachelor's program "Environmental Engineering" was **3000 EUR.** In the new 2021/2022. In the study year, the bachelor's program "Environmental Engineering" has 25 budget places and the study fee is **3050 EUR**. Tuition fee is the same as studying in Latvian or English.

Calculation of the study place costs for the Bachelor's study program "Environmental Engineering" see in the appendix "Study_progam_Environmental_Engineering_bach".

For data on the amount and dynamics of funding of the study programme, see Figure "Distribution of Students by Sources of Financing" and in Table "Funding of the study programme" in Annex "Statistical data_bachelors".

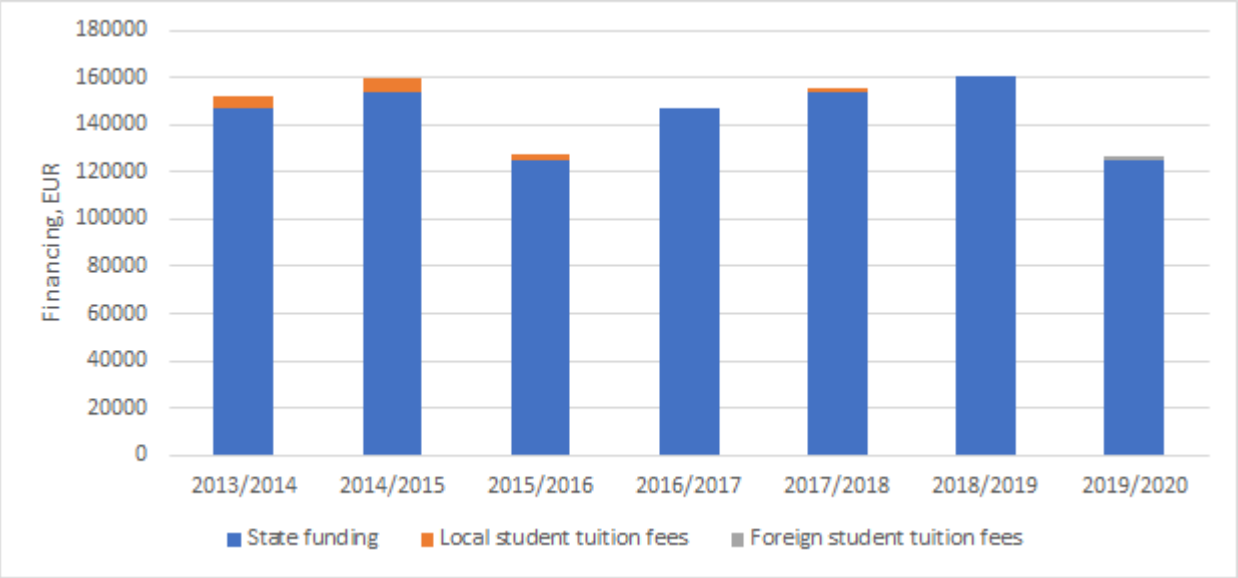

Figure: *Breakdown of funding of the Bachelor's programme "Environmental Science" by years.*

The study process is mainly ensured by staff of RTU FEEE Institute of Energy Systems and Environment (11500). In addition, the following organisational units are involved in the compulsory part (part A), professional specialisation part (part B1), humanities and social study courses part (part B2):

- Department of Engineering Mathematics;
- Institute of Technical Physics;
- Department of Chemistry;
- Department of Polymer Materials Technology;
- Department of Occupational Safety and Civil Defence;
- Department of Innovation and Business Management;
- Department of Water Engineering and Technology;
- Department of Social Sciences;
- Department of Languages for Special Purposes.

In addition, RTU organisational units ensuring the implementation of Part C ("Elective study courses") are also involved. Annex "Study course, module mapping_bachelors" contains the planning of the study programme for all forms of implementation of the study programme and Annex "Study course descriptions_bachelors" contains study course descriptions.

RTU IESE ensures teaching and methodological work: creates and updates study course descriptions, ensures appropriate teaching of study courses (including practical laboratory and seminar classes), supervision and defence of graduation papers and performs other activities related to teaching, methodological and scientific work.

Students of the study programme "Environmental Engineering" conduct their scientific research for their Bachelor's thesis, as well as laboratory works in one of five RTU IESE laboratories: *Environmental Monitoring Laboratory, Biosystem Laboratory, Combustion Research Laboratory, Solar Energy Systems Laboratory or Building Energy Efficiency Laboratory*.

RTU IESE **Environmental Monitoring Laboratory** obtained accreditation for solid energy source (including biofuel) testing services – ash content, moisture content, thermal heat capacity (higher and lower) and other services. The Environmental Monitoring Laboratory was accredited in the Latvian National Accreditation Bureau as a testing laboratory (reg. No. LATAK-T-559-00-2017).

The **Biosystem Laboratory** does research in several directions, which are related to research and development of biosystems. Research conducted at the Biosystem Laboratory: study of algae as a resource, production and study of innovative materials, study of biogas, study of electrolysis and methanation processes. The purpose of the laboratory is to provide students with an environment for research and development of biosystems in the academic study process and scientific research.

Main research directions of the **Combustion Research Laboratory** are study and optimisation of the combustion process. The laboratory is equipped with modern equipment, allowing to determine the performance efficiency of and created emissions generated by heating units. The efficiency of boilers and furnaces, as well as amounts of emissions are determined based on the methods of the Latvian national standard (LVS NE 303-5 and LVS NE 13240/AC). In addition, the laboratory is working on the research of methods for the reduction of harmful emissions generated as a result of the combustion process. Some of the methods developed are patented and are used on real sites in Latvia. Services provided by the laboratory: testing of heating equipment; measurements of energy efficiency and emissions in boiler houses, plants and other sites; boiler house audits, including full or partial boiler balance. The laboratory is planning to start a study of the biomass gasification process, which includes both theoretical and experimental research.

The purpose of work of the **Solar Energy Systems Laboratory** is to study, simulate and develop solar heat systems. Studies performed in the laboratory are related to studies of solar collectors; study of heat storage systems and their control systems; modelling and improvement of systems using modelling programmes; study of phase change materials. The laboratory studies and develops the use of phase change materials in heat storage systems and the use of computerised dynamic flow programmes to optimise system elements.

The **Building Energy Efficiency Laboratory** studies both the quality of construction materials and rooms and the possibilities to improve their energy efficiency. As part of several projects, the identification of construction materials of Latvian historic buildings and the determination of their hygrothermal properties is taking place in order to facilitate forecasts regarding the impact of internal heat insulation on the outer wall. In the laboratory, it is possible to perform the determination of the hygrothermal properties of construction materials; assessment of the energy performance of buildings; energy modelling of buildings.

For RTU IESE to be able to manage and improve performance in the field of environment, as well as to demonstrate the importance of environmental management in governance of higher education institutions to students, an RTU IESE Environmental Management System was created in 2007 and is still maintained. The environmental management system has been developed in accordance with the basic principles of the environmental management system in accordance with the conditions of LVS EN ISO 14001:2017. The Environment Management System of RTU IESE has been documented, is implemented and maintained in accordance with the requirements of the standard, reviewed annually and updated as needed. The administration of RTU IESE, laboratory administration, teaching staff and the Master's level students of the study course "Environmental Management Systems" as experts participate the self-monitoring procedure of the system. The environmental management system contributes to the rational use of resources and the improvement of the Institute's activities.

The study, science, informative (including the library), material, technical and financial basis of FEEE in general and also specifically of RTU IESE creates the preconditions for achieving the results of studies and demonstrate the possibility of providing a high-quality study process for the new study programme "Environmental Engineering". For the effective implementation of the study programme, teachers and students at the faculty have access to auditoriums equipped with the latest generation visual and audio equipment, as well as highly certified and evaluated laboratories that meet the specifics and implementing conditions of the study programme.

Funding per study place has increased by 12% in the year of studies 2019/2020 compared to year of studies 2013/2014 (see Figure *Dynamics of study funding of the Bachelor's programme "Environmental Science" over the reporting period per 1 student*).

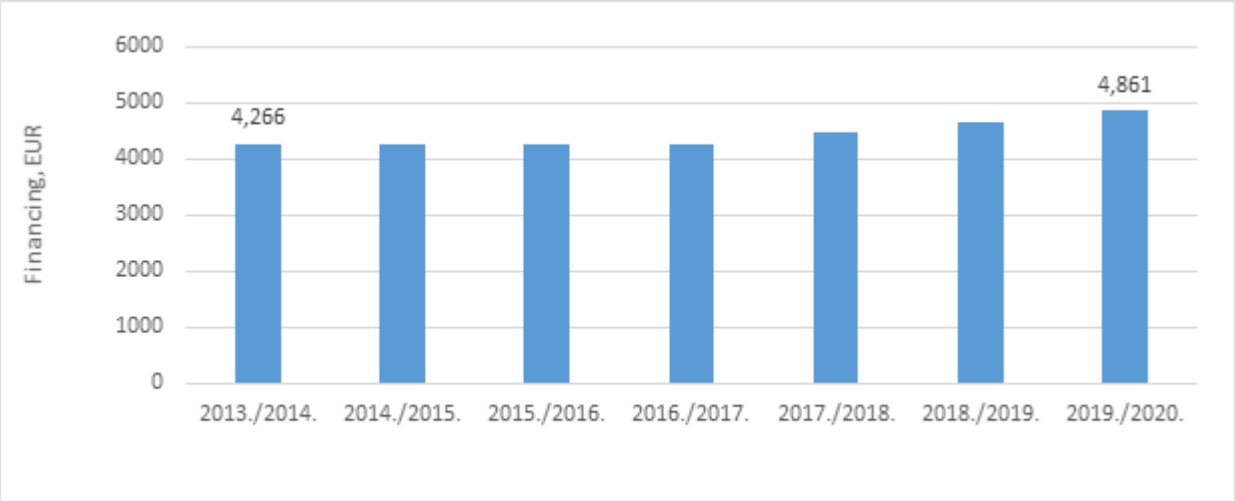

Figure: *Dynamics of study funding of the Bachelor's programme "Environmental Science" over the reporting period per 1 student.*

In the period from 2013 to 2019 RTU IESE purchased infrastructure for laboratories, practical classes (e.g. modelling software) and lectures (e.g. Scientific literature, databases of scientific articles), computer equipment (monitors, computers, presentation lasers), laboratory equipment (data loggers, barometers, air humidifiers, gas analyser, set of cold cameras, climate station, weights, muffle furnace, drying cabinet, detector, gas sensor adapter, etc.) for the needs of the study direction "Environmental protection" to ensure the study process.

Students of the study programme "Environmental Engineering" have access to the library of the Institute of Energy Systems and Environment, which has about 400 books in the field of environmental engineering, including doctoral theses and their abstracts in the field of environmental engineering and energy sciences, as well as methodological materials for students of the study direction "Environmental protection". RTU IESE library provides students with access to professional educational literature, which is supplemented every year. In the reporting period, several books were purchased for the needs of the programme in addition to other library resources.

For instance, in the study year 2019/2020:

- William McDonough, Michael Braungart "The Upcycle: Beyond Sustainability-Designing - Designing for Abundance", 2013
- Ken Webster "The circular Economy: A Wealth of Flows", 2016
- Townsend, T.G., Powell, J., Jain, P., Xu, Q., Tolaymat, T., Reinhart, D. "Sustainable Practices for Landfill Design and Operation", 2015
- Mohammad J. Taherzadeh, Tobias Richards "Resource Recovery to Approach Zero Municipal", 2015
- Bruce Lankford "Resource Efficiency Complexity and the Common", 2017
- Dieter M. Imboden, Stefan Pfenninger "Introduction to Systems Analysis: Mathematically Modeling Natural Systems", 2012
- Steven Tadelis "Game Theory: An Introduction", 2013
- N.V. Prasad "Bioremedition and Bioecomomy", 2015
- "Advanced Modelling Techniques Studying Global Changes in Environmental Sciences, Volume 27, 1st Edition", 2014
- Trevor Letcher "Future energy. Improved, Sustainable and Clean Options for Our Planet. Second edition", 2014
- Randy Olson "Houston, We Have a Narrative: Why Science Needs Story", 2015
- Kathleen Hall Jamieson, Dan Kahan, Dietram A. Scheufele "The Oxford Handbook of the Science of Science Communication (Oxford Library of Psychology)", 2017

In the RTU ORTUS environment, students can access international databases: Web of Science, EBSCO, SCOPUS, SCIENCE DIRECT, SpringerLink full-text journals and books, several databases and other information resources. At the RTU library students have access to the database of "Latvian Standard".

The RTU Design Factory has "theLAB", a workshop open to students, where they can materialize their inventions using the technological capabilities of 3D printing, laser cutting and engraving, plotting, large-format printing, and more. In turn, FEEE has created a LATVENERGO student creative laboratory, where students can use latest technologies to develop their products. This is the possibility of students to act and use the obtained theoretical knowledge in practice.

As already mentioned, the overall assessment of resources is reflected in the information provided

in Study Direction Report Part II, Section 3, Criteria 3.1 to 3.3.

3.2. Assessment of the study provision and scientific support, including the resources provided within the cooperation with other science institutes and institutions of higher education (applicable to the doctoral study programmes).

III - DESCRIPTION OF THE STUDY PROGRAMME (4. Teaching Staff)

4.1. Analysis and assessment of the changes to the composition of the teaching staff over the reporting period and their impact on the study quality.

Overall assessment of the academic staff is shown in the information provided in the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff. This section will highlight changes in the academic staff involved in the program and their competence in teaching specific courses.

Teaching staff of the Department of Energy Systems and Environment and teaching staff of other RTU departments and industry visiting lecturers are involved in the implementation of the Bachelor's study programme "Environmental Engineering". RTU IESE scientific and academic staff are involved in the implementation of the study programme: with a doctoral degree – 24 doctors of science, of which 19 are experts of the Latvian Council of Science (LCS) in environmental engineering or environmental science and 15 European exerts (CORDIS); teaching staff without a doctoral degree (doctoral students) – 8 persons. Elected academic staff of other RTU departments are also involved as the teaching staff responsible for the study course: *Dr.oec. professor* Elīna Gaile Sarkane, *Dr.sc*.ing. Marija Iltiņa, *Dr. math.* Inta Volodko, *Dr.*sc. ing. Sergejs Gaidukovs, *Dr*.sc.ing. Gerda Gaidukova, *Dr*.philol. assistant professor Irina Liokumoviča, *Dr*.sc.ing. Linda Mežule, *Dr*.sc.*ing.* Jānis Rubulis, *Dr*.phys. Juris Blūms, associate professor *Dr*. psych. Airisa Šteinberga, Asoc. prof. *Dr*. sc. soc. Gunārs Ozolzīle, *Dr*. sc. ing. Tālis Juhna and other. The justification of selection of teaching staff is related to experience of scientists, scientific research interests, scientific performance, etc., taking into account the specifics of the study programme and study courses. The teaching staff responsible for the implementation of study courses (practical work, laboratory works) also invites visiting lecturers (industry experts, company directors) and candidates for a doctoral degree.

Table with the list of teaching staff responsible for the study course in the Bachelor's study programme "Environmental Engineering" see in Annex "Table of resbonsible teaching staff_bachelors"

In the implementation of the study program "Environmental Engineering" are involved lecturers from the "Environmental Science" program and other lecturers. This is due to the fact that the study program has been supplemented with new study subjects. The choice of teaching staff, taking into account their experience, research interests and scientific performance, allows us to offer a high-quality study program.

Measures are taken on a regular basis within the study programme “Environmental Engineering” to make changes in teaching staff have a positive impact on the development and the quality of implementation of the study programme, and to ensure compliance of the study programme with the requirements specified in regulatory enactments.

Other FEEE and RTU faculty organisational units are also involved in the implementation of the study programme “Environmental Engineering”.

The general education study course in Part A “Introduction to Study Field” is implemented by the teaching staff of RTU IESE.

Industry-specific theoretical study courses (Part A and Part B1) are implemented by several RTU organisational units, for example:

- the study source “Enviroenmental Mathematics” is implemented by the teaching staff of the Department of Engineering Mathematics of the RTU Faculty of Computer Science and Information Technology;
- the study source “Physics” is implemented by the teaching staff of the Department of Materials Physics of the RTU Faculty of Material Science and Applied Chemistry;
- the study source “Environmental Engineering Chemistry and Materials Science” is implemented by the teaching staff of the Department of Chemistry and the Department of Polymer Materials Technology of the RTU Faculty of Material Science and Applied Chemistry;
- the study source “Civil Defence” is implemented by the teaching staff of the Department of Occupational Safety and Civil Defence of the RTU Faculty of Engineering Economics and Management;
- the study source “Innovative Product Development and Entrepreneurship” is implemented by the teaching staff of the Department of Innovation and Business Management of the RTU Faculty of Engineering Economics and Management;
- the study source “Water Treatment Technology” is implemented by the teaching staff of the Department of Water Engineering and Technology of the RTU Faculty of Civil Engineering.

In section B.1 of Part B students have the opportunity to master different **professional specialisation courses**, which shape basic knowledge in the field of environmental engineering. The courses offered in section B1 “Thermal energy systems. Basic course”, “Combustion Processes”, “Demand Side Management”, “Basics of Systems Simulation”, “Energy Audit”, “Heating and Cooling Supply Systems”, “Concepts and Technologies of Waste Management”, “Raw Materials and Resources”, “Environmental Monitoring”, “Carbon Dioxide Capture, Storage and Utilisation”, “Metrology”, “Theoretical Aspects of Climate Technologies”, “Air Pollution Control” and “Gas and Fluid Mechanics” are implemented by academic staff of RTU IESE. In addition to the above-mentioned study courses the following study courses are implemented in section B.1: “Microbiology of Engineering Systems”, “Wastewater Treatment”, “Hydrological Processes and Modelling”, “Artificial Recharge of Groundwater”, “Water Resources Risk Analysis”, “Basics in Biology”. Academic staff of the Department of Water Engineering and Technology of the RTU Faculty of Civil Engineering will participate in the implementation of these courses.

In section B.2 of Part B students have the opportunity to master **humanities and social study courses**. Section B.2 includes study courses “General Sociology”, “Sociology of Management ”, “Sociology of Personalities and Small Groups”, “Politology”, “Political System of Latvia” and “United Europe and Latvia”. Teaching staff of the Department of Social Sciences of the RTU Faculty of E-Learning Technologies and Humanities are involved in the implementation of these study courses.

In section B.6 of Part B “Languages” students are provided with the opportunity to supplement their knowledge of English or German by mastering terms and definitions internationally

recognisable in the field of environment. Study courses “The Terminology Minimum in English” and “The Terminology Minimum in German” within the section are implemented by the teaching staff of the Department of Technical Translation of the Faculty of RTU E-Learning Technologies and Humanities.

Foreign students must learn the study course “Latvian for Foreign Students” of 1 CP, which will be implemented by the teaching staff of the Department of Technical Translation of the RTU Faculty of E-Learning Technologies and Humanities.

In Part C students have the opportunity to freely select study courses for 4 CP. In Part C of the study programme “Environmental Engineering” students can also select the study course “Practice” (2 CP or 4 CP). The Doctor of Engineering, RTU IESE Assistant Professor Dzintars Jaunzems coordinates internship and provides methodological support, as well as provides tutorials on the preparation of internship report. In the period from 2017/2018 to 2019/2020, students of the RTU Bachelor’s study programme “Environmental Science” selected the study course “Practice” 20 times. In the last three years, internship as elective study course of Part C has been selected by 50 – 68 % of students.

In Part E, the process of drafting of the Bachelor’s thesis, the study course “Bachelor Thesis” (15 CP) is coordinated by the responsible teaching staff of RTU IESE – *Dr.sc.ing.* Associate Professor Dace Lauka and assistants (students of doctoral studies) Zane Indzere and Ketija Bumbiere.

Until now, no teaching staff of several study courses, which are the responsibility of RTU IESE and ensure mastering of exactly engineering matters in the study programme “Environmental Science” and since September 2020 also in the study programme "Environmental Engineering”, was changed due to complaints of students, which is an evidence of satisfaction of students with the work of the teaching staff and regular improvement of the study course. Every other year, lecturers supplement and change the content and methods of the study course based on the recommendations received in the previous year of studies and the involvement of students in on-site and independent work activities. No complaints about teaching staff and visiting teaching staff of other departments have been received in the last two years, and students have positively evaluated the work of the teaching staff. For additional information on the teaching staff see the information provided in criteria 3.5.-3.6 in Chapter 3 of Part II of the report on the study direction.

4.2. Assessment of the compliance of the qualification of the teaching staff members (academic staff members, visiting professors, visiting associate professors, visiting docents, visiting lecturers, and visiting assistants) involved in the implementation of the study programme with the conditions for the implementation of the study programme and the provisions set out in the respective regulatory enactments. Provide information on how the qualification of the teaching staff members contributes to the achievement of the learning outcomes.

Overall assessment of the academic staff is reflected in the information provided in the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff. This section will highlight relevance of the qualifications and competences of the academic staff involved in the study program to teaching particular courses.

The qualification of teaching staff involved in the implementation of the study programme fully corresponds to the conditions of implementation of the study programme and the requirements of

regulatory enactments, as well as ensures the achievement of aims and learning outcomes of the study programme and respective study courses (see CVs of teaching staff). RTU's elected teaching staff, visiting teaching staff and leading industry specialists are involved in the implementation of the Bachelor's study programme "Environmental Engineering". The elected academic staff of RTU is responsible for the content and creation of study courses. A team of teaching staff usually works on the implementation of the study course under the leadership of the director of the study programme and responsible teaching staff, and industry professionals, doctoral students, visiting lecturers may be included into it. Teaching staff with relevant education and/or professional experience are responsible teaching staff in the Bachelor's study programme. RTU's elected academic staff and industry visiting lecturers with a Master's degree and 5 years of experience in environmental engineering participate in the implementation of the programme.

RTU IESE scientific and academic staff are involved in the implementation of the Bachelor's study programme "Environmental Engineering": with a doctoral degree – 24 doctors of science, of which 18 are experts of the Latvian Council of Science (LCS) in environmental engineering or energy/environmental science or other field of science and 15 European exerts (CORDIS). The scientists and young scientists involved in the implementation of the study programme specialise in environmental engineering and energy.

9 professors of RTU IESE participate in the implementation of the study programme – doctors of science, who have been elected professors by the Council of Professors of the Energy Industry and whose scientific and pedagogical activity meets the criteria for evaluation of scientific and pedagogical qualification of the candidate for the professor's position set in regulatory enactments. Professors elected by the Council of Professors of Environmental Science or Environmental Engineering and Energy or the Energy Sector: Dagnija Blumberga, *Dr. habil. sc. ing*.; Ivars Veidenbergs, *Dr. habil. sc. ing*.; Andra Blumberga, *Dr. sc. ing*.; Gatis Bažbauers, *Dr. sc. ing*.; Marika Rošā, *Dr. sc. ing*.; *Claudio Rochas*, *Dr. sc. ing*., Jūlija Gušča, *Dr. sc. ing*.; *Francesco Romagnoli, Dr. sc. ing*.; Jeļena Pubule.

Summaries about the **qualification** of **RTU IESE professors** (as mentioned before, teaching staff of RTU IESE forms 69 % of all the teaching staff in the study programme "Environmental Engineering", teaching staff of other organisational units – 31 %) are provided below:

> *Professor, **Dr.hab.sc.ing. Dagnija Blumberga.** Dagnija Blumberga, habilitated doctor of engineering sciences and RTU professor, founder of the RTU study direction "Environmental protection", Director of RTU IESE. Is the Director of the RTU study direction "Environmental protection", Director of Bachelor's, Master's and doctoral study programmes "Environmental Engineering" and "Environmental Science". Her total service record in energy and environmental protection is over 50 years. She has extensive experience by leading and participating many national and international projects in the field of energy and environment, for example, bioeconomy, renewable sources, climate change, energy and other environmental engineering related topics. She is on editorial boards of international scientific journals and conference organising committee. Dagnija Blumberga is the author of more than 300 publications, which were mainly published in scientifically reviewed with a high citation rate. The total number of scientific publications is over 400, of which 389 are published in Scopus. Co-author of 14 patents. Experience in more than 50 scientific projects and research, of which more than 30 as project manager. Hirsch index 22. In the Bachelor's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Smart Energy Systems", "Guiding of Energy Consumers", "Heat Supply and Cold Supply Systems" and "Air Pollution Control", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor Dr.sc.ing. Andra Blumberga. *Professor Andra Blumberga is an expert with large experience in the field of energy performance of buildings and system dynamics. She has more than 25 years of professional experience. She works as the head of the Ventilation Department at ABB Latvia, then as Managing Director and the Energy Consultant and in the last 20 years she has been RTU academic staff and since 2012 she has been the RTU FEEE Vice-Dean for Research. She has extensive experience by leading and participating many national and international projects in the field of energy and environment. A.Blumberga is a co-author of 115 scientific publications, which are available in SCOPUS, and her H-index is 17. She is a co-author of 4 patents. In the Bachelor's study programme "Environmental Engineering" she is responsible for the implementation of graduation papers and Bachelor's level study courses: "Introduction to Modelling of Environmental Systems Dynamics" and "Energy Audit", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor Dr.sc.ing. Francesco Romagnoli. *Professor Francesco Romagnoli was graduated from the Faculty of Georesources and Geotechnology of the Polytechnic University of Turin, obtaining the degree of an environmental engineer in 2001. In 2002-2008, Francesco Romagnoli worked as an engineering for geotechnical and tunnelling projects in Rocksoil, Italian design company (Milan, Italy). In 2012, he was graduated from Riga Technical University defending the doctoral degree "Model for Sustainable Production and Use of Bioenergy". The main action direction include teaching of courses at the university, supervision of Bachelor's and Master's theses, conducting of scientific research and project management. The main topics of research of Francesco Romagnoli are: biogas, alternative types of biomass for the production of biogas (e.g. seaweed and microalgae), growing of microalgae in a laboratory and their initial cultivation conditions, life cycle analysis and system dynamics modelling with technically provided and sustainably evaluated bioenergy capabilities, provision of cities with anti-flood resilience with a focus on significant infrastructure systems. In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Raw Materials and Resources", "Carbon Dioxide Capture, Storage and Use", "Waste Processing Concept and Technologies", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor Dr.sc.ing. Gatis Bažbaeurs. *In 1995, Gatis Bažbauers was graduated from the Massachusetts Institute of Technology, obtaining a Master's degree in Mechanical Engineering, and in 1999 obtained a doctoral degree in Environmental Engineering. Since 2009, he has been working at the RTU Faculty of Energy and Environmental Engineering as a professor. Since 2012, Gatis Bažbauers is a RTU Vice-Rector for Research, whose direct job duties include management of the research system and research policy making. In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Mechanics of Gases and Fluids", "Heat Systems. Basic course", "Air Quality Engineering", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor Dr.sc.ing. Jeļena Pubule. *In 2014, Jeļena Pubule obtained a doctoral degree in Environmental Engineering. In the last 10 years, she has been working in the field of environmental impact assessment, renewable energy sources, climate change, reading study courses and participating in the implementation of scientific research projects. In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Raw Materials and Resources", "Waste Processing Concept and Technologies", as well as participates in*

drafting of Bachelor's theses as a scientific supervisor.

Professor Dr.sc.ing. Jūlija Gušča. *In 2011, she obtained a doctoral degree in Environmental Engineering, doctoral thesis "Development of Latvian energy sources, Study of the impact of carbon dioxide storage processes". Since 2014, she led the RTU Department of Energy Systems and Environment. Research and project management in climate technologies, resource and waste management, environmental performance assessment of products and processes. In 2004-2012, work experience in international companies and organisations in the field of environmental protection and energy – AS Ramboll, United National Development Programme. Since 2011, she has been on the board of the environmental education society "Dabas koncertzāle". Participates in several advisory councils of ministries as RTU representative. In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Waste Processing Concept and Technologies", "Carbon Dioxide Capture, Storage and Use", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor, Dr.sc.ing. Claudio Rochas. *He obtained the Master's degree in the Polytechnic University of Turin, but in 2008 RTU obtained a doctoral degree in energy and continue working at RTU. Specialises in solar heat systems, combustion processes, optimisation of heat and mass exchange processes, combi-systems for renewable energy sources, planning of energy performance of buildings, energy planning and cost optimisation, and quantitative assessment of resilience of cities. In parallel to academic work, he has been actively working on boards of companies (Renesco, SIA Ekodoma) and in professional organisations (Solar Energy Association). Actively participates in drafting and implementation of scientific projects. He is the author of more than 70 scientific publications, which can be studied in detail in the research gateway profile or in his ortus.rtu.lv profile. quantitative assessment of resilience of cities. In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Metrology", "Foundations of System Modelling", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Professor, Dr.sc.ing. Marika Rošā. *Marika Rošā is an author of 57 scientific articles, which are indexed in the Scopus database, and her Hirsch index is 13. M.Rošā focuses on study of climate technologies in her scientific activity. In recent years, there was also research on energy efficiency from different aspects – her publications and activity in projects includes energy studies at local government level, in the fields of transport, industry, household and agriculture, as well as environmental impact assessment and assessment of climate change related aspects. She is a project coordinator in three Horizon 2020 projects (whether RTU IESE is the leading partner of the project), project manager or coordinator in six other projects (ERDF, IIE, EEA, Nordic Energy Research, etc.) and worked as an expert in another 12 international projects and 19 national level projects (both as participant and manager). In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of Bachelor's level study courses: "Environmental Monitoring", "Theoretical Foundations of Climate Technology", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Scientific performance of the above-mentioned professors (citation of publications in 2015-2020) in provided in the Figure below. Publications of 9 professors were cited 3848 times in total.

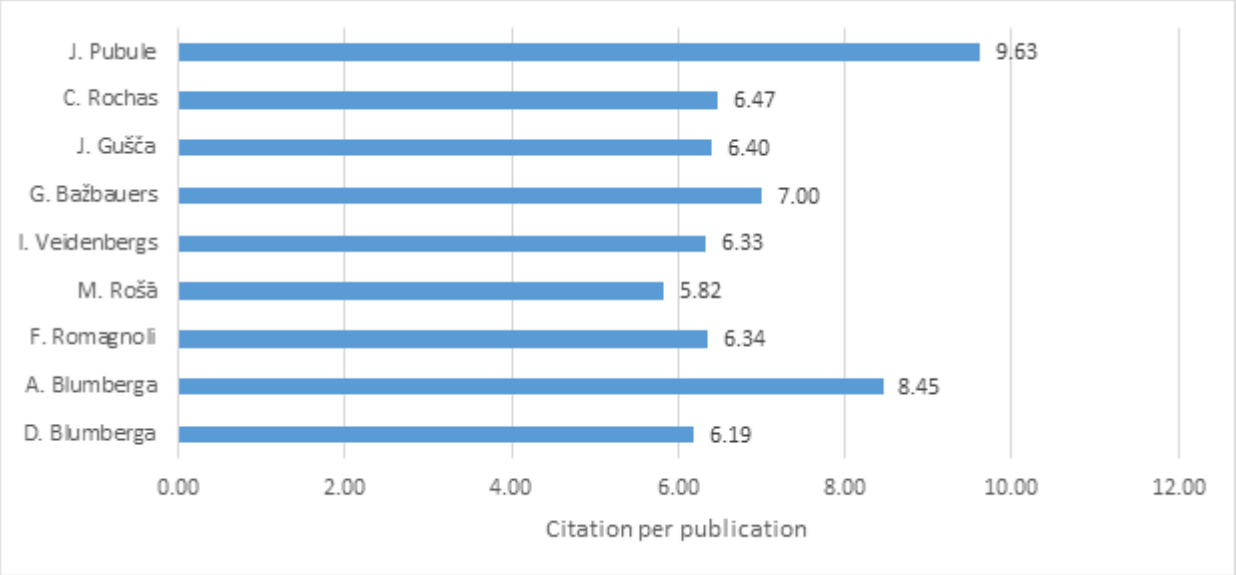

Figure: *Citation of SCOPUS publications of RTU IESE professors per publication in 2015-2020.*

4 elected associate professors of RTU IESE participate in the implementation of the study programme – doctors of science, who have been elected associate professors by the Council of Professors of the Environmental Science or Energy Industry or Environmental Engineering and whose scientific and pedagogical activity meets the criteria for evaluation of scientific and pedagogical qualification of the candidate for the associate professor's position set in regulatory enactments. Associate professors elected by the Council of Professors of Environmental Science or Environmental Engineering and Energy or the Energy Sector: Edgars Vīgants, *Dr. sc. ing*.; Agris Kamenders, *Dr. sc. ing*., Aiga Barisa, *Dr. sc. ing*., Anna Kubule, *Dr. sc. ing*.

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Summaries about the **qualification** of **RTU IESE associate professors** (as mentioned before, teaching staff of RTU IESE forms 69 % of all the teaching staff in the study programme "Environmental Engineering", teaching staff of other organisational units – 31 %) are provided below:

> ***Associate Professor Dr.sc.ing. Agris Kamenders.*** *A. Kamenders is an Associate Professor at Riga Technical University and he obtained a doctoral degree in engineering sciences. Specialises in energy performance of buildings and industry, district heating systems, renewable energy sources, energy planning and cost optimisation. A. Kamenders is currently actively working in the management of SIA "Ekodoma", where he is the project manager of several energy efficiency projects. Job duties of A. Kamenders include leading of study courses, supervision and implementation of energy projects using latest energy saving technologies and renewable energy systems. In general, A. Kamenders participated in many scientific research projects and research. During his career, Agris has proven his ability to work in a multicultural environment. In the Bachelor's study programme "Environmental Engineering" he is responsible for supervision of graduation papers and implementation of the following courses: "Energy Audit", as well as participates in drafting of Bachelor's theses*

as a scientific supervisor.

Associate Professor Dr.sc.ing. Anna Kubule. *Obtained a doctoral degree in Environmental Engineering. While working at IESE, during 10 years he has obtained experience in direct work with students and scientific research. Participation in over 5 European and global and more than 5 Latvian scientific projects provided her with significant experience. Hirsch index 7. She has experience in reading of lectures to up to 200 people, as well as preparation of seminars and other individual works for smaller audiences, as well as conducting of practical experiments in fuel research and testing laboratory, as well as field trips to companies. In the Bachelor's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Air Pollution Control", "Air Quality Engineering", "Theoretical Foundations of Climate Technology", as well as participates in drafting of Bachelor's theses as a scientific supervisor.*

Associate Professor Dr.sc.ing. Aiga Barisa. *Obtained a doctoral degree in Environmental Engineering. Dr.sc.ing. Aiga Barisa is the author of 21 SCOPUS indexed scientific publications, cited 206 times in total, her Hirsch index is 8. She is a co-author of 9 scientific monographs and textbooks. Her scientific activity is related to research topics line sustainable transport systems, energy efficiency in the transport sector, system dynamics modelling software "PowerSim". She has experience as a participant of 8 international and national level projects as a scientific manager and as a participant. In the Bachelor's study programme "Environmental Engineering" she is responsible for supervision of graduation papers and implementation of the following courses: "Theoretical Foundations of Climate Technology", "Introduction to Biotechonomics".*

Associate Professor Dr.sc.ing. Edgars Vīgants. *Scientific activity of Dr.sc. ing. Edgars Vīgants is related to sustainable heat supply, development of energy technologies and combustion technologies. Scientific abilities have been confirmed by more than 20 scientific articles, which have been published in local and international scientific editions in the last 5 years. Experience of participation in EU projects as a manager and participant. He is a co-author of several state patents. Extensive practical experience in generation of energy from renewable sources. Actively participates in the work of the Latvian Association of Heating Companies, as well as in the Latvian Renewable Energy Federation. Within the Bachelor's study programme Dr.sc.ing. Edgars Vīgants, participates in drafting of Bachelor's theses as a scientific supervisor.*

Scientific performance of the above-mentioned associate professors (citation of publications in 2015-2020) in provided in the Figure below. Publications of 4 professors were cited 3848 times in total.

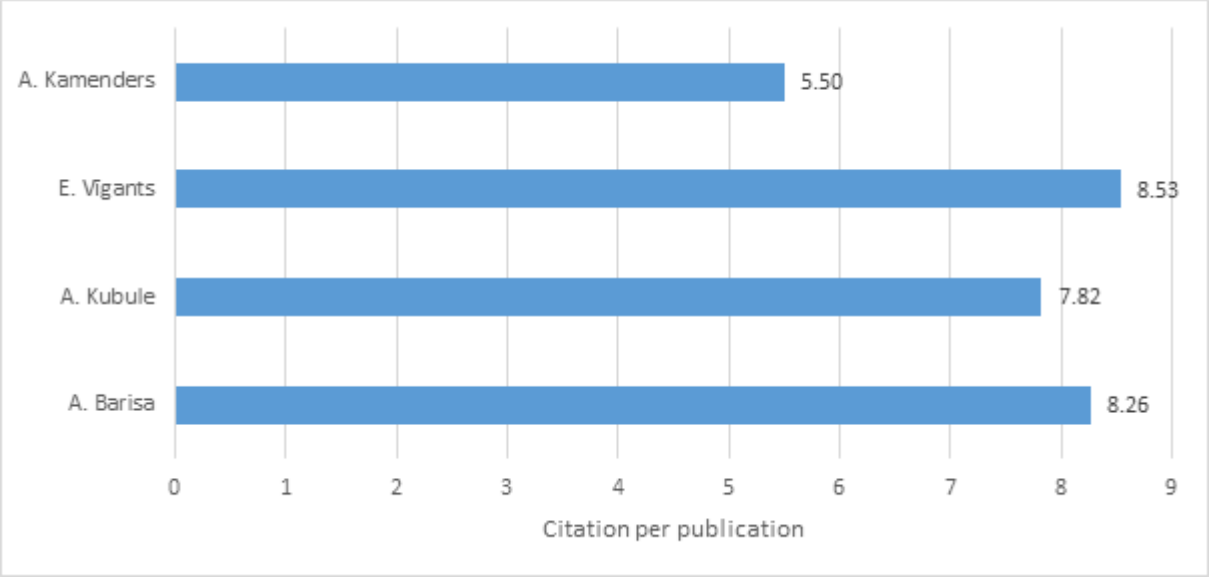

Figure: *Citation of SCOPUS publications of RTU IESE associate professors per publication in 2015-2020.*

The justification of selection of teaching staff is related to experience of scientists, scientific research interests, scientific performance, etc., taking into account the specifics of the study programme and study courses. The academic staff involved in the implementation does international level scientific research, improving own qualification and performing scientific research activities (incl. biographies of teaching staff). Academic staff has the opportunity to supplement their professional knowledge and obtain valuable experience in a foreign higher education institution (using Erasmus, COST or project mobility opportunities), which is in harmony with the development strategy of the European Higher Education Area, as well as through traineeship in companies.

The teaching staff responsible for the implementation of study courses (practical work, laboratory works) also invites visiting lecturers (industry experts, company directors) and candidates for a doctoral degree. For instance,

- In academic year 2014/2015, Ieva Sīmane participated in the study course "Theoretical Aspects of Climate Technologies" of the Bachelor's study programme "Environmental Science" as a visiting lecturer and familiarised students with the nature of the Climate Change Financial Instrument.
- In academic year 2014/2015 and then in 2015/2016, Sandris Jūra participated in the study course "Foundations of Ecological Research" of the Bachelor's study programme "Environmental Science" as a visiting lecturer, who within lectures and practical works trained students to build and process scientific video presentations.
- In academic year 2016/2017, Artūrs Biedris participated in the study course "Theoretical Aspects of Climate Technologies" of the Bachelor's study programme "Environmental Science" as a visiting lecturer, who led a lecture and practical work on calculation of greenhouse gas emissions and their audit in companies.
- In academic year 2018/2019, Rudīte Vesere, the Head of the Environmental Protection Department of the Ministry of Environmental Protection and Regional Development, and Vita Jaunzeme, the head of society "Pēdas.lv", participated in the study course "Environmental Protection and Reprocessing Processes" of the Bachelor's study programme "Environmental Science" as visiting lecturers.
- In academic year 2019/2020, *sc.ing.* Kristaps Ločmelis, the Chairman of the Supervisory Board of Joint Stock Company "Sadales tīkls" participated in the implementation of the study

course “Smart Energy Systems” of the Bachelor’s study programme “Environmental Engineering”.

Teaching staff of the Bachelor’s study programme “Environmental Engineering” participate on a regular basis in the upskilling activities organised by the RTU Trade Union Organisation, the Student Parliament, the Study Department, as well as RTU IESE organises own upskilling activities for its employees.

For example, on 31 May 2017, there was a lecture on psychological burnout and its evaluation tools for all teaching staff of RTU IESE, as well as Bachelor, Master and doctoral students. The lecture was intentionally organised at the end of the academic year, because this was the time when students (in particular 3rd year Bachelor students, and 2nd year Master students, who draft their graduation papers) and teaching staff feel increased stress.

The RTU IESE academic staff involved in the implementation of the Bachelor’s study programme “Environmental Engineering” is highly qualified and has extensive scientific experience.

Table: *Summary of scientific specialisations of responsible teaching staff involved in the implementation of the Bachelor’s study programme “Environmental Engineering”*

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
1.	Andra Blumberga	*Dr.sc.ing.*	Professor	System dynamics analysis, modelling of policy instruments, energy performance of buildings, energy performance of historical buildings, low and zero energy buildings, biomimicry, modelling of bioeconomy, smart air exchange systems	17

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
2.	*Francesco Romagnoli*	*Dr.sc.ing.*	Professor	Bioresources, biogas and biomethane, life cycle analysis, biogas from microalgae, risk assessment, resilience to climate change	13
3.	Marika Rošā	*Dr.sc.ing.*	Professor	Energy management, sustainable transport, sustainable industry, GHG emissions reduction technologies, modelling of GHG emissions	13
4.	Dagnija Blumberga	*Dr.hab.sc.ing.*	Professor	Climate technologies, renewable energy, cleaner production, bioeconomy, sustainable heat and cold supply, energy end-user management, energy sector modelling	22

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
5.	Jūlija Gušča	*Dr.sc.ing.*	Professor	Circular economy, recovery of resources from waste, sustainability assessment, ecodesign, CO2 capture and storage	8
6.	Anna Kubule	*Dr.sc.ing.*	Associate Professor	Environmental pollution prevention technologies, cleaner production, industrial symbiosis, environmental sustainability assessment of manufacturing companies	7
7.	Kārlis Valters	*Dr.sc.ing.*	Assistant professor	Scientific research principles, prevention of water pollution, evaluation of chemical processes in enterprises	4
8.	Gatis Žogla	*Dr.sc.ing.*	Assistant professor	Energy performance of buildings, energy audit	6

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
9.	Dzintars Jaunzems	*Dr.sc.ing.*	Assistant professor	Management of solar combi-systems, solar energy end-user management	2
10.	*Claudio Rochas*	*Dr.sc.ing.*	Professor	Energy management, energy end-user management, solar combi-systems, feasibility study of energy processes, biogasification	7
11.	Gatis Bažbauers	*Dr.sc.ing.*	Professor	Socio-economic assessment of energy supply, modelling of energy systems, heat supply processes	10
12.	Jeļena Pubule	*Dr.sc.ing.*	Professor	Environmental impact assessment, resource management	5
13.	Vladimirs Kirsanovs	*Dr.sc.ing.*	Assistant professor	Biogasification, sustainable heat supply	7

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
14.	Dace Lauka	*Dr.sc.ing.*	Assistant Professor	Solar heat supply systems, modelling of renewable energy, cleaner production in enterprises, recovery of resources	9
15.	Silvija Nora Kalniņš	*Dr.sc.ing.*	Assistant Professor	Environmental management, sustainability assessment, ecomanagement	5
16.	Aiga Barisa	*Dr.sc.ing.*	Assoc. professor	Sustainable transport, biogas, bioresources	8
17.	Ruta Vanaga	*Dr.sc.ing.*	Assistant Professor	Biomimicry, passive buildings, energy performance of buildings	5
18.	Valdis Vītoliņš	*Dr.sc.ing.*	Assistant professor	District heating and cooling	3
19.	Agris Kamenders	*Dr.sc.ing.*	Associate Professor	Energy performance of buildings, energy planning, low-energy, zero-energy buildings	5

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
20.	Uldis Bariss	*Dr.sc.ing.*	Assistant professor	Smart energy, electricity end-user	5
21.	Ieva Pakere	*Ph.D.*	Assistant Professor	Sustainable heat supply, renewable energy sources	7
22.	Lauma Žihare	*Ph.D.*	Researcher	Bioeconomy, production of high value added products from agricultural and forestry waste, multiple-criteria analysis of bioeconomy processes	5
23.	Ilze Vamža	*M.sc.*	Researcher	Biotechnology, processing of low quality resources into high value added products	1
24.	Vivita Priedniece	*M.sc.*	Researcher	Combustion processes, technology for prevention of gaseous emission pollution	4
25.	Miķelis Dzikēvičs	*Dr.sc.ing.*	Assistant professor	Combined energy systems, solar energy systems	4

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
26.	Zane Indzere	*M.sc.*	Researcher	Bioresources, fish processing waste valorisation, bioeconomy	3
27.	Armands Grāvelsiņš	*M.sc.*	Researcher	Modelling of technical, environmental, socio-economic processes of energy systems, system dynamics modelling	8
28.	Signe Allena-Ozoliņa	*M.sc.*	Researcher	Modelling of technical, environmental, socio-economic processes of energy systems, energy independence	1
29.	Lauma Balode	*M.sc.*	Researcher	Assessment of sustainability of resources, environmental impact	0
30.	Baiba Ieviņa	*M.biol.*	Researcher	Bioresources, algae growth technologies	3
31.	*Fabian Diaz Sanchez*	*M.sc.*	Researcher	Life cycle assessment, life cycle cost assessment, bioresources, cold supply chains	1

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
32.	Tālis Juhna	*Dr.sc.ing.*	Professor	Sustainable management of water resources, water purification methods	13
33.	Linda Mežule	*Dr.sc.ing.*	Associate Professor	Use of biological processes in engineering sciences, Microbiology and quality of water	7
34.	Jānis Rubulis	*Dr.sc.ing.*	Associate Professor	Water supply, network safety and modelling	6
35.	Juris Blūms	*Dr. phys.*	Professor	Alternative energy sources, physics Didactics	6
36.	Elīna Gaile-Sarkane	*Dr. oec.*	Professor	Innovation management	4
37.	Inta Volodko	*Dr.math.*	Professor	Research of mathematical education	2
38.	Oksana Pavļenko	*Dr.math.*	Assistant professor	System analysis	3
39.	Sergejs Gaidukovs	*Dr.sc.ing.*	Associate Professor	Biocomposite research	9
40.	Gerda Gaidukova	*Dr.chem.*	Assistant Professor	Biocomposite research	6

No.	Name and surname	Scientific degree	Academic position	Area of scientific research	h-index
41.	Gunārs Ozolzīle	*Dr. paed.*	Associate Professor	Analysis of political systems	-
42.	Aleksejs Šņitņikovs	*Dr. sc. Soc.*	Assistant professor	Organisational sociology	-
43.	Marina Platonova	*Dr. philol.*	Professor	Technical translation and terminology	0
44.	Larisa Iļinska	*Dr. philol.*	Professor	Analysis of technical texts	-
45.	Jeļena Malahova	*Dr.oec.*	Associate Professor	Assessment of technogenic risks	1
46.	Romāns Neilands	*Dr.sc.ing..*	Professor	Wastewater treatment modelling	-
47.	Sandis Dejus	*Dr.sc.ing.*	Researcher	Water quality monitoring	2
48.	Krišs Spalviņš	*PhD*	Researcher	Single-cell protein production	5
49.	Ketija Bumbiere	*M.sc.ing.*	Researcher	Environmental aspect assessment	0
50.	Ritvars Freimanis	*M.sc.ing.*	Researcher	Energy efficiecy of buildings	3

Scientific excellence of all the teaching staff involved in the implementation of academic Bachelor's study programme "Environmental Engineering" in 2015-2020 (data on 2020 are incomplete) is summarised in the Figure. Since 5 teaching staff members (Gunārs Ozolzīle, Aleksejs Šņitņikovs, Marina Platonova, Larisa Iļinska, Jeļena Malahova) represent the humanities and social sciences sector, data of this teaching staff are not available in the *SciVal* database and are not included in the information summarised in the Figures.

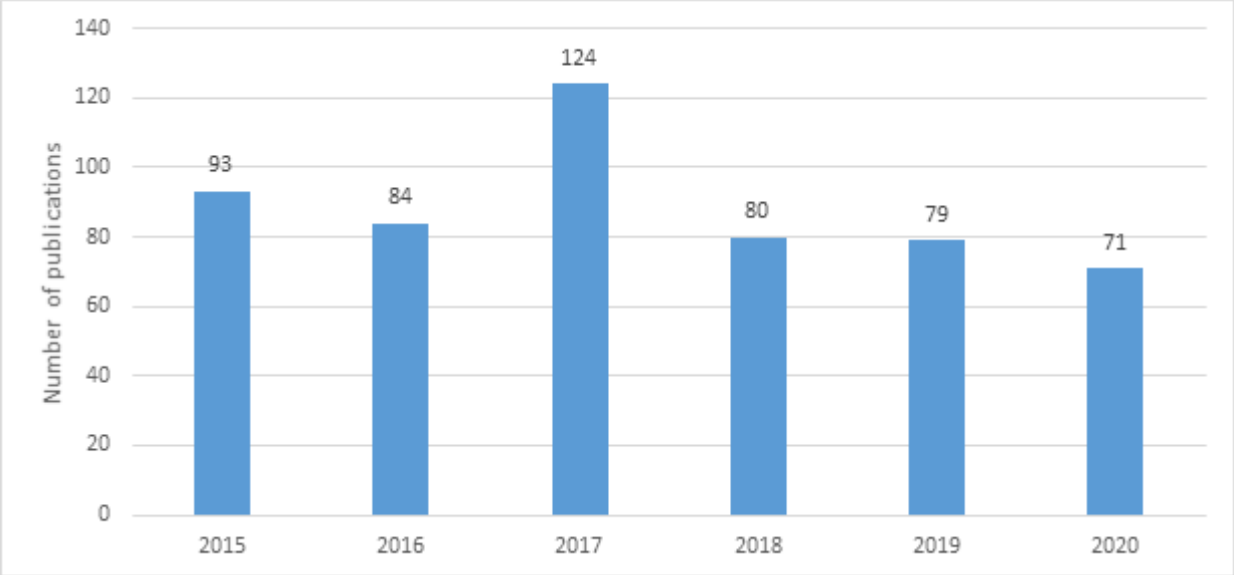

***Figure: Dynamics of SCOPUS publications** of the **teaching staff involved** in the implementation of the RTU **academic Bachelor's** study programme "Environmental Engineering" in 2015-2020 (data from the SciVal Tool).*

In 2015-2020, the teaching staff involved in the implementation of the RTU academic Bachelor's study programme "Environmental Engineering" **published 531 SCOPUS indexed scientific publications,** which were **cited 2925 times.** The teaching staff published SCOPUS-indexed articles in 2015-2020 and made a contribution to the development of fields of science in the following fields of science: Engineering (9.4 %), Environmental science (18.6 %), Energy (44.6 %), Agriculture and biology (5.3 %), material science and chemistry (7.1 %), mathematics and computer science (4.8 %), business and management (2.2 %) and other (0.8 %). The Figure below shows the breakdown of publications by research areas (234 areas in total).

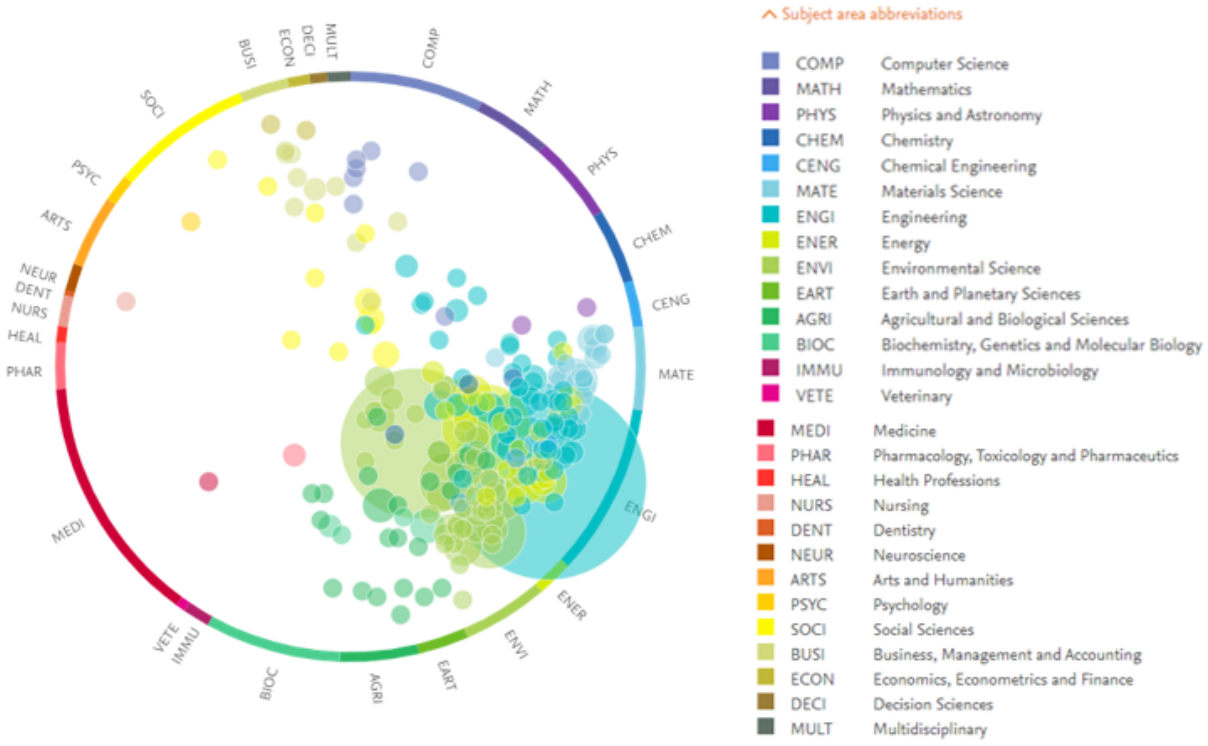

***Figure:** Contribution of SCOPUS-indexed publications of the **teaching staff involved** in the implementation of **academic Bachelor's** study programme "Environmental Engineering" (in 2015-2020) in the development of thematic areas (data from the SciVal Tool).*

In the reporting period from 2015-2020, SCOPUS indexed publications of the teaching staff involved in the implementation of academic Bachelor's study programme "Environmental Engineering (531 publications) were cited 2925 times, 5.5 citations per 1 publication on average.

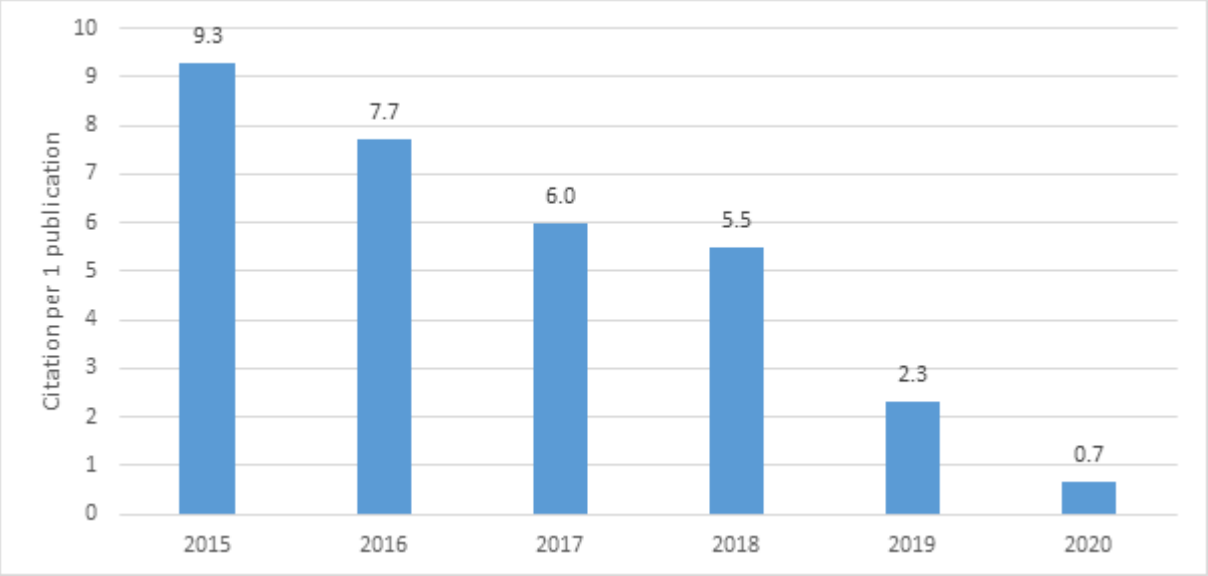

***Figure: Citation** of publications of the **teaching staff involved** in the implementation of the RTU **academic Bachelor's** study programme "Environmental Engineering" **per 1 publication** in 2015-2020 (data from the SciVal Tool).*

As it has already been mentioned, for individual achievements of teaching staff members also see CVs, for publications of teaching staff see the report on the Study Direction.

Every year, visiting lectures of foreign teaching staff are organised as a compulsory components of the study process. Some examples of foreign teaching staff involved in the implementation of the study programme as visiting teaching staff. For example, in academic year 2018/2019 *Dr.sc.ing.* Andres Siirde, professor of the Tallinn University of Technology (Estonia) specialising in modelling of heat processes, worked at RTU IESE as a visiting professor for 12 months within a project and read visiting lectures in study courses "Combustion Processes", "Heat Systems".

4.3. Information on the number of the scientific publications of the academic staff members, involved in the implementation of the doctoral study programme, as published during the reporting period by listing the most significant publications published in Scopus or WoS CC indexed journals. As for the social sciences, humanitarian sciences, and the science of art, the scientific publications published in ERIH+ indexed journals may be additionally specified (if applicable).

4.4. Information on the participation of the academic staff, involved in the implementation of the doctoral study programme, in scientific projects as project managers or prime contractors/ subproject managers/ leading researchers by specifying the name of the relevant project, as well as the source and the amount of the funding. Provide information on the reporting period (if applicable).

4.5. Provide examples of the involvement of the academic staff in the scientific research and/or artistic creation activities both at national and at international level (in the fields related to the content of the study programme), as well as the use of the obtained information in the study process.

Overall assessment of the academic staff is reflected in the information provided in the Study Direction Report, Part II, Section 3, Criteria 3.5 to 3.6 and in the CVs of the academic staff. For more information about the study process and student involvement in research, see Section 2.5.

The academic staff members of the study program, both at national and international level, are engaged in scientific research in the field of quality management and conformity assessment, and the acquired information and experience are integrated into the study process.

RTU IESE research directions mainly focus on environmental protection, environmental and climate technologies and energy. Research in the following areas was conducted within RTU IESE: energy change modelling, renewable energy sources, sustainable use of resources, biotechnologies, infrastructure resilience to disasters and risk analysis, energy efficiency, bioeconomy, fuel technology, energy and environmental policy, environmental management and other. Thanks to many conducted researches, RTU IESE academic staff continues to develop scientifically and professionally. Research results and conclusions are integrated in the study process (lectures are supplemented with examples from research projects. The results of scientific research are used in laboratory and practical work, for example, as developed methodologies, models, stands). The research is closely related to the implemented study programmes at the Bachelor and Master level of studies. For instance:

- ***Energy performance of buildings*** – professor *sc.ing.* Andra Blumberga, assoc. professor *Dr.sc.ing.* Agris Kamenders, assistant professor *Dr.sc.ing.* Ruta Vanaga, assistant professor *Dr.sc.ing.* Gatis Žogla, scientific assistant *M.sc.* Ritvars Freimanis, scientific assistant Roberts Bāliņš, scientific assistant Zigmārs Zundāns, researcher Juris Antužs, researcher *M.sc.* Edīte Biseniece.
- **Climate technology *and renewable energy sources*** – professor *hab.sc.ing.* Dagnija Blumberga, professor *Dr.sc.ing.* Marika Rošā, professor *Dr.sc.ing*. *Claudio Rochas*, professor *Dr.sc.ing.* Jūlija Gušča, assoc. professor *Dr.sc.ing.* Aiga Barisa, assoc.professor *Dr.sc.ing.* Edgars Vīgants, assistant professor *Dr.sc.ing.* Miķelis Dzikēvičs, assistant professor *Dr.sc.ing.* Dace Lauka, assistant professor *PhD.* Ieva Pakere, assistant professor *Dr.sc.ing.* Dzintars Jaunzems, scientific assistant Beate Zlaugotne.
- **Environmental impact assessment, environmental management** – professor *sc.ing.* Jeļena Pubule, assistant professor *Dr.sc.ing.*Silvija Nora Kalniņš, *Dr.sc.ing.* Sarma Valtere, researcher *M.sc.* Ketija Bumbiere.
- **Industrial microbiology** – researcher Krišs Spalviņš, researcher *M.sc.* Ilze Vamža.
- **Cleaner production** – professor *hab. sc.ing.* Dagnija Blumberga, assistant professor *Dr.sc.ing.* Dace Lauka, *M.sc.* Zane Indzere.
- **Modelling of energy systems and system dynamics modelling** – professor *sc.ing.* Andra Blumberga, professor *Dr.sc.ing.* Gatis Bažbauers, researcher *M.sc.* Armands Grāvelsiņš, researcher *M.sc.* Signe Allena-Ozoliņa.
- ***Combustion processes and*** **testing of biofuel** – professor *sc.ing.* Ivars Veidenbergs,

professor *Dr.sc.ing*. *Claudio Rochas*, assoc.professor *Dr.sc.ing.* Edgars Vīgants, assistant professor *Dr.sc.ing.* Vladimirs Kirsanovs, researcher and lecturer *M.sc.* Vivita Priedniece, specialist *B.sc.* Lauma Beinaroviča, scientific assistant *B.sc.* Jurģis Plankājs.

- ***Management of resources (incl. bioresources)*** – professor *sc.ing. Francesco Romagnoli*, professor *Dr.sc.ing.* Julija Gušča, professor *Dr.sc.ing.* Jeļena Pubule, researcher *M.biol.* Baiba Ieviņa.
- ***Biotechonomy*** – professor *hab. sc.ing.* Dagnija Blumberga, professor *Dr.sc.ing.* Gatis Bažbauers, professor *Dr.sc.ing.* Andra Blumberga, researcher *PhD.* Lauma Žihare, assistant professor *Dr.sc.ing.* Dzintars Jaunzems.
- ***Energy management and energy planning*** – professor *sc.ing*. *Claudio Rochas*, professor Dr.sc.ing. Marika Rošā, assoc. professor *Dr.sc.ing.* Agris Kamenders.
- ***Infrastructure resilience to natural disasters and risk analysis*** – professor *sc.ing. Francesco Romagnoli*, researcher *M.sc.* Maksims Feofilovs, researcher *M.sc. Fabian Diaz Sanchez.*
- ***Sustainable energy supply (incl. heat supply and transport)*** – professor *hab. sc.ing.* Dagnija Blumberga, professor *Dr.sc.ing.* Gatis Bažbauers, assoc.professor *Dr.sc.ing.* Edgars Vīgants, assoc. professor *Dr.sc.ing.* Aiga Barisa, assistant professor *Dr.sc.ing.* Vladimirs Kirsanovs, assistant professor *Dr.sc.ing.* Dace Lauka, assistant professor *PhD.* Ieva Pakere.

Students obtain skills in research work by working with literature, different scientific databases and internet resources to successfully develop study papers and the Bachelor's thesis. The Bachelor's thesis will be a serious research, which is developed as a feasible solution to the current problem based on a research in a specific company or area. As it has been mentioned in Paragraph 2.5, students will present the results of their research paper at student conferences.

Research is integrated in the study process. This interaction is supplemented and updated by labour market research and consultations with employers and practicing specialists. Changes focus mainly on modern and applied research. The research and study process is organised in a way that study and research work topics of students would include pressing environmental protection matters.

Personnel of RTU IESE is working actively in industry research. Research results and achievements are confirmed by participation in international conferences and acknowledgement for achievements.

Every year, RTU IESE academic staff participates in international and local scientific conferences (see sections 4.4 and 4.5 of the Report).

In 2016, RTU IESE teaching staff participated in the following conferences:

- *University of Latvia conference "Climate Change and Energy"*
- *24th European Biomass Conference and Exhibition (EUBCE)*
- *2nd South East European Conference on Sustainable Development of Energy, Water and Environment Systems*
- *CONECT 2016*
- *SET Plan 2016 – Central European Energy Conference*

In 2017, RTU IESE teaching staff participated in the following conferences:

- *Meeting of the Information Technology and Innovative Business Sub-Committee of the National Economy, Agrarian, Environmental and Regional Policy Committee on bioeconomy in Latvia and progress and news in strategy development.*
- *The University of Latvia commercialises: Success stories*
- *Conference "Environmental science and education in Latvia and Europe"*

- *Baltic Gas Conference 2017*
- *Conference "The Conference of Environmental and Climate Technologies CONECT 2018"*
- *The 35th International Conference of the System Dynamics Society*
- *International Conference of Applied Energy 2017 ICAE2017*
- *Symposium on ,medicinal plants in the context of globally sustainable land use and bioeconomy*
- *3rd International Conference on Smart Energy Systems and 4th Generation District Heating*
- *Energy 2017*
- *58th RTU International Scientific Conference- Bioenergy Technology*
- *SIMWOOD project final conference "Solutions for Wood Mobilisation in Europe"*
- *Annual High-Level Experts Conference 2017*
- *International conference "Clean Energy for Smart City"*
- *International conference "Lab Space Design"*
- *Baltic Pathway Towards Low Carbon and Climate Resilient Development*

In 2018, RTU IESE teaching staff participated in the following conferences:

- *International conference "HOW TO: engage in innovations"*
- *"Science meets industry"*
- *Scientific practical conference "Forest science – its diversity"*
- *Conference "Energy Efficiency 2018"*
- *Conference "Importance of education in sustainable development goals in Latvia"*
- *Conference "For greener business in Europe"*
- *Conference "Biosystems Engineering 2018"*
- *Conference "26th European Biomass Conference & Exhibition"*
- *Conference "The Conference of Environmental and Climate Technologies CONECT 2018"*
- *CUE2018-Applied Energy Symposium and Forum 2018: Low carbon cities and urban energy systems*
- *The 10th International Conference on Applied Energy (ICAE2018)*
- *5G TECHRITORY*
- *Baltic Sea Conference "Energy Efficient Cities" How to set the ball rolling?*
- *Bioeconomy in the forefront of national policies BIOEAST conference*
- *Conference "National Energy and Climate Plan 2021–2030" – energy development and climate change mitigation"*
- *Conference "Innovation in fishery and Latvian fishery development trends"*

In 2019, RTU IESE teaching staff participated in the following conferences:

- *Conference "Energy management in local governments: achievements and future prospects"*
- *Conference"Biosystems Engineering 2019"*
- *Conference "The Conference of Environmental and Climate Technologies CONECT 2019"*
- *Conference "ENERGY EFFICIENCY FOR SUSTAINABLE FUTURE"*
- *Conference "Algae biomass for a sustainable future"*
- *Conference "Smart Energy Systems and 4th Generation District Heating 2019"*
- *Conference "The Future of Thermal Grids"*
- *Conference "100% Climate Neutrality Conference 2019"*
- *Conference "European Transport Conference 2019 (ETC)"*
- *13th SET-Plan Conference: 'R&I in the energy sector to enhance European industrial leadership'*
- *Is it the time for transformation in the Latvian energy sector?*

In 2020, RTU IESE teaching staff participated in the following conferences:

- *International scientific Environmental and Climate Technology Conference CONECT 2020*
- *Conference "The European Biomass Conferences and Exhibition e-EUBCE 2020"*
- *Conference "38th International Conference of the System Dynamics Society"*
- *Conference "Kokkola Material Week"*

RTU IESE not only participates in scientific conferences, but also organises them. Every year, in May, an international environmental and climate technology scientific conference CONECT is organised, where industry scientists and researchers and doctoral students share their research and research results. The research and its results presented at the conference are published in the internationally recognisable scientific journal "Environmental and Climate Technologies", selected publications from which are published in a special edition in the international scientific journal "Environmental Management" (ELSEVIER) and "Journal of Cleaner Production" (ELSEVIER). Editions of these journals are cited and are available in the scientific databases indexed in Scopus and Web of Science. On 13.05-15.05.2020, the seventh CONECT 2020 conference organised by RTU IESE was held, which was attended by 140 participants from 20 countries, including Latvia. Every year, CONECT is held in the premises of the RTU FEEE, but this year it was held online due to the restrictions caused by the pandemic. Scientific research in the following areas related to the environment were presented during the conference: renewable energy sources, sustainable development of technology, green transport systems, energy and carbon market, bioeconomy and low carbon development, energy efficiency improvement and other. This year, IESE teaching staff presented their research and the publication by RTU IESE researcher Lauma Žihare "Bioeconomy instruments: market considerations" received the *Best Paper Award "Best Junior Paper"*.

In 2014, the following publications created by RTU IESE representatives were presented at the international conference CONECT 2014:

- *Pastare, F. Romagnoli, D. Lauka, I. Dzene "Multi-criteria analysis of sustainable use of macro-algae for biogas production in Latvian conditions: A preliminary study"*
- *Dzirkevics, A. Zandeckis "Mathematical model of packed bed solar thermal enery storage simulation"*
- *Blumberga, D. Blumberga, J. Pubule, F. Romagnoli "Cost-benefit analysis of plasma-based flue gas treatment technologies"*
- *Barisa, M. Rosa, I. Laicane, R. Sarmins "Application of low-carbon technologies for cutting household greenhouse gas emissions"*
- *Kamandere, G. Zogla, A. Kamenders, J. Ikaunieks, C. Rochas "Analysis of mechanical ventilation system with heat recovery in renovated apartament"*
- *Paturska, M. Repele, G. Bazbauers "Economic assessment of biomethane supply system based on natural gas infrastructure"*
- *Zvaigznitis, C. Rochas, G. Zogla, A. Kamenders "Energy efficiency in multi-family residential buildings in Latvia. Costs benefit analysis comparing different business models"*
- *Laicāne, D. Blumberga, A. Blumberga, M. Rosa "Reducing household electricity consumption: The role of home appliance scheduling, improved energy performance and user behavioural change"*
- *Bolonina , G. Bolonins ,D. Blumberga "Analysis of the impact of decreasing heating supply temperature on combined heat and power plant operation"*

In 2015, the following publications by RTU IESE representatives were presented at the international conference CONECT 2015:

- *Klavenieks, D. Blumberga "Historical and future analysis of waste flow"*
- *Barisa, I. Dzene, M. Rosa, K. Dobraja "Waste-to-biomethane concept application: A case study of Valmiera city in Latvia".*

- *Kubule, L. Zogla, M. Rosa "Resource and energy efficiency in small and medium breweries"*
- *Skujevska, M. Rosa, A. Kamenders "Evaluation of energy consumption of municipal buildings by heat and energy demand mapping"*
- *Kancane, R. Vanaga, A. Blumberga "Modeling of building envelope's thermal properties by applying phase change materials"*
- *Miezis, Dz. Jaunzems "Predictive control of a building heating system"*
- *Klavina, J. Klavins, I. Veidenbergs, D. Blumberga, "Charcoal production in a continuous operation retort. Experimental data processing"*
- *Blumberga, K. Kass, E. Kamendere "Survey on Latvian historical buildings stock with heavy walls"*

In 2016, the international conference CONECT 2016 was held in the RTU FEEE premises on 12-14.10.2016. Participants from 14 countries of the world participated in the conference presenting their latest research results. RTU IESE representatives presented the following publications at the conference:

- *Blumberga, A. Blumberga, G. Bazbauers, A. Gravelsins "Why Biotechonomy is actual for Latvia. Research Achievements in IESE"*
- *Dzikevics, V. Kirsanovs, D. Blumberga, I. Veidenbergs "Design of experimental investigations on the effect of flow rate and PCM placement on thermal accumulation"*
- *Purviņš, E. Kamendere, A. Blumberga "Influence of Properties of Materials to Energy Efficiency of Historical Buildings"*
- *Locmelis, U. Bariss, D. Blumberga "Energy policy on electricity consumption in industries"*
- *Feofilovs, F. Romagnoli "Measuring community disaster resilience in the Latvian context: an apply case using a composite indicator approach"*
- *Balina, F. Romagnoli, L. Pastare, D. Blumberga "Seaweed cultivation laboratory testing: effects of nutrients on growth rate of Enteromorpha intestinalis"*

In 2017, the international conference CONECT 2017 was held in the RTU FEEE premises on 10-12.05.2017. Participants from 14 countries of the world participated in the conference presenting their latest research results. RTU IESE representatives presented the following publications at the conference:

- *Gusca, I. Kuznecova "Analysis and characterization of biomethanation input composition and reaction boundaries"*
- *Locmelis, D. Blumberga, U. Bariss "Energy policy for energy intensive manufacturing companies and their impact on energy efficiency improvements"*
- *Vanaga, R. Purvins, A. Blumberga, I. Veidenbergs, D. Blumberga "Heat transfer analysis by use of lens integrated in building wall"*
- *Locmelis, D. Blumberga, U. Bariss "Energy policy for energy intensive manufacturing companies and their impact on energy efficiency improvements"*
- *Blumberga "Energy efficiency in historical buildings. Horizon 2020 project experience"*
- *Feofilovs, F. Romagnoli "Resilience of critical infrastructures: probabilistic case study of a Latvian municipality district heating network"*
- *Rochas "ESCO in dwelling buildings. Horizon 2020 project experience"*
- *N. Kalnins "Results from ecosystem approach in climate change mitigation and adaptation: case study from pilots in 7 countries"*
- *Rosa "Low carbon municipalities"*
- *Blumberga, I. Muizniece, L. Zihare "Bioeconomy mapping indicators and methodology"*
- *Romagnoli "Making communities resilient to disasters: focus on the Critical Infrastructures"*

In 2018, the international conference CONECT 2018 was held in the RTU FEEE premises on

16-18.05.2018. Participants from 15 countries of the world participated in the conference presenting their latest research results. RTU IESE representatives presented the following publications at the conference:

- *Julija Gusca, Edgars Kavals, Kaspars Klavenieks, Dagnija Blumberga "Indicator analysis of integrated waste managment system. Case study of Latvia"*
- *Lauma Zihare, Kriss Spalvins, Dagnija Blumberga "Multi criteria analysis for products derived from agro industrial by-products"*
- *Reinis Azis, Andra Blumberga, Gatis Bazbauers "The role of forest biotechonomy industry in the macroeconomic development model of the national economy of Latvia – an in-depth insight and results"*
- *Kristaps Locmelis, Dagnija Blumberga "Energy efficiency in large industrial plants. Legislative aspects"*
- *Claudio Rochas "Third party financing of energy efficiency in dwelling buildings. Involvement of municipalities"*
- *Francesco Romagnoli "Towards the pathway for enhancing climate change resilience of urban Infrastructure: overview on the state-of-art and implementation"*
- *Aiga Barisa, Marika Rosa "A system dynamics model for CO2 emission mitigation policy analysis in road transport sector"*
- *Reinis Aboltins, Dagnija Blumberga "Energy efficiency investments in households. Innovative financing scheme"*
- *Dzintars Jaunzems, Edgars Augustins, Claudio Rochas, Agris Kamenders "Managing energy efficiency of buildings: Analysis of ESCO experience in Latvia"*
- *Agris Kamenders, Kristaps Kass "Quality management for building performance"*
- *Andra Blumberga "Energy efficiency in historic buildings: mathematical and experimental study of hygrothermal processes in external walls with internal insulation"*
- *Gatis Bazbauers "System dynamics modelling of energy production flexibility. Integration of innovative energy technologies"*
- *Dagnija Blumberga "Problems with feed-in tariffs. Energy sector sustainability. Case in Latvia"*

In 2019, the international conference CONECT 2019 was held in the RTU FEEE premises on 15-17.05.2019. Participants from 18 countries of the world participated in the conference presenting their latest research results and sharing their experiences. RTU IESE representatives presented the following publications at the conference:

- *Kriss Spalvins, Ilze Vamza, Dagnija Blumberga "Single cell oil production from waste biomass: review of applicable industrial by-products"*
- *Jelena Pubule, Indra Muizniece, Dagnija Blumberga "Circular economy and bioeconomy interaction development as future for rural regions. Case study of Aizkraukle region in Latvia"*
- *Einars Cilinskis, Dagnija Blumberga, Andra Blumberga "Analysis of multilevel socio-technical transition"*
- *Aiga Barisa, Alina Safronova, Vladimirs Krisanovs "Future transport policy designs for biomethane promotion: a system dynamics model"*
- *Ruta Vanaga, Andra Blumberga, Sandra Treija, Edgars Bondars "Is the high quality Baukultur* a monkey wrench in the global climate challenges? *Davos Declaration 2018"*
- *Andra Blumberga, Liva Asere "Does energy efficiency-indoor air quality dilemma have impact on the gross domestic product?"*
- *Claudio Rochas "Analysis of regulatory instruments promoting building energy efficiency"*
- *Gatis Bazbauers "Power sector flexibility through power-to-heat and power-to-gas application"*

- *Dagnija Blumberga "Sustainability analysis of bioenergy application according to bioeceonomy development"*

In 2020, the international conference CONECT 2020 was held remotely on the Zoom platform on 13-15.05.2019. Participants from 20 countries of the world participated in the conference presenting their latest research results and sharing their experiences. RTU IESE representatives jointly with representatives of foreign universities and other representatives of RTU organisational units presented the following publications at the conference:

- *Andra Blumberga "Traditional urban block moving towards positive energy block"*
- *Ruta Vanaga, Toms Mols, Andra Blumberga "Solar Facade Module for Nearly Zero Energy Building. Extended Test Period"*
- *Liva Asere, Andra Blumberga "Energy efficiency - indoor air quality dilemma in educational buildings: a possible solution"*
- *Mikelis Dzikevics, Ivars Veidenbergs - Riga Technical University, Latvia - Kestutis Valancius - Vilnius Gediminas Technical University, Lithuania - "Sensitivity analysis of packed bed PCM thermal storage for domestic solar thermal system"*
- *Dzintars Jaunzems Signe Allena-Ozolina, Ieva Pakere, Ritvars Freimanis, Andra Blumberga, Gatis Bazbauers "Adaptation of TIMES model structure to industrial, commercial and household sectors"*
- *Francesco Romagnoli - Riga Technical University, Latvia - Samuele Tortoioli, Luisa Paolotti, Antonio Boggia, Lucia Rocchi - University of Perugia, Italy - "Environmental Assessment of bio-oil transformation from thistle in the Italian context: an LCA study"*
- *Toms Mols, Andra Blumberga "Inverse Modeling of Climate Adaptive Building Shells"*
- *Gatis Bazbauers "Modelling transition to low carbon energy systems"*
- *Ieva Pakere, Dace Lauka, Dagnija Blumberga "Methodology for application of district heating climate benchmark"*
- *Anda Jekabsone, Agris Kamenders, Marika Rosa "Implementation of certified Energy management system in municipality. Case study."*
- *Gunars Valdmanis, Gatis Bazbauers "Influence of wind power production on electricity market price"*
- *Jelena Pubule, Andra Blumberga, Antra Kalnbalkite, Dagnija Blumberga "Education for advancing the implementation of the Bioeconomy goals: an analysis of Master study programmes in Bioeconomy"*
- *Julija Gusca, Silvija-Nora Kalnins "Circular economy approaches in health care waste management"*
- *Kriss Spalvins, Zane Geiba, Dagnija Blumberga "Waste cooking oil as substrate for single cell protein production by Yarrowia lipolytica"*
- *Lauma Zihare, Dagnija Blumberga "Bioeconomy investments: market considerations"*
- *Andra Blumberga "System dynamics model of COVID-19, different scenarios"*

When we evaluate the development of the scientific environmental and climate technologies CONECT conference, it is clear that participants from increasingly more countries of the worlds participate in it every year. This contributes to visibility of RTU IESE and promotes international academic cooperation. The increase in publications of RTU IESE representatives is evident and confirms the development at international level.

Starting from 2019, RTU IESE jointly with the RTU FEEE Institute of Industrial Electronics and Electrical Engineering has been organising the international conference "IEEE International Scientific Conference on Power and Electrical Engineering of Riga Technical University (RTUCON)", where a separate section "Environmental Assessment in Electrical Engineering" is organised. The purpose of the conference is to enable scientists, engineers and representatives of production

companies, as well as doctoral students from all over the world to discuss latest achievements and achievements in the field of electrical engineering and energy.

In 2019 and 2020, the following RTU IESE teaching staff and doctoral students participated in the RTUCON conference:

2019

- *Linda Ieviņa, Artis Vidžups, Andra Blumberga, Dagnija Blumberga."Mapping of Distributed Power Generation Versus Biomass Availability"*
- *Vladimirs Kirsanovs, Dace Lauka, Ivars Veidenbergs, Dagnija Blumberga. "Energy saving measures for a district heating company. Case study of Latvia*"
- *Kristaps Locmelis, Dagnija Blumberga. "Energy taxation exemptions for energy intensive industries and its impact on energy efficiency in Latvia*"
- *Liga Rozentale, Dagnija Blumberga. "Energy intensive manufacturers in state economy. Case study of Latvia*"
- *Anna Kubule, Marika Rosa, Andra Blumberga, Dagnija Blumberga "Energy efficiency barriers in Latvian industry*"
- *Gunārs Valdmanis, Gatis Bažbauers "Modelling the best scenario. Application of EnergyPlan modelling tool for comparative analysis of selected energy policies in case of Latvia*"

2020

- *Uldis Bariss, Kristiāna Dolge, Roberts Kaķis and Dagnija Blumberga."Emission Trading Impact to GHG Changes in Power Production Towards Green Deal Target*"
- *Ketija Bumbiere, Agita Gancone, Jelena Pubule and Dagnija Blumberga. "Sustainable biogas application in energy sector*"
- *Signe Allena-Ozolina, Ieva Pakere, Dzintars Jaunzems, Andra Blumberga and Gatis*
- "*The Integrated MARKAL-EFOM System (TIMES) Model Application for Power Sector Modelling*"
- *Līga Rozentāle, Antra Kalnbalkite and Dagnija Blumberga. "Aggregator as a new electricity market player*"
- *Ieva Pakere, Ivonna Bērziņa, Dace Lauka and Dagnija Blumberga. "Cooling load as a blind spot for energy system development*"
- *Vladimirs Kirsanovs, Aiga Barisa and Alīna Safronova. "Cost-benefit assessment of electric vehicle vs internal combustion engine in Latvia*"
- *Maksims Feofilovs, Armands Gravelsins and Francesco Romagnoli. "Review of disaster resilience assessment methods*"
- *Rudīte Vesere, Silvija-Nora Kalniņš, Dace Lauka and Dagnija Blumberga. "Circular Economy Analysis. Ranking of Energy Resources from Waste*"

RTU IESE academic staff actively participates in research work of the faculty and promotion of international cooperation (see Chapter 4 of the report). RTU IESE participates in the implementation of different European Union projects in cooperation with other institutes of the faculty. For example, some of the projects implemented at the institute and at the department:

From 2015 to 2018, IESE together with the Office for Preservation and Energy Savings of Buildings, as well as SIA “Salaspils siltums”, SIA “RENESCO”, SIA “Ekodoma”, SIA “eco.NRG” and “Funding for Future B.V., Nīderlande un Latvija” participated in the project “SUNShINE”, which is the first Horizon 2020 project coordinated by 2020. In this project, IESE scientists implement the idea about the role of the energy service company (ESKO) in the household sector. The main purpose of the project is to create and find a stable place for ESKO in the implementation of energy efficiency measures to fulfil the tasks of the European Union Energy Efficiency Directive. Activities of ESKO in multi-apartment buildings, where each apartment has its own owner, are related to high-level risks,

difficulty to raise funding and the need to resolve legal problems by developing a package of specific energy performance contracts. The tasks of the SUNShINE project are also related to the creation of new ESKO forms, involving local government heat supply companies.

In 2015-2020, IESE together with the Riga City Council and cooperation partners Aalborg University, Denmark; KU Leuven, Belgium, Dresden University of Technology, Germany; Marche Polytechnic University, Italy; SP Technical Research Institute, Sweden; Technical University of Denmark, Denmark; INTRO FLEX ApS, Denmark; Erik Møller Architects, Denmark; University of Applied Sciences Western Switzerland, Switzerland implemented the project RIBuild: Energy Efficiency Improvement in Historic Buildings. This project is financed by Horizon 2020. Scientists of the Aalborg University in cooperation with employees of IESE and representatives from five other countries, based on the experience of the Co2olBricks project, is implemented by the Horizon 2020 RIBuild project. Within this project, wall materials of European historical buildings, wall heat insulation opportunities, scope of reconstruction of buildings and summarised experience in reducing energy consumption and historical buildings will be identified in five years. The purpose of the RIBuild project is to develop guidelines for heat insulation of historical buildings from inside, to model solutions for preservation of historical buildings, as well as energy savings and environmental impact assessment, preserving the historical and cultural value of the building.

Since 2017, IESE together with 19 academic and local government partners participated in the project “Low temperature district heating for the Baltic Sea Region”. The project is related to the implementation of low temperature district heating in countries of the Baltic Sea Region. District heating systems are currently widespread in the region, but in many areas they are outdated and do not meet energy efficiency requirements. The project brings together partners from nine countries of the Baltic Sea Region, representing both local and regional authorities, thermal energy producers, agencies, research institutions and national energy associations. As part of the project, it is planned to develop a strategy for the introduction of low-temperature heating, to test it in existing buildings and heating systems, and to increase the knowledge and capacity of local government employees in the field of low-temperature heating. The new heating systems are expected to have smaller heat losses and will use renewable energy sources and fuels generated from waste to produce energy. Pilot projects in a number of municipalities will be carried out under the project. Gulbene Municipality has been selected as the site for the pilot project in Latvia.

In the reporting period, research results of academic staff of the department were converted into 368 scientific publications, which were published in scientific journals, for example, Journal of Cleaner production, Energy, Energies, *Energy Procedia*, *Chemical Engineering Transactions*, *International Journal of Global Warming,* which are indexed in SCOPUS and Web of Science databases. Here are just a few examples of engagement of academic staff in conferences and preparation of publications, reviewing of journal articles, and conference organisation committees.

4.6. Assessment of the cooperation between the teaching staff members by specifying the mechanisms used to promote the cooperation and ensure the interrelation between the study courses/ modules. Specify also the proportion of the number of the students and the teaching staff within the study programme (at the moment of the submission of the Self-Assessment Report).

The study program has a mechanism for teachers to cooperate with each other, which facilitates

the improvement and interconnection of study courses. The improvement of courses takes place on a regular basis, based on the suggestions made by the students and the trends of the development of the industry.

During the implementation of the courses, there are regular meetings of the teachers, where they exchange experience on the topics of the courses, as well as develop and improve the study content by mutually agreeing on the topics, focuses, responsibilities and compliance with regulatory requirements. All teachers of a particular course are involved in the process of coordination of the courses, thus ensuring that the topics covered in the study program are constantly improved and updated in cooperation with the professionals of the relevant field.

The Bachelor's study programme was built of four thematic blocks – water, air, resources and energy. Study courses and their development and implementation were also planned in these thematic blocks. These blocks were harmonised with each other so that study courses do not overlap and provide students with the basic knowledge needed in environmental engineering.

Cooperation of teachers in ensuring the interconnection of study courses is based on understanding of the thematic structure of the study program. Mechanisms for promoting collaboration are selected based on the individual workload of the academic staff members, the thematic relationship (coherence, continuity, complementarity) of the study courses, and the experience of the teachers.

Within the framework of the study program, the cooperation of the academic staff can be evaluated as contributing to the achievement of the learning outcomes. When reviewing and updating the study program, the teachers agree among themselves on the most appropriate and effective solutions regarding the assessment of student performance and achievement of performance indicators. By periodically discussing and revising the content of the study courses, thematically coordinated and complementary acquisition of the study program is achieved and overlapping of topics in different courses within one study program is avoided.

The cooperation between the teaching staff takes place both within the framework of a specific study course, in cooperation with the responsible teaching staff, doctoral students, industry professionals and in study courses on related topics requiring the mastering of similar topics, at different levels of understanding (in general, in detail, in relation to a specific aspect of the organisation's activities, with an emphasis on the different possibilities for using the method, etc.), and in the process of drafting Bachelor's thesis, evaluating the performance of students in regular seminars.

The student to teaching staff ratio is 1 teaching staff member per 4 students (from the 1st to 3rd year of Bachelor studies) in the academic staff elected to RTU and doing independent work (within the study direction "Environmental Protection").

Annexes

III. Description of the Study Programme - 1. Indicators Describing the Study Programme		
Compliance of the joint study programme with the provisions of the Law on Institutions of Higher Education (table)		
Statistics on the students over the reporting period	Statistical data_bachelors.pdf	Statistikas dati_bakalauri.pdf
III. Description of the Study Programme - 2. The Content of Studies and Implementation Thereof		
Compliance of the study programme with the State Education Standard	Compilance with national standart_bachelors.pdf	Atbilstiba valsts standartam_bakalauri.pdf
Compliance of the qualification to be acquired upon completion of the study programme with the professional standard (if applicable)		
Compliance of the study programme with the specific regulatory framework applicable to the relevant field (if applicable)		
Mapping of the study courses/ modules for the achievement of the learning outcomes of the study programme	Study course,module mapping_bachelors.pdf	Studiju kursu,moduļu kartejums_bakalauri.pdf
Curriculum of the study programme (for each type and form of the implementation of the study programme)	Study programme planning_bachelors.docx	Studiju programmas plānojums_bakalauri.docx
Descriptions of the study courses/ modules	Study course descr_bachelors.pdf	Studiju kursu apraksti_bakalauri.pdf
Description of the Study Direction - Other mandatory attachments		
Sample of the diploma to be issued for the acquisition of the study programme.	Diploma, diploma supplement_bach.zip	Diploms, diploma pielikums_bak.zip
Description of the Study Programme - Other mandatory attachments		
Document confirming that the higher education institution/ college will provide the students with the options to continue the acquisition of education in another study programme or at another higher education institution/ college (a contract with another accredited higher education institution/ college), in case the implementation of the study programme is discontinued	Agreement for possibility to continue studies_bachelors.zip	Vienošanās par studiju turpināšanu_bakalauri.pdf
Document confirming that the higher education institution/ college guarantees to the students a compensation for losses if the study programme is not accredited or the licence of the study programme is revoked due to the actions of the higher education institution/ college (actions or failure to act) and the student does not wish to continue the studies in another study programme	01000-2.2.1-e_178.edoc	01000-2.2.1-e_178.edoc
Confirmation of the higher education institution/ college that the teaching staff members to be involved in the implementation of the study programme have at least B2-level knowledge of a related foreign language according to European language levels (see the levels under www.europass.lv), if the study programme or any part thereof is to be implemented in a foreign language.	02000-2.2.1-e_22.edoc	02000-2.2.1-e_22.edoc
If the study programmes in the study direction subject to the assessment are doctoral study programmes, a confirmation that at least five teaching staff members with doctoral degree are among the academic staff of a doctoral study programme, at least three of which are experts approved by the Latvian Science Council in the respective field or sub-field of science, in which the study programme has intended to award a scientific degree.		
If academic study programmes are implemented within the study direction, a document confirming that the academic staff of the academic study programme complies with the provisions set out in Section 55, Paragraph one, Clause three of the Law on Institutions of Higher Education	02000-2.2.1-e_24.edoc	02000-2.2.1-e_24.edoc
Sample (or samples) of the study agreement	Study agreement sample_bachelors.pdf	Studiju liguma paraugs_bakalauri.pdf
If academic study programmes for less than 250 full-time students are implemented within the study direction, the opinion of the Council for Higher Education shall be attached in compliance with Section 55, Paragraph two of the Law on Institutions of Higher Education.	AIP conclusion_55th Article_bachelors.zip	AIP Atzinums 55.pants_bakalauri.pdf