



LITHUANIAN
ENERGY
INSTITUTE



ANNUAL REPORT
2023



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MESSAGE FROM THE DIRECTOR

In 2023, the Lithuanian Energy Institute (LEI) successfully pursued its strategic goals of becoming a recognised centre of excellence in science, innovation and technology in energy and related fields.

A comparative expert assessment of Lithuanian universities and research institutes conducted last year for the period of 2018-2022 showed that LEI remained a leader in technology sciences in Lithuania.

In 2023, LEI continued to develop cooperation with business and research institutions, actively participated in both national and international research programmes' projects, with a particular focus on addressing the challenges of energy transformation and climate change mitigation.

In the international research arena, LEI actively participates in international networking organisations such as the European Association of Research and Technology Organisations (EARTO), the European Energy Research Alliance (EERA), the European Technical Safety Organisations Network (ETSON), which bring together institutions collaborating in areas of research of interest to LEI.

In 2023, seven Horizon Europe projects and its complementary sub-programme EURATOM projects were carried out, two of which – coordinated by LEI. One project coordinated by LEI (GIFFT) focuses on the development of sustainable glass production technology and is carried out in collaboration with scientific and industrial institutions in Lithuania, Germany, Sweden and the UK (AB Panevėžio stiklas, SCHOTT AG, Technical University of Munich, etc.). The other LEI coordinated project (HARMONISE) addresses the issues of harmonisation of licensing of future nuclear energy technologies, which is also relevant for Lithuania in the context of the prospects of small nuclear reactors. LEI has a substantial portfolio of projects in various international programmes.

We are pleased that in 2023, LEI's operations have become more sustainable with the installation of a 500 kW solar power plant and the completion of the renovation of two buildings. The solar power plant generated 487 MWh of electricity, or more than 60% of LEI's electricity needs. In addition, the renovation of the buildings reduced the consumption of thermal energy by 30-40%. To improve working conditions for staff during the summer, air-conditioning was installed in two buildings.

In recent years, increasing State budget funding for R&D activities, rising revenues from international programmes' projects, orders from Lithuanian and foreign entities and national competitive funding have ensured that the Institute's annual revenues increased by 70 % over the last 5 years. In 2023, funding from industry increased significantly, indicating more intensive cooperation with business enterprises. This allowed LEI to achieve one of the highest average salaries among all state scientific and educational institutions in Lithuania.

The continuity, efficiency, and prospects of the Institute's activities largely depend on attracting young people to the Institute. For several years, significant attention has been paid to this matter – LEI participates in various career and public events. It's gratifying to see results – the number of doctoral students at the Institute doubled over 5 years. However, attracting young people and doctoral students remains our priority, so we actively invite youth to undertake internships, employment, and doctoral studies at LEI.

LEI will continue to strive to remain a leading scientific institution, responsibly pursuing its mission to create, collect and disseminate new scientific knowledge to meet the needs of society.

Director of LEI
DR. SIGITAS RIMKEVIČIUS

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MISSION

To conduct fundamental and applied research and develop innovative technologies in the fields of energy, thermal engineering, environmental engineering, measurement engineering, materials science and economics, to participate in study processes, to transfer the results of applied research and innovations to industry, to advise the state, the government, public, private institutions, and companies on issues related to the development of sustainable energy in Lithuania, to cooperate actively with higher education institutions in the preparation of specialists for the Lithuanian society.

LITHUANIAN ENERGY INSTITUTE (LEI) IS INTERNATIONALLY RECOGNIZED ENERGY-RELATED RESEARCH, DEVELOPMENT AND INNOVATION (R&D&I) COMPETENCE CENTER.

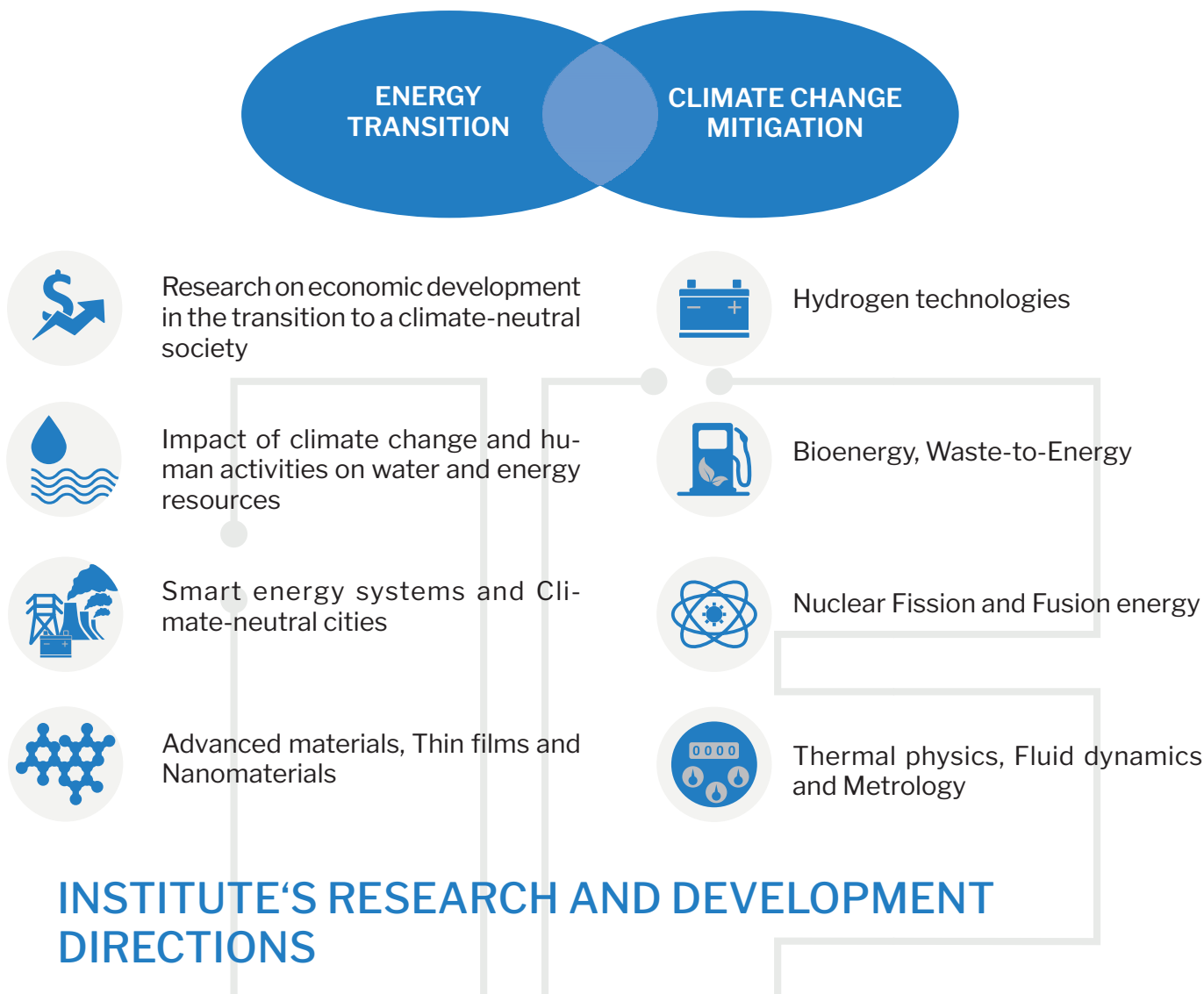
OBJECTIVES OF THE INSTITUTE'S ACTIVITIES

- To perform long-term international level fundamental and applied research, to ensure international excellence in the fields of technology and social sciences, and carry out long-term fundamental and applied research and innovations of an international standard, which is necessary for the sustainable development of the Lithuanian energy sector and the rest of the Lithuanian economy sectors, and for its integration into the European energy systems and the European Research Area;
- In cooperation with industry, government and society, to transfer knowledge and innovations into technically and commercially useful processes and equipments, ensuring the development of energy technologies and the rational evolution of energy systems, the security and reliability of energy supply, the efficient use of energy resources, the protection of the environment and the reduction of climate change;
- To disseminate knowledge to the public and contribute to the creation of an innovation- and knowledge-based Lithuanian economy;
- Initiate and actively participate in Lithuanian and international programme's projects, expand cooperation with Lithuanian and foreign research and educational institutions and scientists;
- To carry out the functions of the designated Institute in accordance with the provisions of the Law on Metrology of the Republic of Lithuania;
- In cooperation with universities, to train scientists of the highest competence for research in the fields of economics, energy and the environmental engineering, and to ensure the attraction and career development of doctoral students.

AREAS OF ACTIVITY OF THE INSTITUTE

—●— Research and development activities in the fields of technology and social sciences.

LEI STRATEGIC R&D TOPICS



INSTITUTE'S RESEARCH AND DEVELOPMENT DIRECTIONS

- Renewable energy and technologies enabling it;
- Environmental impact of climate change and anthropogenic activities;
- Economic development research towards climate-friendly economy;
- Modelling of energy systems and research of their control systems;
- Safety and reliability of industrial and energy facilities;
- Thermal physics, gas and fluid dynamics and metrology;
- Decommissioning of nuclear facilities and radioactive waste management.

LEI IN NUMBERS

230+

EMPLOYEES

130+

RESEARCHERS

40+

PhD STUDENTS

10+

RESEARCH LABORATORIES

10+ mln. Eur

R&D INFRASTRUCTURE

11+ mln. Eur

ANNUAL INCOME

60+

ANNUAL R&D CONTRACTS

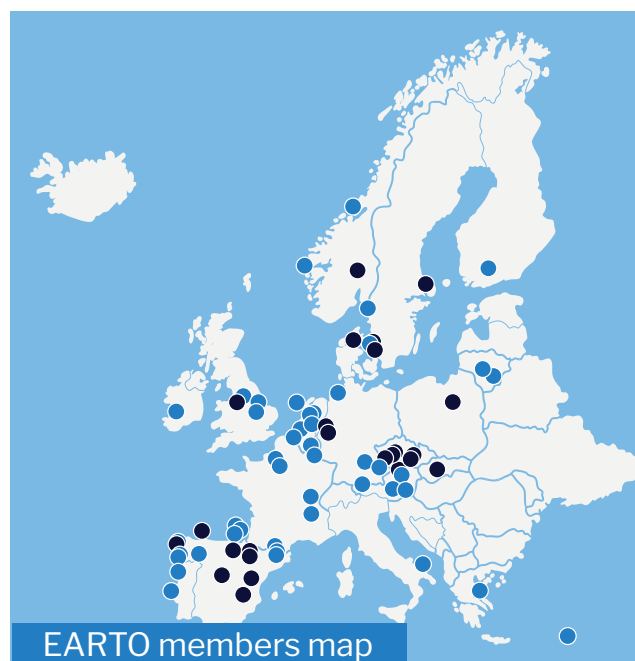
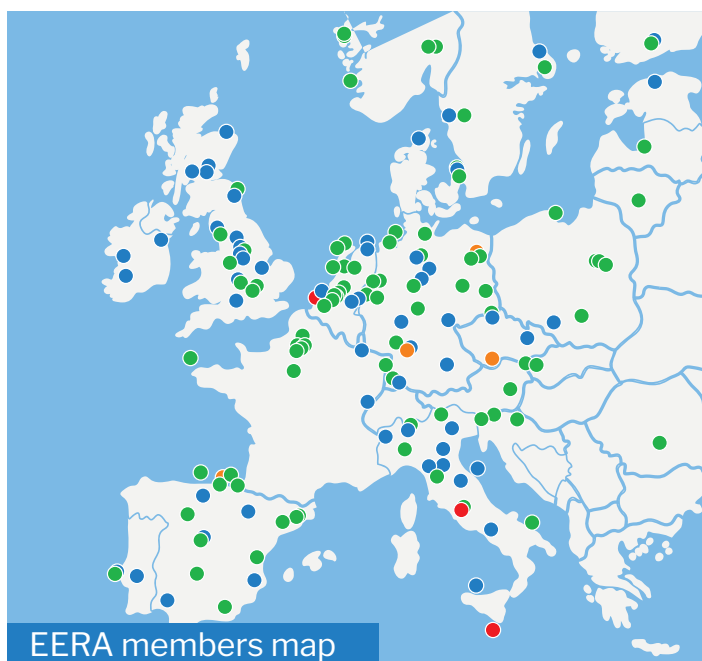
LONG-TERM RESEARCH AND EXPERIMENTAL DEVELOPMENT PROGRAMMES (2022-2026)

- Development and integration of advanced energy technologies.
Manager – Dr. Raimondas Pabarčius
- Interdisciplinary research on decarbonisation and adaptation to climate change.
Manager – Dr. Vidas Lekavičius
- Investigation of process regularities and resulting products in innovative energy/technological systems that use renewable resources.
Manager – Dr. Robertas Poškas
- Numerical investigations of safety issues and processes in the facilities for spent nuclear fuel and decommissioning radioactive waste storage and final disposal.
Manager – Dr. Artūras Šmaižys

MEMBERSHIP IN INTERNATIONAL ORGANISATIONS

- European Association of Research and Technology Organisations (EARTO)
- European Energy Research Alliance (EERA)
- European Safety, Reliability & Data Association (ESReDA)
- European Network of Freshwater Research Organisations (EurAqua)
- The European Association of National Metrology Institutes (EURAMET)

- Sustainable Nuclear Energy Technology Platform (SNETP)
- Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP)
- Nuclear Generation II & III Association (NUGENIA)
- European Technical Safety Organisations Network (ETSON)





MAIN LEI EVENTS

- A 500 kW solar power plant has been installed on the institute's premises. In 2023, it generated 487 MWh of electricity, which accounted for 62% of the energy consumed;
- The implementation of the project GIFFT (www.gifft-europe.eu) coordinated by LEI of the "Horizon Europe" program has started;
- A conditioning system has been installed in building B, significantly improving working conditions during the summer;
- Two charging stations for electric cars were installed;
- The modernization works of buildings A and B have been completed (only final project submissions remain), resulting in 30-40% less thermal energy consumption and up to 20% less electricity consumption in renovated buildings.

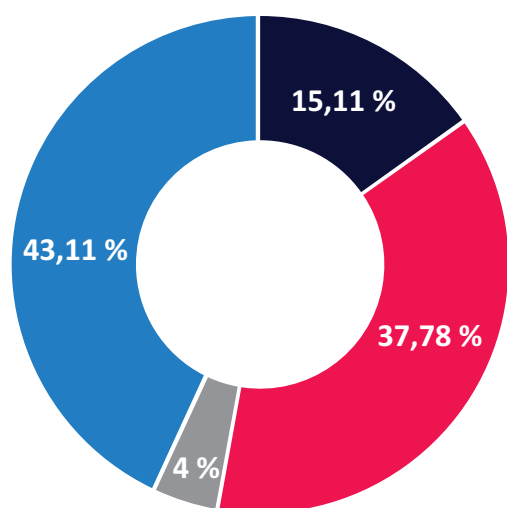
ACHIEVEMENTS OF OUR EMPLOYEES

- Dr. Sigitas Rimkevičius was elected to the executive board of EARTO;
- Dr. Sigitas Rimkevičius was awarded the commemorative medal of University of Lithuania on its 100th anniversary;
- Awards were presented to LEI employees on the occasion of Lithuanian Energy Day (Dr. Darius Milčius, Dr. Rimantas Bakas, Dr. Rolandas Urbonas);
- Dr. Rimantas Bakas was awarded the commemorative silver medal of AB “Panevėžio energija”;
- Dr. Eimantas Neniškis won in the category of the third level of studies of the competition organized by the Ministry of Transport and Communications of the Republic of Lithuania.



SCIENTIFIC ACTIVITY RESULTS

STRUCTURE OF PUBLICATIONS OF THE INSTITUTE IN 2023

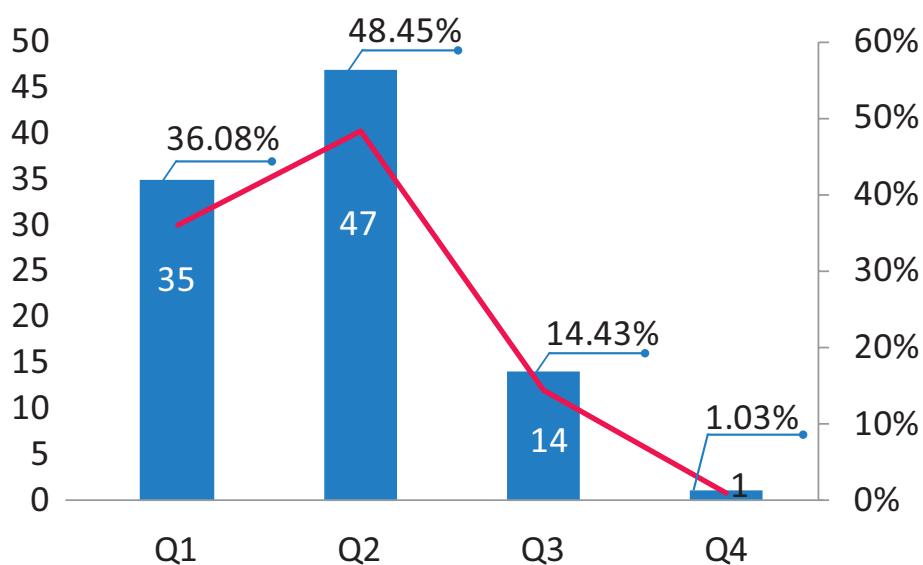


- Articles referenced in international databases
- Other peer-reviewed articles
- Proceedings of conferences held abroad
- Proceedings of conferences held in Lithuania

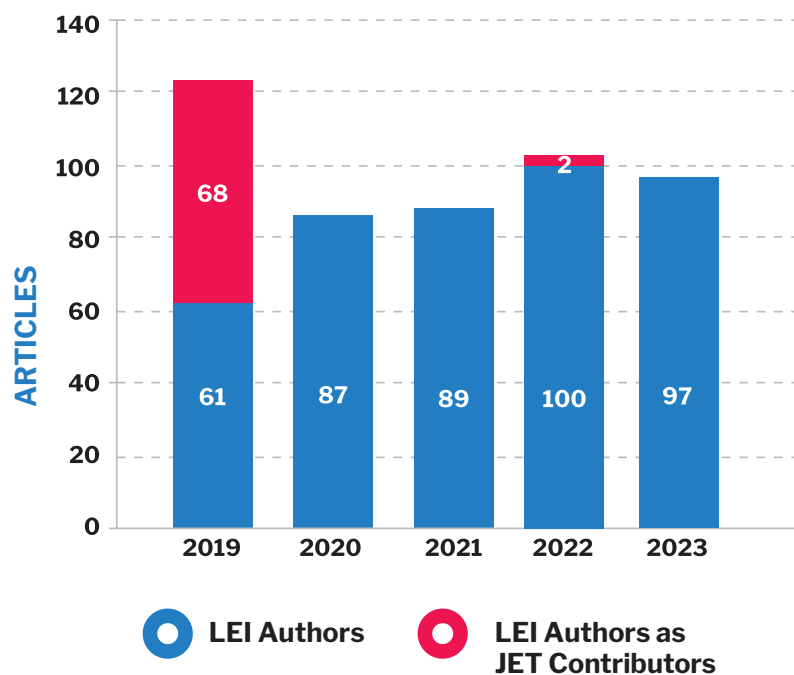
Scientific publications:



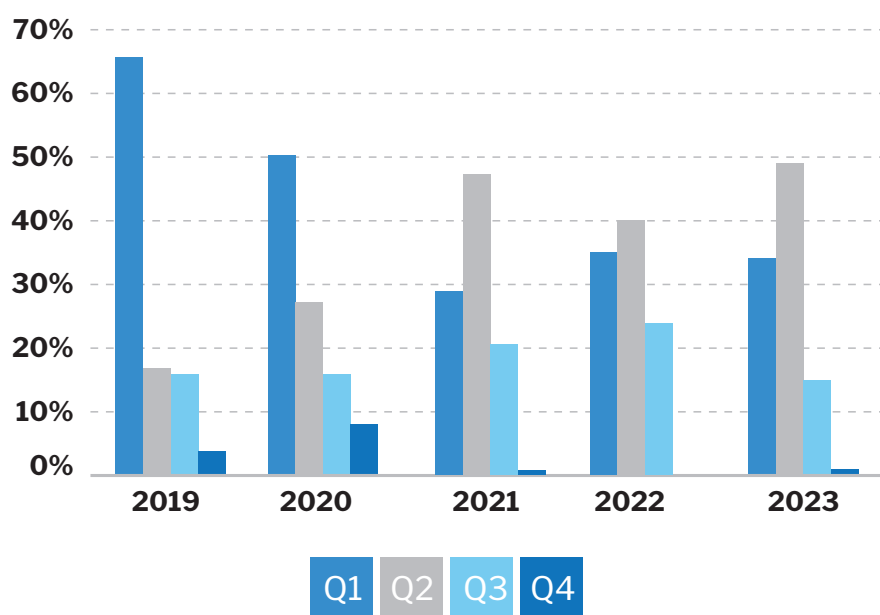
PUBLICATION OF RESEARCH RESULTS BY CA WOS QUARTILES



Dynamics of articles referred in the Clarivate Analytics WoS database



Dynamics of articles referred in the Clarivate Analytics WoS database by quartiles



LEI PROJECTS

International programmes' projects implemented in 2023

Horizon Europe and EURATOM	7 projects
Digital Europe Programme	1 project
Horizon 2020	7 projects
Nordic Energy Research Programme (NERP)	1 projects
Baltic Research Programme	2 projects
LIFE Programme	3 projects
INTERREG Programme	2 projects
International Atomic Energy Agency (IAEA)	5 projects
COST Programme	11 projects
Other international projects	2 projects

Institute in International programmes (projects portfolio)

Horizon Europe and EURATOM (2021-2027)	7 projects
Digital Europe Programme (2021-2027)	1 project
Horizon 2020 (2014-2020)	26 projects
7 Framework Programme (2007-2013)	24 projects
6 Framework Programme (2002-2006)	14 projects
5 Framework Programme (1998-2002)	11 projects
LIFE Programme (2021-2027)	3 projects
Intelligent Energy Europe (2007-2013)	31 projects
INTERREG Programme	17 projects
Nordic Energy Research Programme (NERP)	7 projects
Baltic Research Programme	2 projects
International Atomic Energy Agency (IAEA)	19 projects
International partnerships (EuropeAid)	4 projects
COST Programme	34 projects
EUREKA	4 projects



INTERNATIONAL PROJECTS STARTED IN 2023

Horizon Europe and EURATOM:

- REplicable, interoperable, cross-sector solutions and Energy services for demand side FLEXibility markets (REEFLEX);
- Sustainable Glass Industry with Fuel-Flexible Technology (GIFFT) [LEI coordinated].

LIFE Programme:

- Developing methodologies for the integration of low-grade energy sources into high-temperature district heating networks (LIFE22-CET-Low2HighDH).

ERASMUS+:

- Supporting the energy transition of the building stock (SHERLOCK).

INTERREG:

- Carbon driven energy equilibrium at the municipal scale (Energy Equilibrium).

INTERREG:

- Identification of Similarities and Differences Between Managing the Spent Fuel from RBMK and SMR.

COST:

- Cyber-Physical systems and digital twins for the decarbonisation of energyintensive industries (CA22151).

M-ERA.NET:

- INNOvative catalyst and its regeneration for clean HYdrogen Production via methane PYrolysis (InnoHyppy).

NATIONAL PROJECTS STARTED IN 2023

Lithuanian Academy of Sciences

1. Nuclear analysis of high power molten targets at MEDICIS and ISOLDE for the production of radioisotopes.

Research Council of Lithuania

1. P-MIP-23-84 Flammable oil and fibers recovery from pyrolysis of wind turbine blade waste and their applications in cementitious matrix reinforcement and LCA. Coordinator – KTU.
2. P-MIP-23-160 Application of plasma and aeroponic technologies for increasing plant biomass gain and yield of biologically active compounds. Coordinator – VDU.
3. P-MIP-23-167 Development of combined physical behavior and artificial intelligence models to determine hydromorphology of rivers by indirect measurements (ArHyReS). Coordinator – KTU.
4. P-MIP-23-186 Theory, technology and circularity of material recovery from multi-layer composite waste by simultaneous delamination and leaching. Partner – KTU.
5. P-MIP-23-201 Investigation of thermal radiation enhancement from alternative fuel flames in industrial furnaces (Rad2Fun).
6. P-MIP-23-299 From waste to resources: shrimp waste regeneration to sustainable anti-microbial products applied in agriculture. Coordinator – LAMMC.
7. P-SV-23-287 Simulation of hydrogen-air flame and turbulence interaction in an acceleration tube with annular obstacles using open-source CFD combustion solver flameFoam.
8. P-ST-23-10 Thermal decomposition of composite materials and analysis of the obtained products.

DOCTORAL STUDIES

LEI IN COOPERATION WITH LITHUANIAN UNIVERSITIES
IMPLEMENTS JOINT DOCTORAL STUDIES IN THE
FOLLOWING SCIENCE FIELDS:



Energetics and Power
Engineering (T 006)



Environmental
Engineering (T 004)



Economics (S 004)

TECHNOLOGICAL SCIENCES,
two programmes in cooperation
with Kaunas University of Tech-
nology and Vytautas Magnus
University.

SOCIAL SCIENCES, one pro-
gramme in cooperation with
Kaunas University of Technolo-
gy and Klaipėda University.

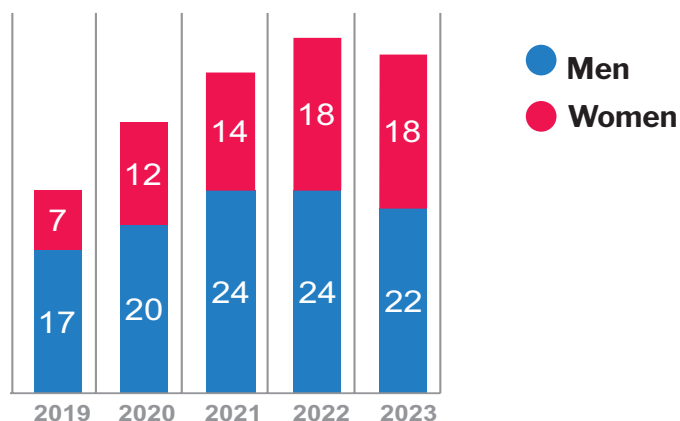
PhD STUDIES IN NUMBERS

During 1992-2023, 88 doctoral
theses have been defended at the
Lithuanian Energy Institute

In 2023, 8 doctoral students
have been admitted

By the end of 2023, 40 doctoral
students have been carrying
their studies

PhD STUDENTS DYNAMICS



DOCTORAL THESES DEFENDED IN 2023

Eimantas Neniškis

Thesis – “Integrated assessment of least-cost decarbonization pathways of transport and energy sectors” (Economics – S004). Scientific Supervisor – dr. Arvydas Galinis.

Gintaras Adžgauskas

Thesis – “Projection of hydropower resources of Lithuanian rivers in the context of climate change” (Environmental Engineering – T004). Scientific Supervisor – dr. Darius Jakimavičius.

Lina Vorotinskienė

Thesis – “Analysis of Chipped Wood Moisture Loss in Biofuel Reactors” (Energetics and Power Engineering – T006). Scientific Supervisor – dr. Nerijus Striūgas.

Inna Pitak

Thesis – “Solid recovered fuel: extraction from municipal solid waste and use in industry” (Environmental Engineering – T004). Scientific Supervisor – prof. dr. Gintaras Denafas.

CYSENI CONFERENCE

SINCE 2003 LEI ORGANISES ANNUAL INTERNATIONAL CONFERENCE OF YOUNG SCIENTISTS ON ENERGY ISSUES (CYSENI).

The main goal of the Conference is to discuss issues and perspectives of energy sector worldwide; as well as to allow young scientists to develop their skills and networking.

PhD students, postdocs, master students and all other young scientists doing research on energy issues are welcome to the Conference as speakers and participants.

From 2022 onwards, LEI organizes CYSENI conference together with the Lithuanian Research Centre for Agriculture and Forestry.



Participation in the Conference is free of charge



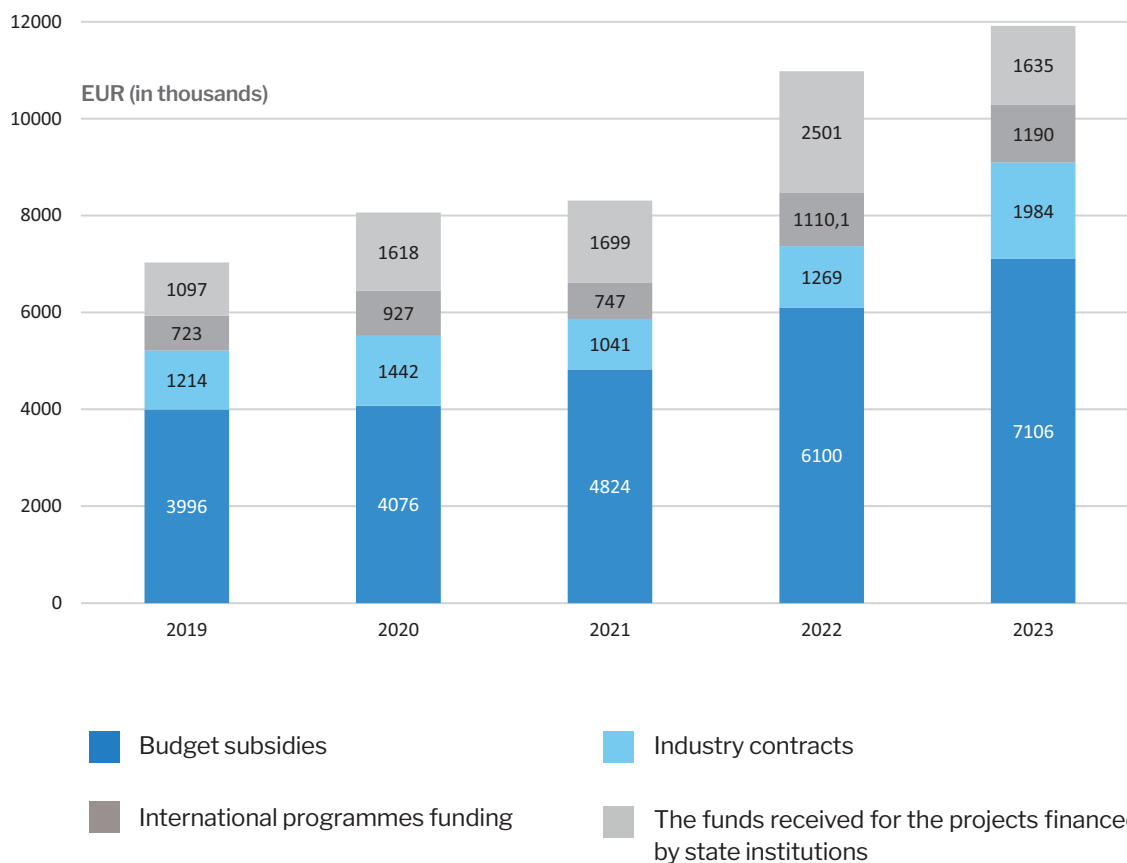
More information at

 www.cyseni.com

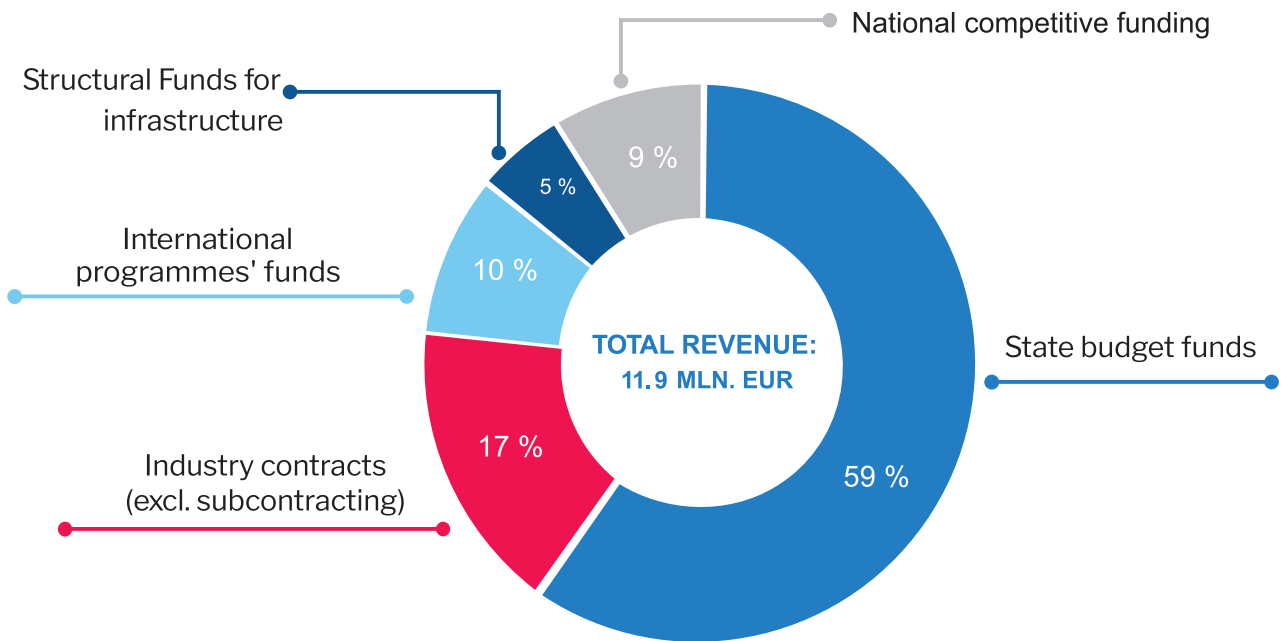
FINANCIAL ACTIVITY RESULTS

FINANCIAL DYNAMICS 2019-2023

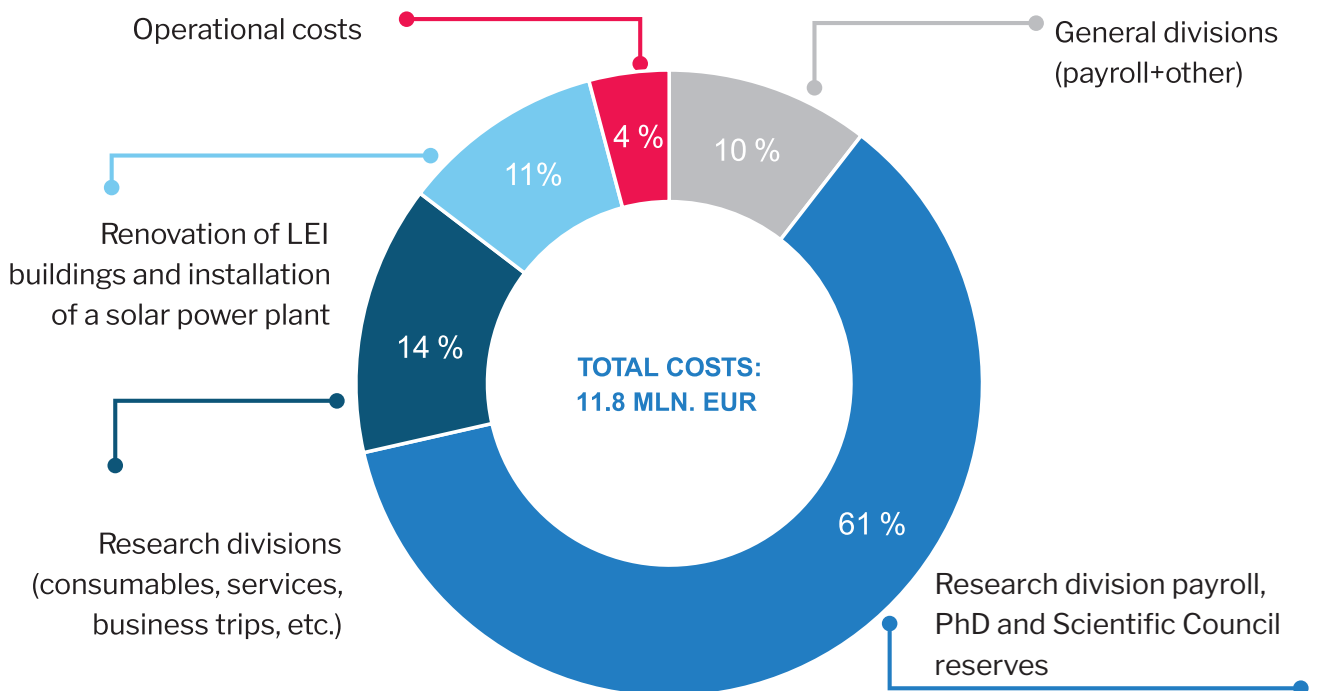
The institute's income has increased by 70% over the past five years. This was achieved due to increasing R&D funding from the State budget and more active participation of LEI researchers in national and international projects.



REVENUE STRUCTURE IN 2023



DISTRIBUTION OF COSTS IN 2023





COLLABORATION WITH BUSINESSES

31 contracts with business partners signed in 2023 (not including small orders).

The following new contracts are worth mentioning:

- With Ignalina NPP regarding the engineering services related to the dismantling of the reactor cores of the Ignalina nuclear power plant.
- With AB “Ignitis Group” for consulting and implementation services for innovative pilot projects.
- With AB “ORLEN Lietuva”:
 - I) regarding the updating and verification of the model of the T-1 speed control system of the thermal power plant.
 - II) for the nozzles of the heavy fuel oil sprayer.

Additionally, contracts with business partners from previous years were also executed. In 2023, projects funded by AB “Energijos skirstymo operatorius”, AB “ORLEN Lietuva”, AB “Litgrid”, AB “Amber Grid”, UAB “Sweco Lietuva”, Ignalina Nuclear Power Plant, UAB “Axioma Metering”, and other business partners were completed.



PARTICIPATION IN THE NETWORKS OF LITHUANIAN INDUSTRIAL ORGANISATIONS

Lithuanian Energy Institute is a member of:

- Lithuanian Confederation of Industrialists (LPK),
- Association LITBIOMA,
- Biopower Plants Development Cluster,
- Food Technologies Digitalization LT Cluster,
- Smart Energy DIH,
- Smart Technology Cluster (SMARTTA),
- Lithuanian Engineering Industries Association (LINPRA),
- Lithuanian Electricity Association (LEEAA),
- National Lithuanian Energy Association,
- National Defence Industries Association,
- Liquefied Natural Gas Cluster,
- International Energy Cluster,
- Hydrogen Energy Association,
- Hydrogen Platform,
- Lithuanian Nuclear Energy Association.





In 2023 three interinstitutional SANTAKA VALLEY projects were implemented:

- **Development of dose verification method in targeted particle therapy (RaDos)**, coordinated by G. Stankūnas (LEI), D. Vajauskas (LSMU), D. Adlienė (KTU).
- **Laser ablation of silicon nanoparticles and their use in charge-coupled devices for UV photon sensing (UVsense)**, coordinated by D. Gimžauskaitė (LEI), A. Lazauskas (KTU).
- **The use of nanotechnologies for the development of textiles with enhanced biosafety and medical applications (NANOTEXTILES)**, coordinated by D. Milčius (LEI), A. Giedraitienė (LSMU).



VYTAUTAS
MAGNUS
UNIVERSITY
MCMXXII



LITHUANIAN
ENERGY
INSTITUTE





In 2023 three interinstitutional RTO LITHUANIA projects were implemented:

- **Adapting urban green infrastructure to capture traffic related microplastic particles for a healthier urban environment (GREENURGI)**, coordinated by Algis Džiugys (LEI), Valda Araminienė (LAMMC), Steigvilė Byčenkienė (FTMC).
- **Application of labelled ^{13}C and ^{15}N isotope methods for research of climate change mitigation potential of recent winter wheat genotypes and common mugwort (Karbolzotopas)**, coordinated by Stasė-Irena Lukošiuūtė (LEI), Monika Toleikienė (LAMMC), Rūta Barisevičiūtė (FTMC).
- **Sensor-based assessment of the effects of different types of zinc nanoparticles on leafy beet (AgroNanoSens)**, coordinated by Simona Tučkutė (LEI), Rūta Sutulienė (LAMMC), Rasa Pauliukaitė (FTMC).



OBJECTIVES AND TASKS OF LEI. PERFORMANCE EVALUATION CRITERIA

The strategic objectives of LEI activities are as follows:

- Conduct both fundamental and applied research and development work at the international level;
- Train specialists of the highest qualifications for the development of research in the energy field.

For the attainment of these objectives, two tasks for continued activities have been set. The tasks and measures planned under them are as follows:

1. Create high level knowledge that increases the country's competitiveness.
Measure 1.1 – Conduct R&D in the areas of energy, thermal engineering, environmental engineering, and energy economy;
2. Increase the efficiency of doctoral studies.
Measure 2.1 – Ensure preparation and completion of doctoral theses.

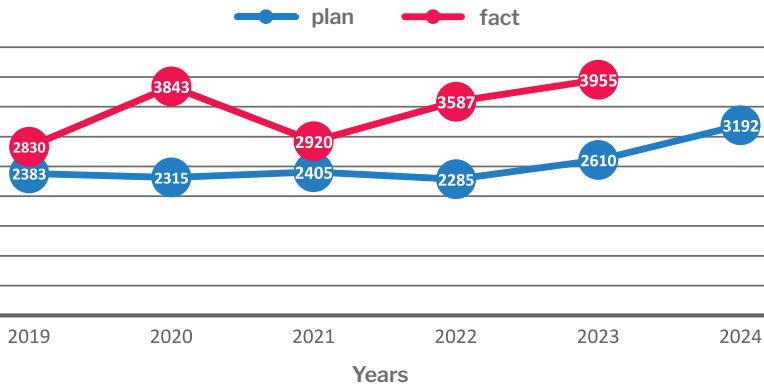
LEI has implemented a Quality and Environmental Management System that meets the requirements of the international standards ISO 9001:2015 and ISO 14001:2015. A key performance indicator's (KPI) system is used for monitoring progress in the attainment of the LEI's objectives and tasks and for controlling the efficiency of activities. The system comprises key indicators focussed on the final result and included in LEI's Strategic Plan of Activities (SVP), as well as additional indicators the monitoring of which contributes to the improvement in activity planning and a smoother process of attainment of the objectives, tasks and key indicators. The indicators are focused on the development of the international dimension, creating new scientific knowledge, commercialisation of research results, and attracting new talented researchers to the Institute. The application of the KPIs covers all research divisions of LEI, and they are planned and monitored according to the Institute's Quality Management System.

LEI tasks, measures and key performance indicators for 2019-2024 (SVP indicators – on blue background)

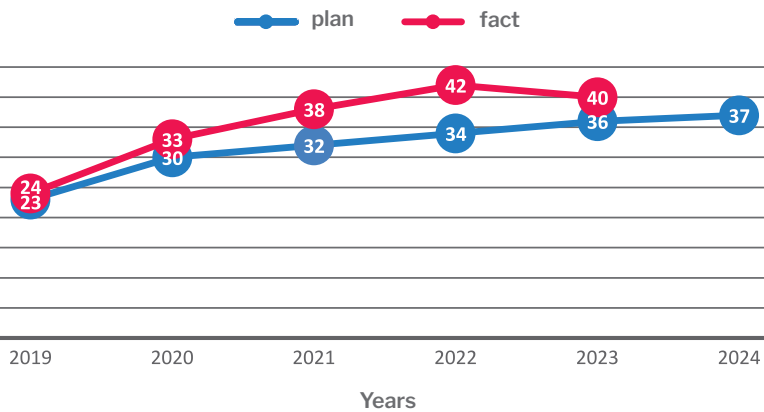
LEI tasks & measures	Key performance indicators (KPI)	2019	2020	2021	2022	2023	2024 target
Task 1. Create high level scientific knowledge that increases the country's competitiveness.	New projects under international programmes launched in the current year, number	10	11	4	9	7	8
	<i>Additional indicator:</i> Number of project applications submitted to international programmes	25	31	23	35	41	17
Measure 1.1 – Conduct R&D in the areas of energy, thermal engineering, environmental engineering, and energy economy	Number of articles in journals referred to in Clarivate Analytics WoS list (Q1-Q3) per scientist	0.35	0.5	0.60	0.69	0.65	0.73
	% share of articles in journals referred to in Clarivate Analytics WoS, in quartiles Q1 and Q2 (from 2019)	79.7	79	77.5	76.5	84.6	75
	<i>Additional indicators:</i>						
	Number of articles submitted to journals referred to in Clarivate Analytics WoS list (Q1-Q3) per scientist	0.74	0.65	0.93	0.96	1.30	1.02
	Funds from contracts, EUR '000	2830	3843	2920	3586	3955	3192
	Funds for the improvement of research infrastructure, EUR '000	129	210	251	459	574	195
	Number of papers at international scientific conferences, per scientist	0.72	0.31	0.76	0.92	0.79	0.53
Task 2: Increase the efficiency of doctoral studies	Successful completion of doctoral studies, %	44	57	33	50	60	75
Measure 2.1: Ensure preparation and completion of doctoral theses	Number of doctoral students	24	33	38	42	40	41
	Number of doctoral theses defended during the year	4	4	1	1	4	7
	<i>Additional indicator:</i> Number of doctoral students admitted	10	12	7	10	8	10

Selected LEI planned and achieved key performance indicators for 2019–2024

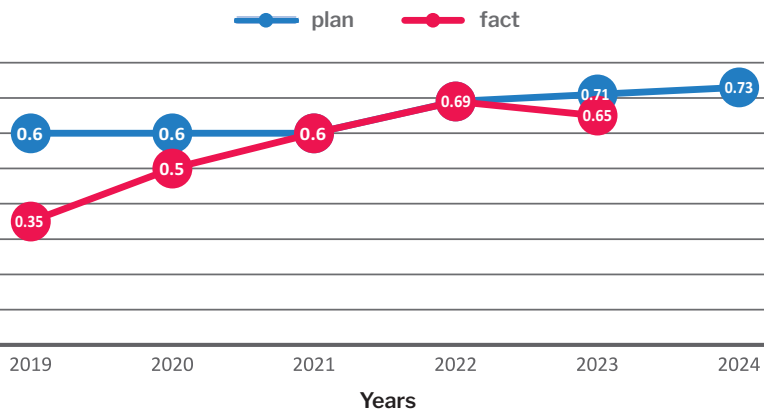
Contracts, thous. EUR



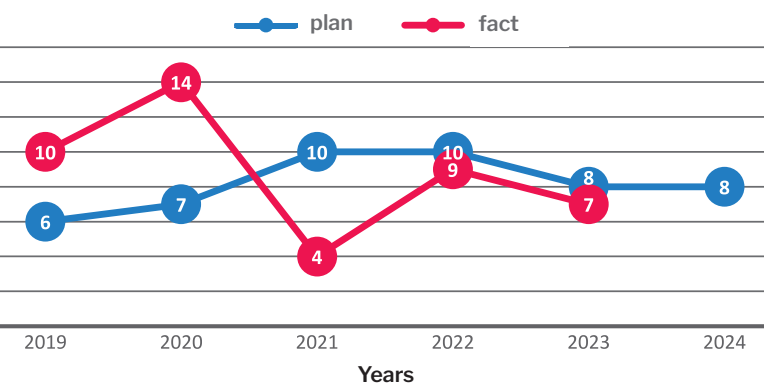
Number of PhD students



Number of articles in journals referred in Clarivate Analytics WoS list (Q1-Q3) per scientist



New projects under International research programmes



ACHIEVEMENTS OF RESEARCH DIVISIONS

RESEARCH DIVISIONS OF THE LITHUANIAN ENERGY INSTITUTE:

- Center for Hydrogen Energy Technologies
- Laboratory of Energy Systems Research
- Smart Grids and Renewable Energy Laboratory
- Laboratory of Combustion Processes
- Plasma Processing Laboratory
- Laboratory of Materials Research and Testing
- Laboratory of Heat-Equipment Research and Testing
- Laboratory of Hydrology
- Laboratory of Nuclear Installation Safety
- Nuclear Engineering Laboratory

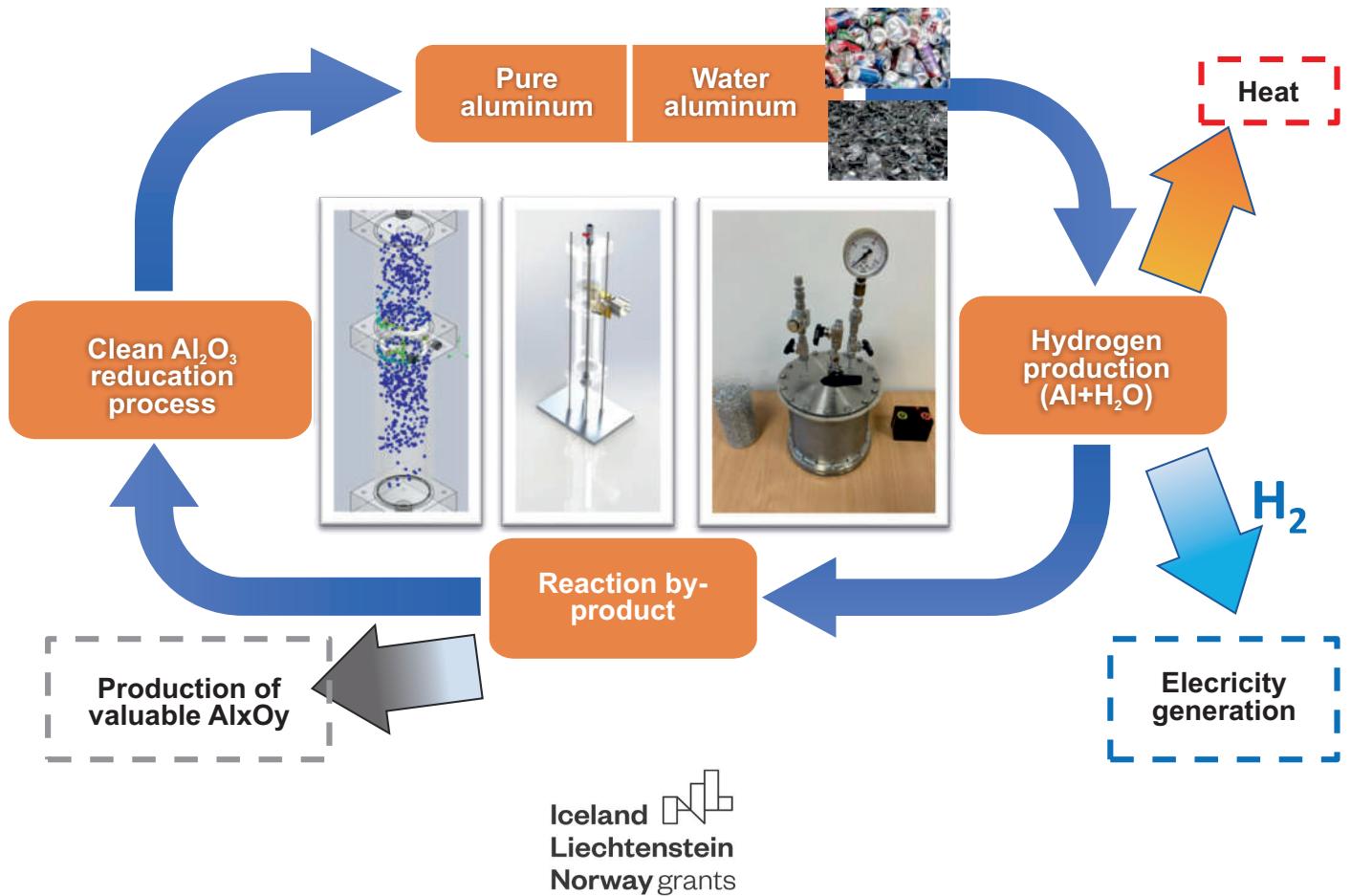
HYDROGEN RESEARCH AND NANOTECHNOLOGIES

CENTER FOR HYDROGEN ENERGY TECHNOLOGIES

MAIN RESEARCH AREAS OF THE CENTER

- Research in the field of hydrogen energy technologies.
- Synthesis of hydrogen separation membranes and analysis of their properties.
- Hydrogen production using water reactions with metals and nanoparticles of their alloys.
- Synthesis of metals and their alloy hydrides designed for hydrogen storage: analysis of their properties.
- Synthesis of hydrogen fuel cell components (anodes/electrolytes/cathodes) applying physical vapour deposition methods.
- Synthesis of catalytic materials for enhanced hydrogen production.
- Synthesis and analysis of photocatalytic materials.
- Application of physical vapor deposition methods for thin films formation and surface modification.
- Surface modification of various materials by application of glow discharge plasma.

Prototyping: project – Aluminum in circle economy – from waste through hydrogen energy to alumina (ALICE-WHY)



During the Alice-Why project (Baltic Research Programme), a prototype is being developed at CHET. It is expected that a single reaction involving 20 grams of waste aluminum would generate up to:

- I) 30 Wh of electricity;
- II) 11.5 Wh of heat energy;
- III) 50 g of by-product, which would be recycled into clean aluminium.



LATVIJAS UNIVERSITĀTES
CIETVIĒLU FIZIKAS INSTITŪTS
INSTITUTE OF SOLID STATE PHYSICS
UNIVERSITY OF LATVIA



UNIVERSITY
OF ICELAND





ENERGY SECTOR DEVELOPMENT ANALYSIS

LABORATORY OF ENERGY SYSTEMS RESEARCH



MAIN RESEARCH AREAS OF THE LABORATORY

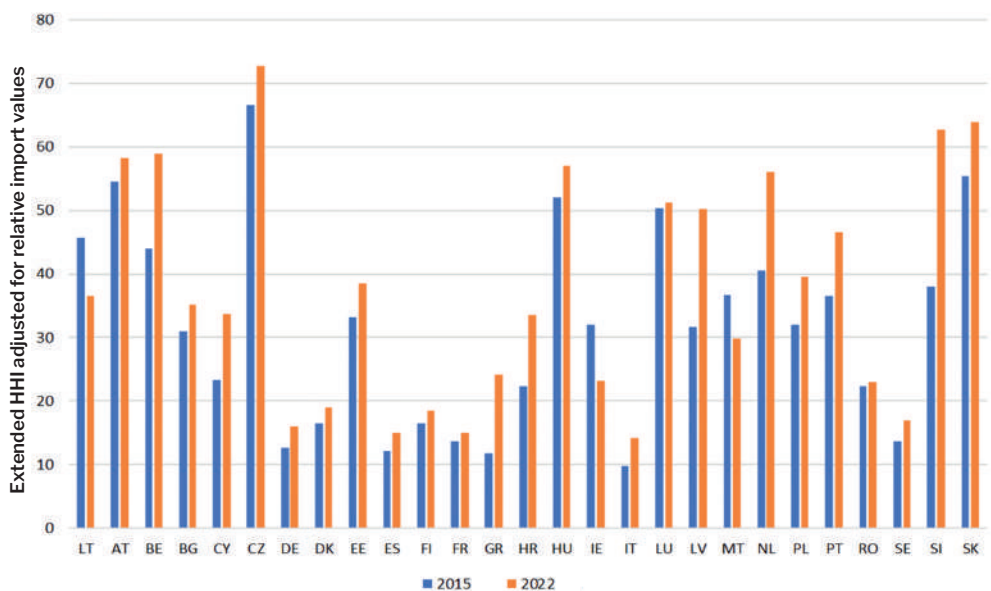
- Economic modeling at the micro and macro level. Analysis and solutions of economic and social problems. Development and application of various types of economic models (microsimulation, input-output, general equilibrium).
- Analysis of optimal allocation of generation, reservation and balancing capacities in energy systems and interconnectors. Elaboration of optimal approaches for balancing intermittent energy generation from renewable energy sources.
- Transport decarbonisation research. Investigation of possibilities to balance intermittent electricity generation from renewable energy sources by means of smart charging of electric vehicles and alternative fuel production.

Development of a universal system (methodology and analytical tools) for assessing import diversification and its economic impact

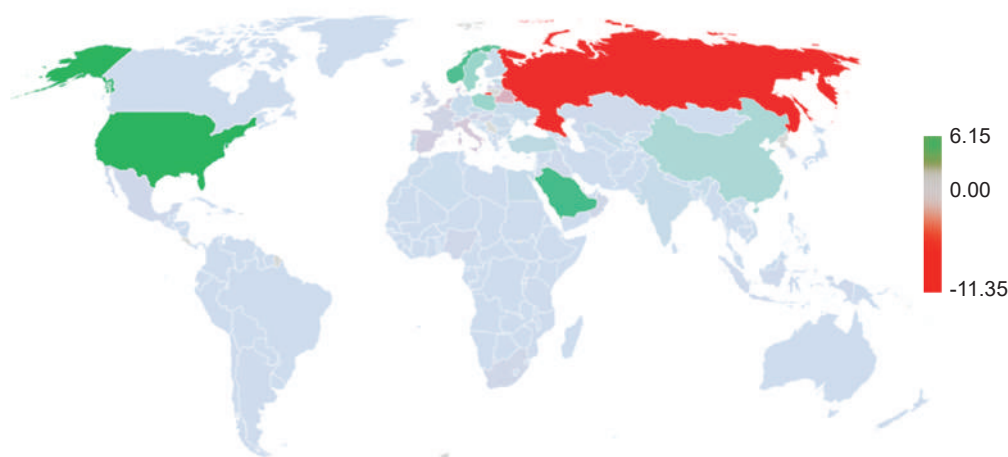
The developed framework for evaluating import diversification and its economic implications enables the identification of risks associated with import concentration. It empowers decision-makers to implement timely measures aimed at mitigating the risks linked to import dependency.

This framework encompasses methods and analytical tools for conducting a thorough analysis of imports. It complements the calculation of direct import diversification indicators with input-output analysis which allows the impact of import shocks to be assessed and indirect import flows to be evaluated. This proves beneficial not only for analysing primary import sources but also for understanding complex supply chains.

Integration with publicly available and continually updated data sources ensures the long-term usability of the developed analytical tools for import analysis and policymaking.



EU imports assessed by Herfindahl-Hirschman Index (HHI), supplemented by an estimate of political stability and adjusted for relative import values. Higher values indicate higher risks.



Changes in Lithuania's import partner structure from 2015 to 2022 (in percentage points)



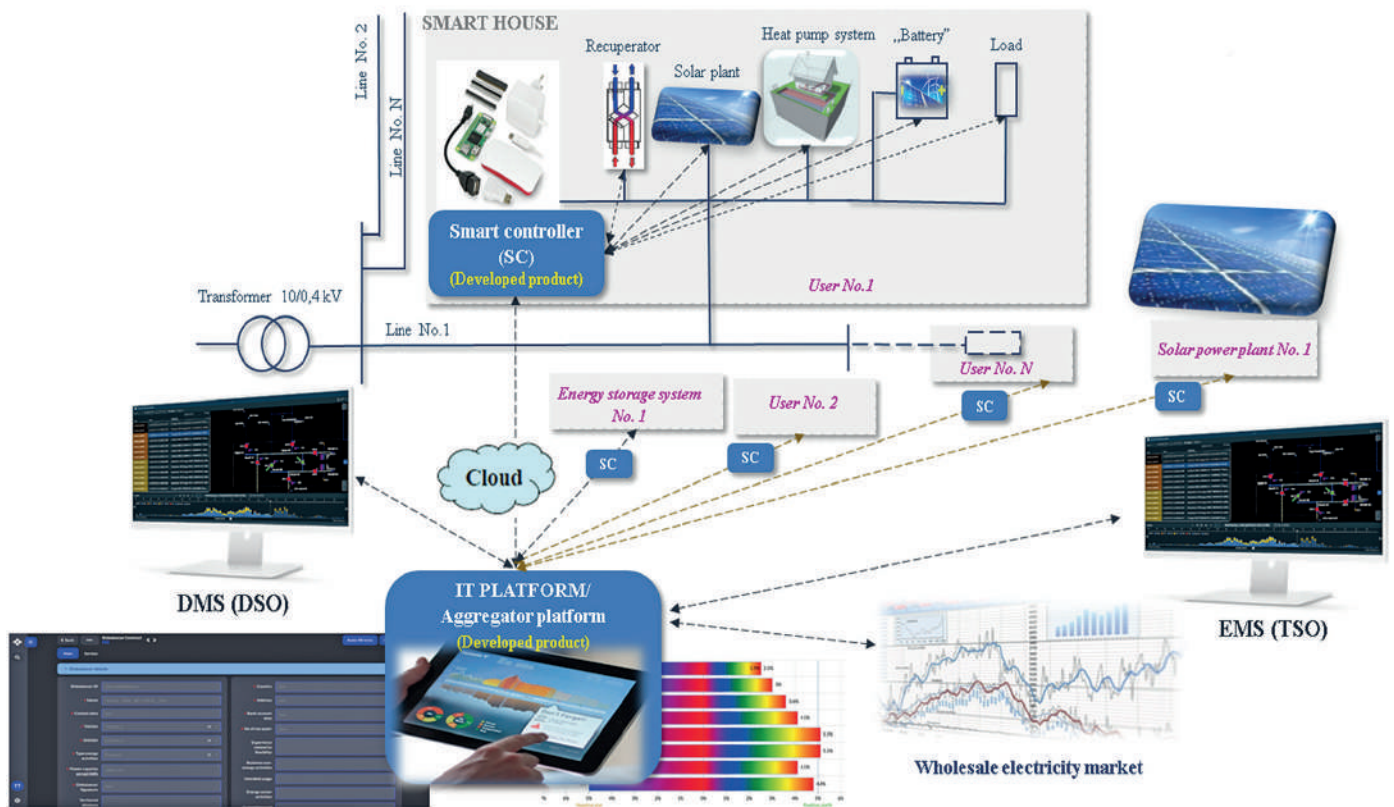
CONTROL OF ENERGY SYSTEMS

SMART GRIDS AND RENEWABLE ENERGY LABORATORY

MAIN RESEARCH AREAS OF THE LABORATORY

- Mathematical modelling of power systems and networks, investigation of their control issues;
- Modelling and optimisation of ICT-based control systems of power systems;
- Research of integration of renewable energy sources (wind, solar, etc.) and distributed generation into power systems.

FLEXENPLAT IT platform and smart controller commercialized



DSO – Distribution system operator
TSO – Transmission system operator

DMS – Distribution Management System
EMS – Energy Management System

The SMART FDI project “Development and demonstration of an integrated smart ecosystem”, funded by Lithuanian Innovation Agency, implemented together with the Energy Ideas Group UAB, has developed FLEXENPLAT IT platform and a smart controller to be deployed at the energy user sites and at RES plants. The embedded AI algorithms provide additional possibilities for user loads, electricity storage systems and RES plants to participate in management of power systems and grids. The practical implementation of this project solutions will extend the integration of new amounts of RES, reduce their payback time and thus CO₂ emissions from energy sector, increase competition between independent electricity suppliers and load aggregators, offer electricity at a more attractive price for the final users, and provide additional services to grid operators thus reducing the costs of power system performance and increasing system’s operational stability and reliability in transition to green electricity future.

Project duration – 29 months (26/03/2020 – 07/09/2023).

The commercial product developed by the project can be purchased by market players in the energy sector.



The European certificate of completion of IT Platform's prototype demonstration project





COMBUSTION RESEARCH

LABORATORY OF COMBUSTION PROCESSES

MAIN RESEARCH AREAS OF THE LABORATORY

- Investigation of gaseous, liquid and solid fuels combustion processes;
- Development and optimization of industrial combustion devices;
- Thermochemical (gasification, pyrolysis, carbonization) processing of biomass and non-hazardous waste;
- Liquid and gaseous biofuel synthesis research.

Investigations of combustion and other thermochemical processes in order to valorize a biomass and waste usage for alternative biofuels and production of chemicals, reduce the environmental emissions and increase technology efficiency.

Implementation of the project “AXIS Tech R&D activities for the development of innovative solutions for renewable energy technologies” (No 13.1.1-LVPA-K-856-01-0098)

Developed and tested AXT_BioT agro biomass combustion technology ensuring low fluidized bed temperatures (650 – 750 °C) and high level of alkali metal binding into the bed layer without fluidized bed agglomeration. The technology ensures combustion of various fraction fuel – chopped up to 2 mm or pelletized.



Rice husk



Smashed
corn cob



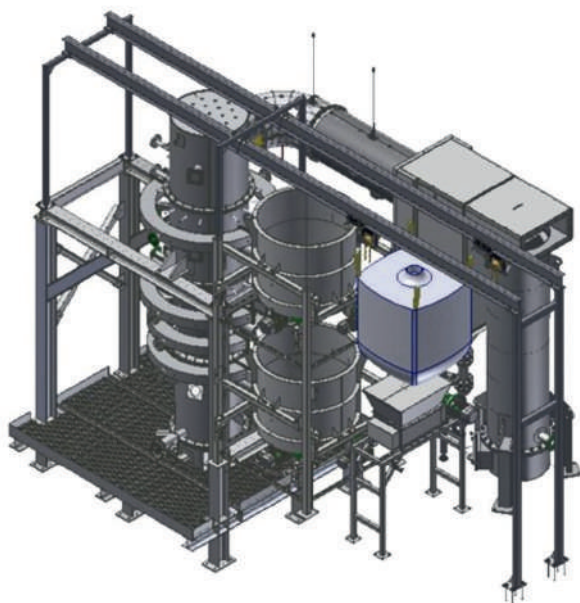
Grain waste



Nutt shells



Logging waster



The total value of the project is 1 801 276.07 EUR (LEI – 180 997.47 EUR)
The European Regional Development Fund has allocated funding of EUR 1 043 050.37 to the project.
The applicant's and partners' own funds – 758 225.70 EUR.



Kuriame
Lietuvos ateitį
2014–2020 metų
Europos Sąjungos
fondų investicijų
veiksmų programa



AXIS Tech



LITHUANIAN
ENERGY
INSTITUTE





PLASMA PROCESSING AND APPLICATION

PLASMA PROCESSING LABORATORY

MAIN RESEARCH AREAS OF THE LABORATORY

- development and research of DC plasma sources for wide range of applications
- research of processes and phenomena taking place in discharge channels, exhaust plasma jets and flows
- diagnostics of plasma and high-temperature flow and development of diagnostic measures
- research on interaction of plasma jets and substances in various plasma-technological processes
- generation of water vapor plasma and its application for fuel conversion and neutralization of hazardous waste
- research and implementation of plasma neutralization process of hazardous substances
- synthesis of catalytic and tribological coatings in plasma ambient and analysis of their properties
- research of thermal and heterogeneous processes for reacting product flowing around catalytic surface
- formation and modification of constructional material surfaces in plasma
- synthesis of micro- and nano- dispersed granules and mineral fiber from hardly meltable materials and analysis of their properties

Development of gliding arc discharge plasma system for the treatment of marine microalgae

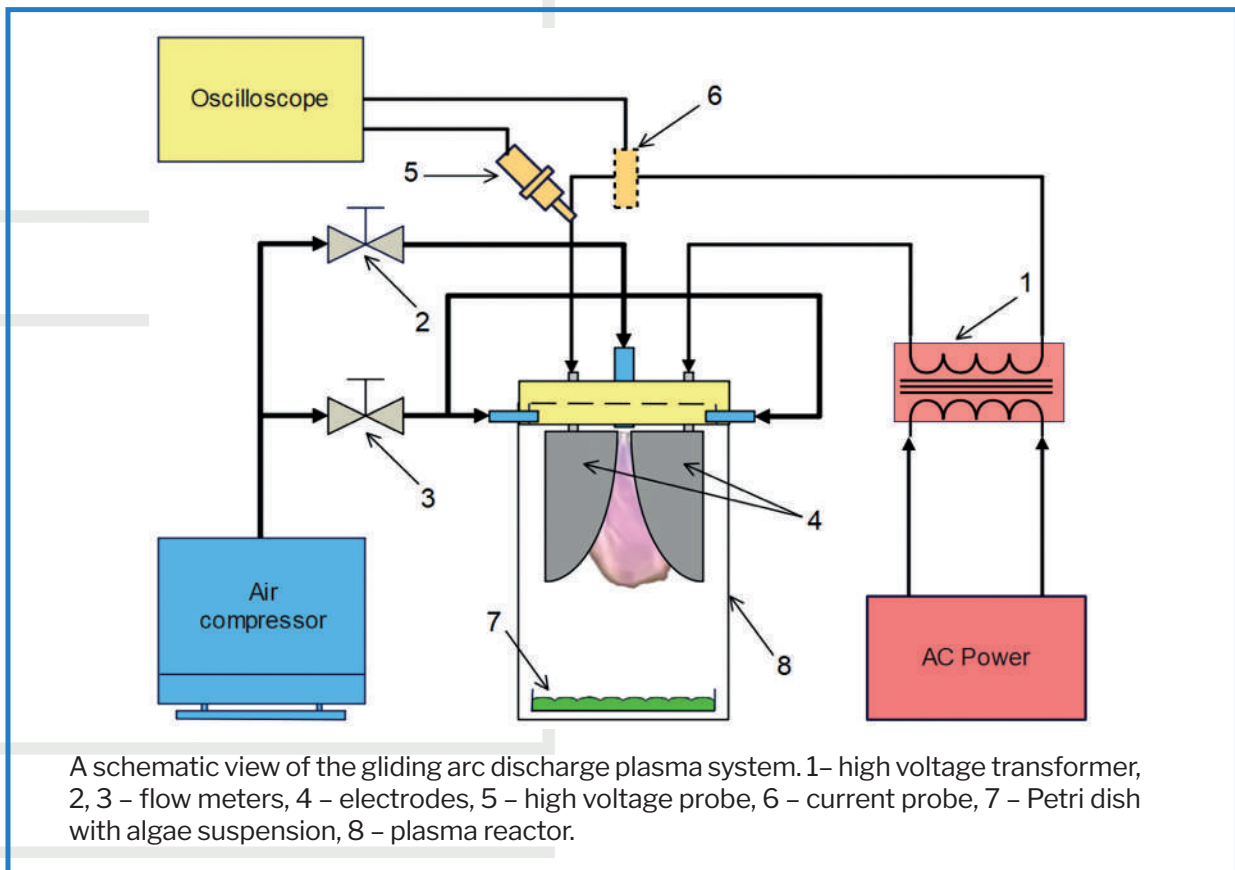
Novel device

- The gliding arc discharge plasma system was developed.
- Investigation of electrical characteristics of the gliding arc discharge plasma.
- Plasma diagnostics was carried out.

Applications

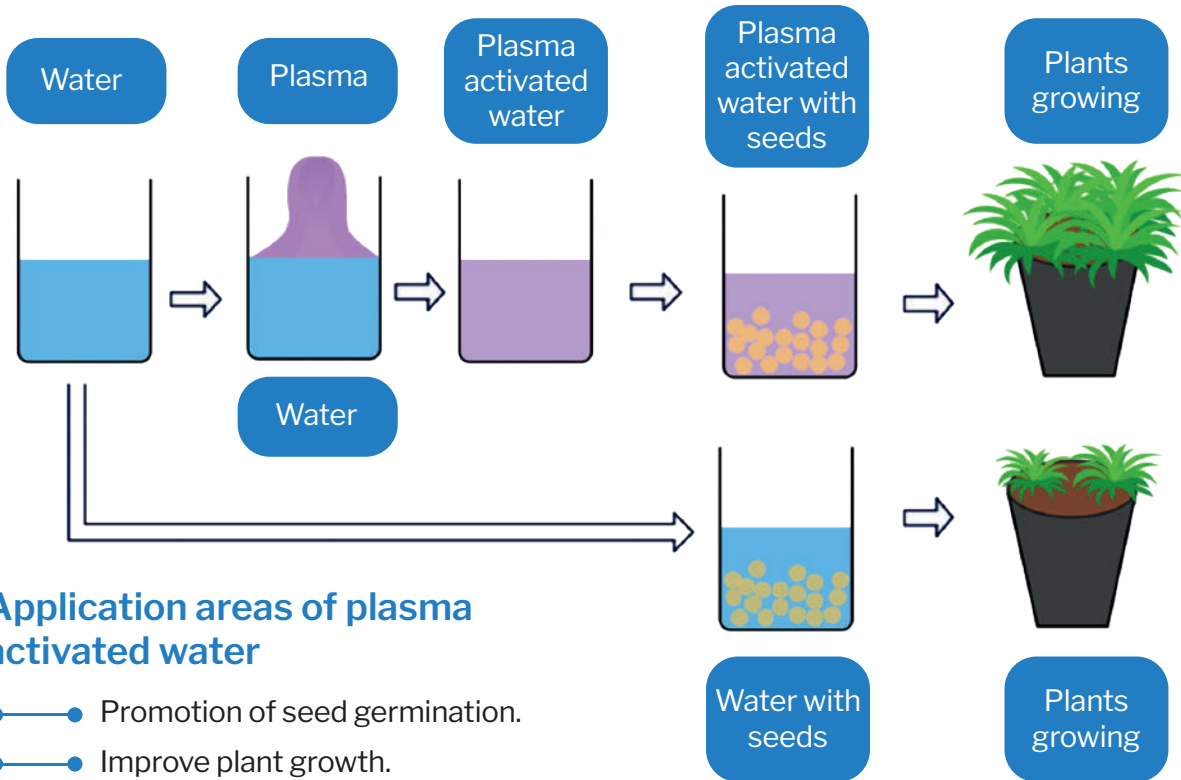
- Treatment of marine microalgae.
- Production of plasma activated water.
- Determination of plasma activated water physicochemical properties.

Title of the project: “The development of plasma and pulsed electric field technologies for the treatment of the marine algae”.



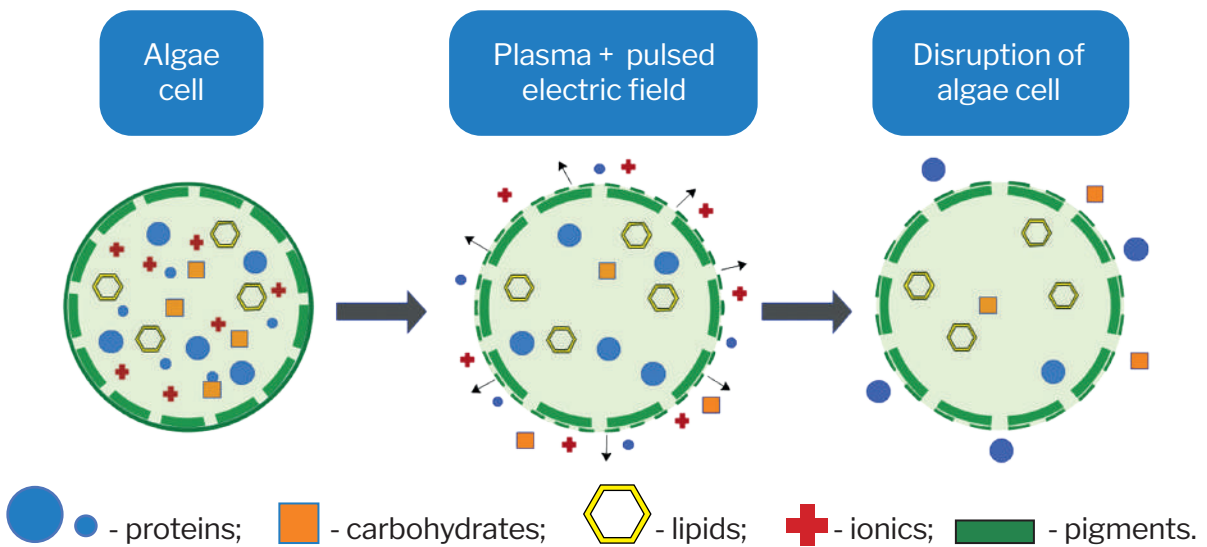
A schematic view of the gliding arc discharge plasma system. 1- high voltage transformer, 2, 3 - flow meters, 4 - electrodes, 5 - high voltage probe, 6 - current probe, 7 - Petri dish with algae suspension, 8 - plasma reactor.

Production of plasma activated water and treatment of seeds



Application areas of plasma activated water

- Promotion of seed germination.
- Improve plant growth.
- Control of plant diseases.
- Food disinfection.
- Healing and treatment of chronic wounds.







MATERIALS RELIABILITY

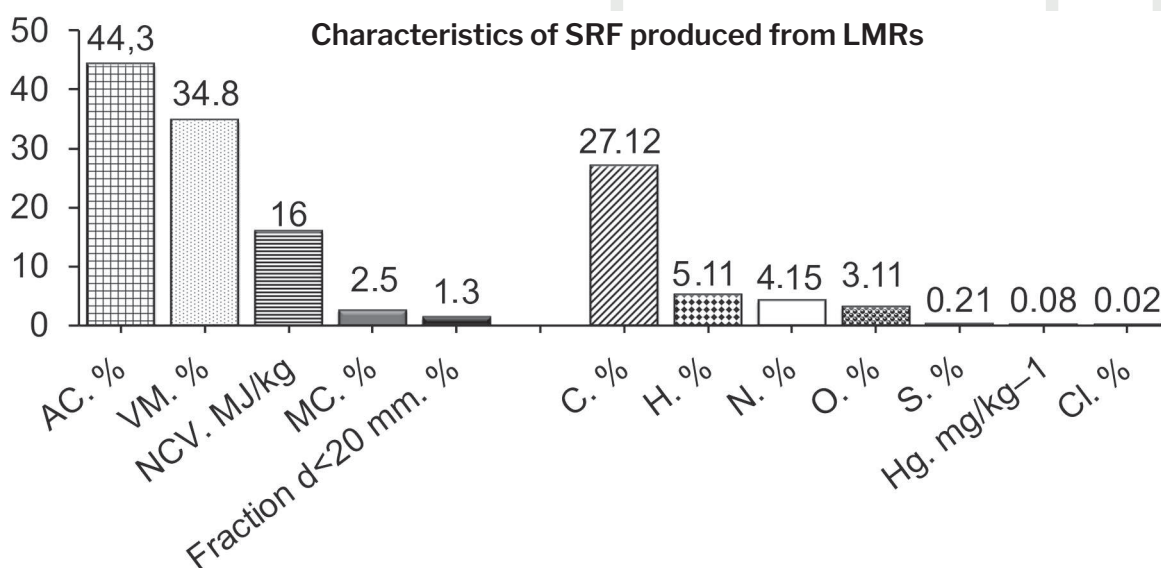
LABORATORY OF MATERIALS RESEARCH AND TESTING

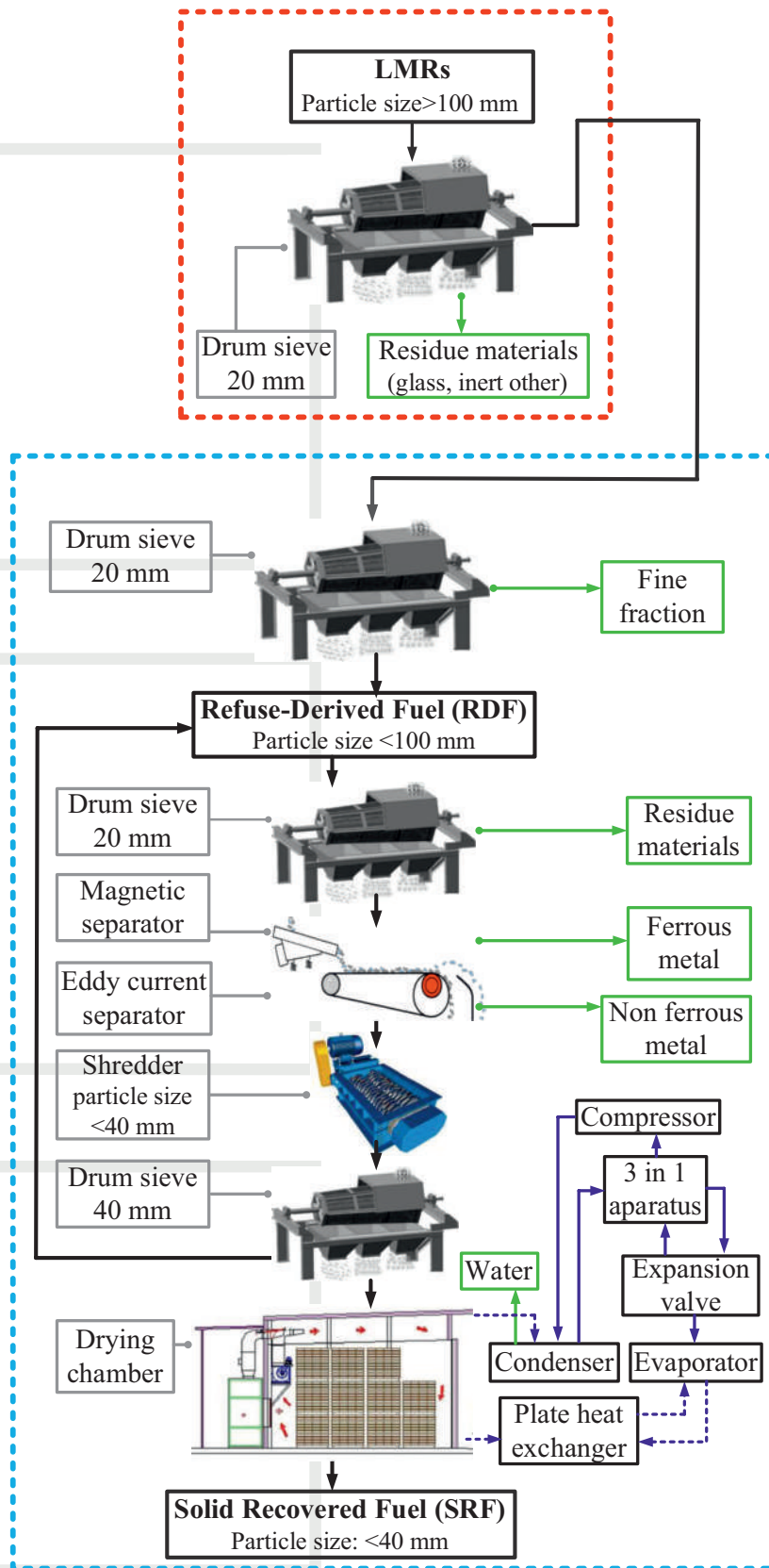
MAIN RESEARCH AREAS OF THE LABORATORY:

- Reliability of power plant facilities: research of metal aging processes and degradation of properties due to the impact of operational factors;
- Development and research of multifunctional materials and composites;
- Testing of materials, assessment and analysis of their qualitative indicators.

Development of Solid Recovered Fuel production line from Landfill Mined Residues

According to the projects “Possibilities and sustainability model of recovery of energy resources from landfills (ISLAND)” and “Model of resource recovery from landfills assessment and its testing in Lithuanian conditions”, there was developed a two-stage mechanism of Landfill Mined Residues (LMRs) extraction and further Solid Recovered Fuel (SRF) production. When using the developed SRF production line, alternative fuel that can be used as a replacement fuel in energy-intensive industries was obtained.





- 1st stage of separation, landfill
- 2^d stage of separation, MBT
- Air
- Refrigerant
- Materials flow
- Residual materials



FLUID DYNAMICS AND METROLOGY RESEARCH

LABORATORY OF HEAT-EQUIPMENT RESEARCH AND TESTING

MAIN RESEARCH AREAS OF THE LABORATORY

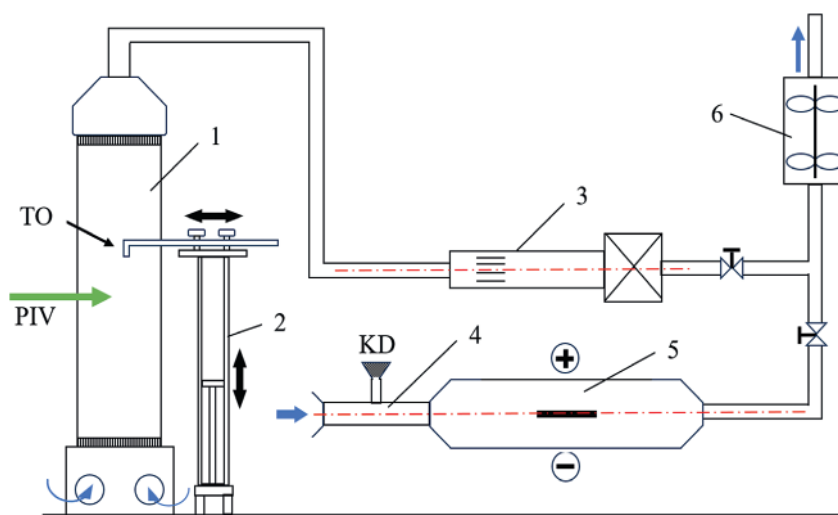
Processes and technologies for the efficient use of Renewable Energy Sources and reduction of environmental pollution:

- physical and thermal properties of solid biomass and recovered fuel
- fuel preparation methods and technologies
- thermal conversion processes (combustion, gasification) of solid fuel
- solid biofuel drying
- solid biofuel dynamics and thermal conversion on moving grate and in fluidized bed
- emission formation processes in heating appliances
- efficiency of low capacity boilers and heating appliances fired by solid fuel

Thermal physics, fluid mechanics and metrology:

- flows mixing in chambers of limited dimensions and various geometry
- permeability of gas mixtures through membranes
- particulate emission reduction
- flow dynamics in elastic channels
- ultrasound propagation in flows
- heat and mass transfer by molecular dynamics
- maintenance of five national flow and pressure standards and assurance of measurement traceability

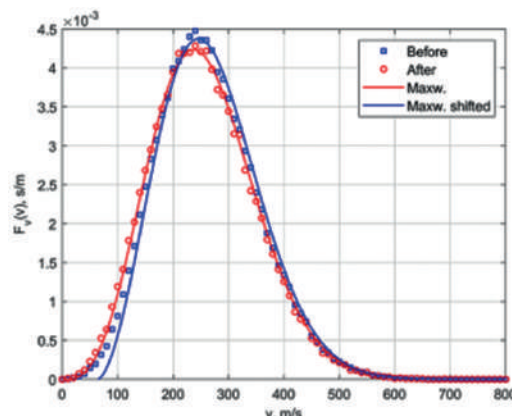
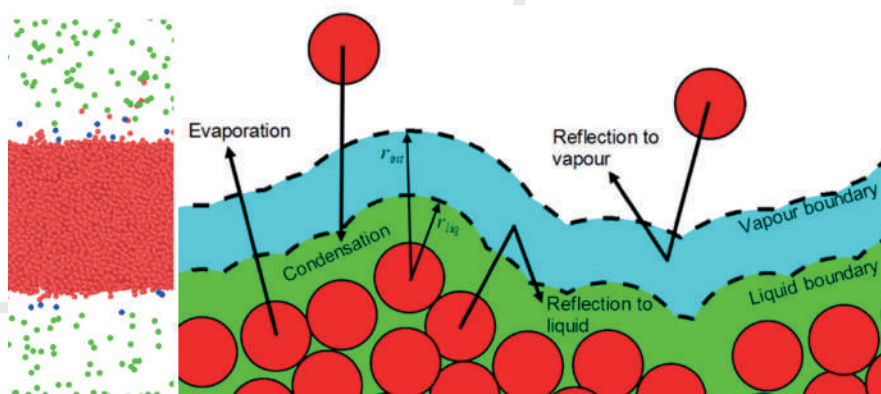
Development of experimental base Installation for air flow structure and PM agglomeration research



1 – vertical channel with particle movement visualization system - PIV; 2 – control device of test object (TO); 3 – section for air flow meter; 4 – section for solid particle (PM) injection; 5 – bipolar PM agglomerator; 6 – fan

Advances in fundamental sciences

- A new concept of molecular interaction between liquid Argon and its vapor in the interphase layer was developed.





HYDROLOGY RESEARCH

LABORATORY OF HYDROLOGY

MAIN RESEARCH AREAS OF THE LABORATORY OF HYDROLOGY

- Research of river runoff and hydrological extremes in the context of climate change;
- Research of wave, hydrodynamic, and sediment processes in water bodies;
- Research of environmental impact of energy and transport objects;
- Research of river hydromorphology by direct measurements and remote sensing methods.

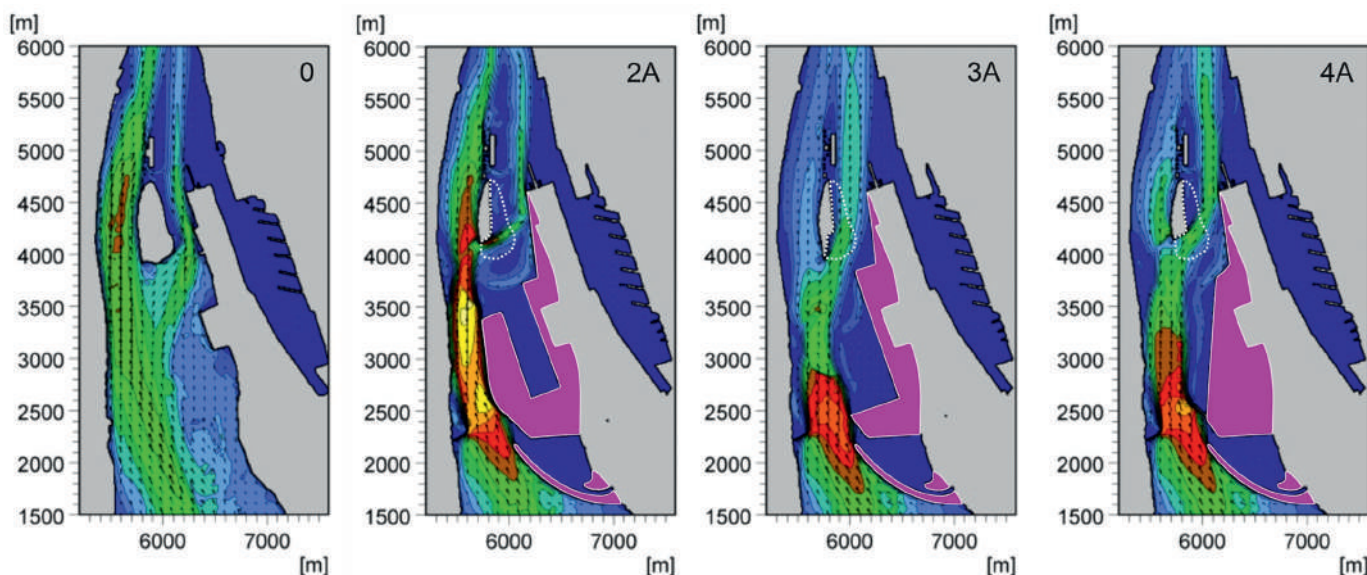
Applying the MIKE 21 numerical modelling system, the impact of the southern expansion of the Klaipėda port territories (three alternatives) on hydrodynamic and sediment transport processes, water salinity and wave propagation in the Klaipėda Strait and the northern part of the Curonian Lagoon was determined. Alternative 4A is proposed for implementation (see the image below), which is an intermediate alternative between the remaining two alternatives in terms of the deepening of the port's water area and the size of the newly formed land territory.

The project “Environmental impact assessment of the development of the southern part of the Klaipėda state seaport”.

Project funding: Klaipėda State Seaport Authority.

Project implementers: UAB “Sweco Lietuva”, Lithuanian Energy Institute, Klaipėda University.

Project manager in LEI: dr. Jūratė Kriauciūnienė.

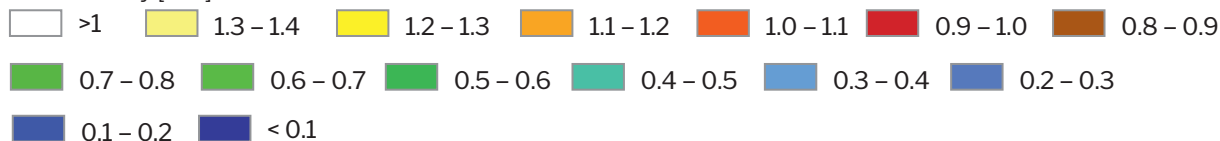


Flow structure of the Klaipėda port area for Alternatives 0, 2A, 3A and 4A, when the water discharge of 2700 m³/s is directed from the Curonian Lagoon to the Baltic Sea

Proposed solutions



Flow velocity [m/s]





SAFETY AND RELIABILITY STUDIES OF ENERGY AND INDUSTRIAL FACILITIES

LABORATORY OF NUCLEAR INSTALLATION SAFETY

MAIN RESEARCH AREAS OF THE LABORATORY:

- Smart cities (integration of heat/electricity/hydrogen/RES/new technologies, district heating modernization, economic evaluation of alternatives, climate neutral/green deal, energy accumulation, digitization)
- Nuclear energy (small modular reactors, assessment of safety, risks and structural integrity of nuclear facilities, development of new nuclear technologies, decommissioning of nuclear facilities)
- Activities under the European Organization for Nuclear Research CERN (particles transport simulations, analysis of radiation processes, material activation calculations, nuclear and particle physics, participation in CERN Baltic Group activities)
- Thermonuclear fusion energy (development of new fusion technologies, international cooperation, experience in EUROfusion activities >9 yrs)
- Multiphase flows (thermal devices, efficiency, accidents, phase transitions, turbulence, flame propagation, gas explosions, water hammer)



Applied scientific research in cooperation with business and creating innovations

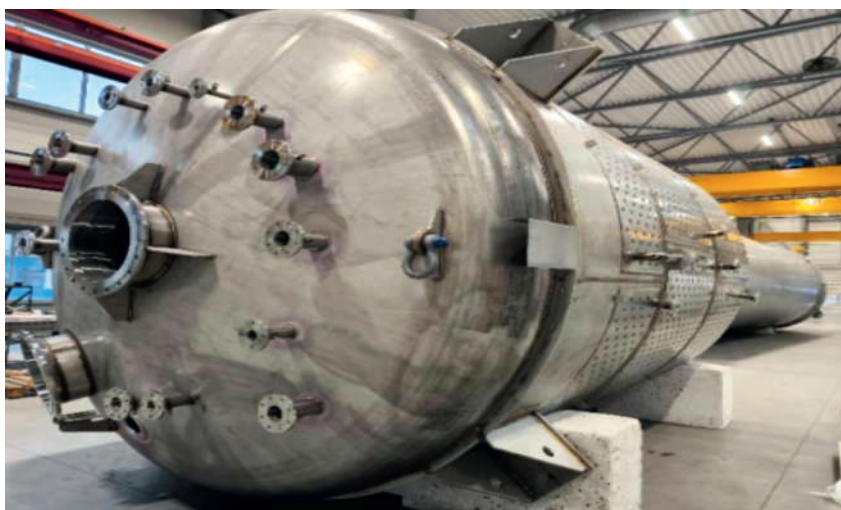
Investments in research and experimental development of very large tanks and reactors with cavitation mixing (Nr. 01.2.1-LVPA-K-856-01-0099), 2020-2023

The project was implemented by Astra LT AB together with partner LEI.

The world-class innovations developed and implemented during the project enabled the production of new products – fully manufactured very large tanks and reactors. These innovative products, based on joint cooperation and co-created innovations, open up new opportunities for Astra LT AB to enter the market and create significantly higher added value.

Contribution of Laboratory scientists:

- modelling and analysing of heat and mass transfer processes during natural convection and mixing;
- numerical studies on structural integrity of tanks, reactors and their components to approve their designs' suitability, strength and reliability for operation.





Funded by the European Union

Active participation in H2020 & Horizon Europe programmes projects

Finished 3



Continued 4



Coordinated by LEI

New 2



Applications 5

GREENWISE

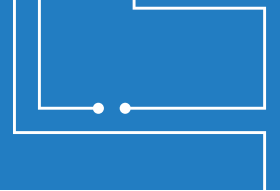
INNOMUSA

EASI - SMR

ISAHEAL

ICARUS+





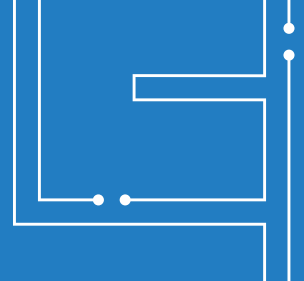


NUCLEAR AND THERMAL ENGINEERING

NUCLEAR ENGINEERING LABORATORY

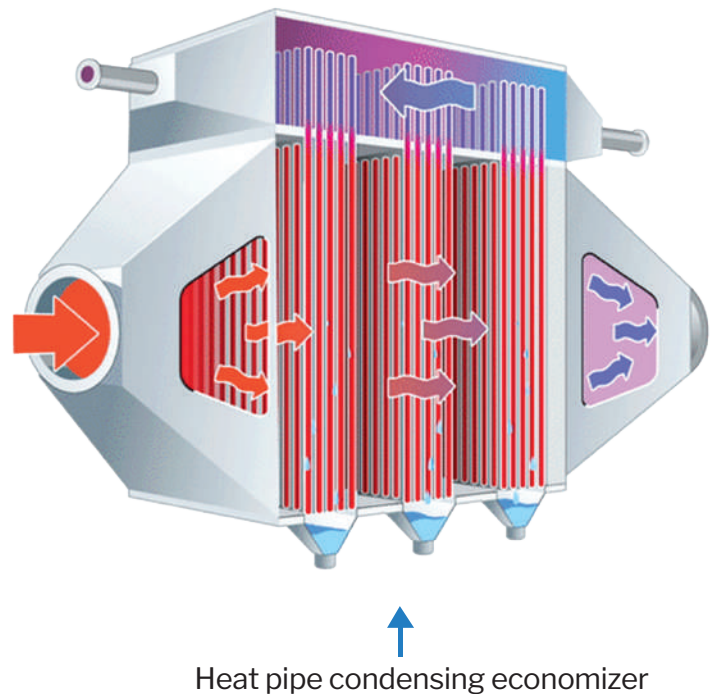
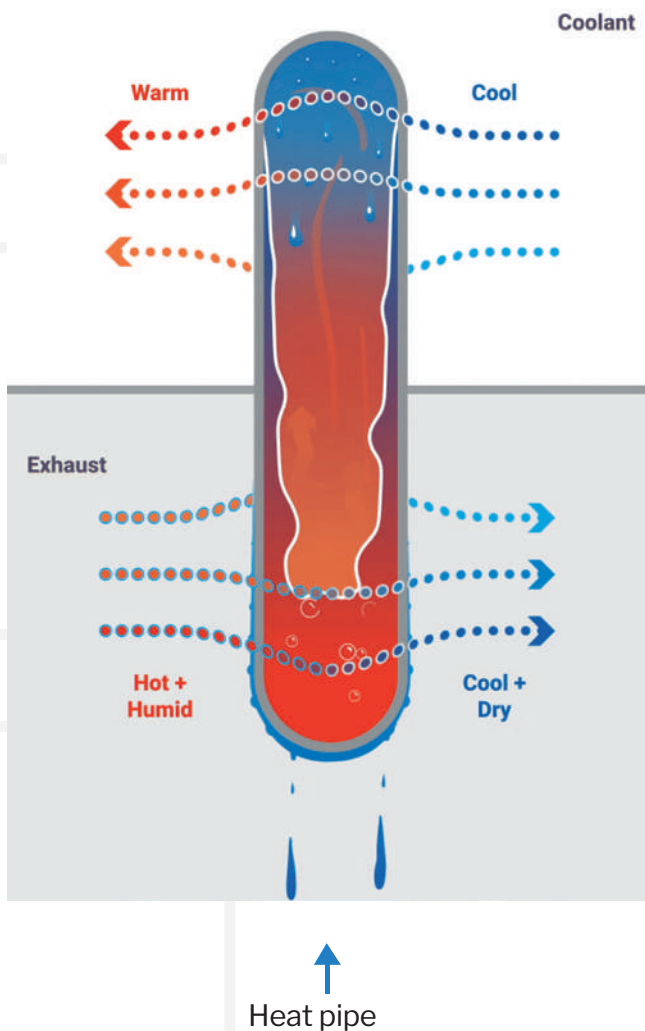
MAIN RESEARCH AREAS OF THE LABORATORY

- Safety of spent nuclear fuel management
 - Interim storage
 - Disposal in deep geological repositories
- Safety of radioactive waste management
 - Treatment
 - Temporal and interim storage
 - Disposal in near-surface repositories
- Assessment of different factors related to decommissioning of nuclear facilities using DECRA (LEI) software
 - Strategy selection
 - Safety assessment
 - Assessment of dose rates to workers and residents
 - Evaluation of radwaste qualities, labor cost, dismantling duration, etc.
- Waste heat recovery from flue gases during biofuel combustion and reduction of the amount of emissions from the exhaust
- Investigation of heat transfer and hydrodynamic processes in various systems and their components
- Fire safety investigation



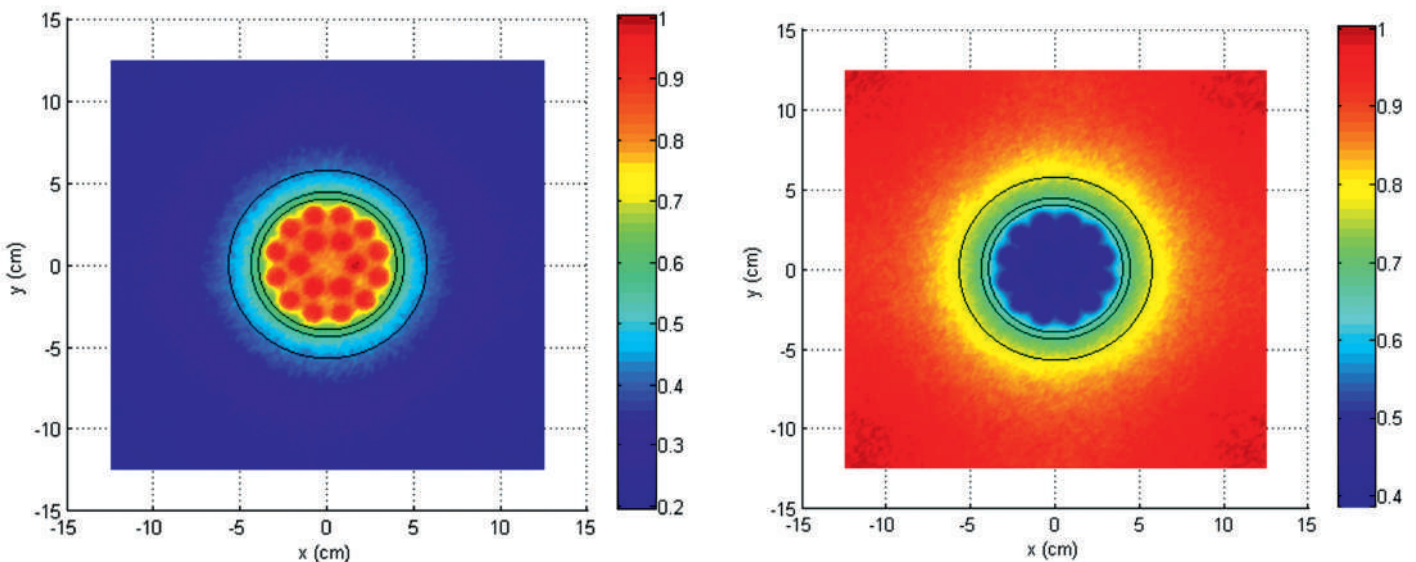
The project “Innovative water recovery solutions through recycling of heat, materials and water across multiple sectors,, (iWAYS), implemented under the Circular economy EU program “Horizon 2020” (2020–2024)

The project will develop a set of industrial technologies and systems to recover water and heat, and in some cases materials, from exhaust gas streams. Laboratory activities are related to the waste heat recovery.



Ignalina NPP has been implementing the Ignalina NPP Megaproject—crucial and extremely significant as well as unique to Lithuania—and Nuclear Engineering Laboratory has been implementing the following related projects:

- Engineering Services Associated with Dismantling of Ignalina Nuclear Power Plant Reactor-Cores
- Environmental impact and safety assessments of the reconstruction and converting of the INPP Bituminised Waste Storage Facility into a repository (B-20)
- Technical Support Organisation Assistance to INPP in respect of Safety Analysis and Repository Waste Acceptance Criteria (TSO.02)
- Services for the determination of conditional uncontrolled levels of radioactivity of waste accumulated at the INPP industrial waste landfills
- Research has also been carried out in two “Horizon 2020” programme projects, namely INNO4GRAPH (2020-2023) and HARPERS (2022–2025)

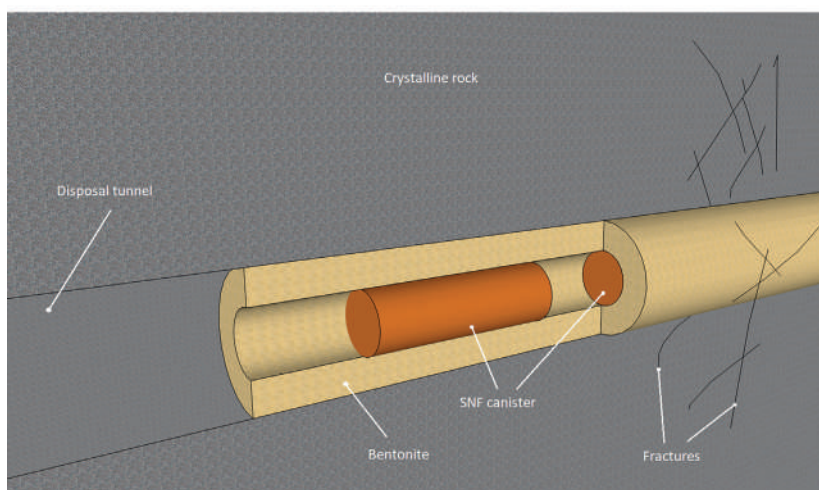
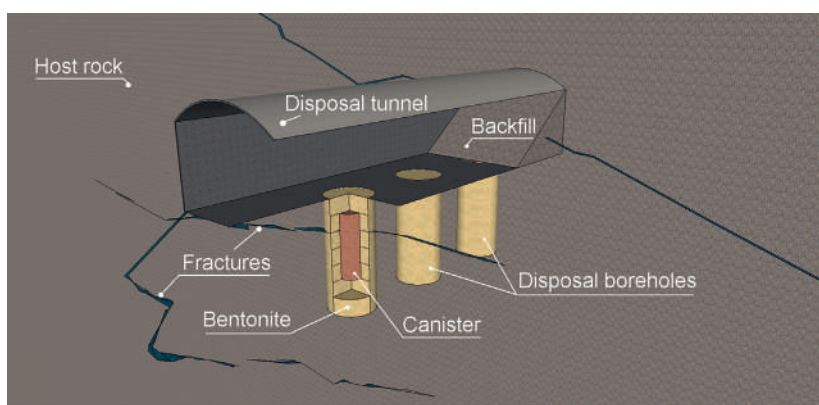


Relative neutron flux in RBMK-1500 reactor channel and graphite block.
On the left: fast neutrons, on the right: thermal neutrons



Ignalina NPP has been implementing a long-lasting deep geological radwaste repository Megaproject in Lithuania. Laboratory has been implementing the following projects:

- Comprehensive assessment of the results of the studies carried out in the deep geological repository project
- Preparation of general safety criteria for deep geological repository construction in Lithuania (Subcontractor to “Posiva Solutions”, Finland)
- Research has also been carried out in a “Horizon 2020” programme project EURAD (2019–2024)



Deep geological repository: vertical and horizontal placement of containers

THE GREEN CAMPUS MODEL

LEI Green Campus is an exemplary model of an ecological smart town planned in the territory of the Lithuanian Energy Institute. The model incorporates and integrates technologies for the supply of renewable energy for hydrogen production and renovated buildings.

LEI's Green Campus vision resonates with the aims and objectives of the EU's mission „Climate-Neutral and Smart Cities“ and with a goal set in Programme of the 18th Government of the Republic of the Lithuania – to establish a first climate-neutral and waste-free Lithuanian city by 2030.

This infrastructure would be used for the development, integration, and testing of green hydrogen production for transport and buildings, as well as for other energy storage and green fuel production technologies.

INFRASTRUCTURE CONSISTS OF THREE INTEGRATED ENERGY ECOSYSTEMS:

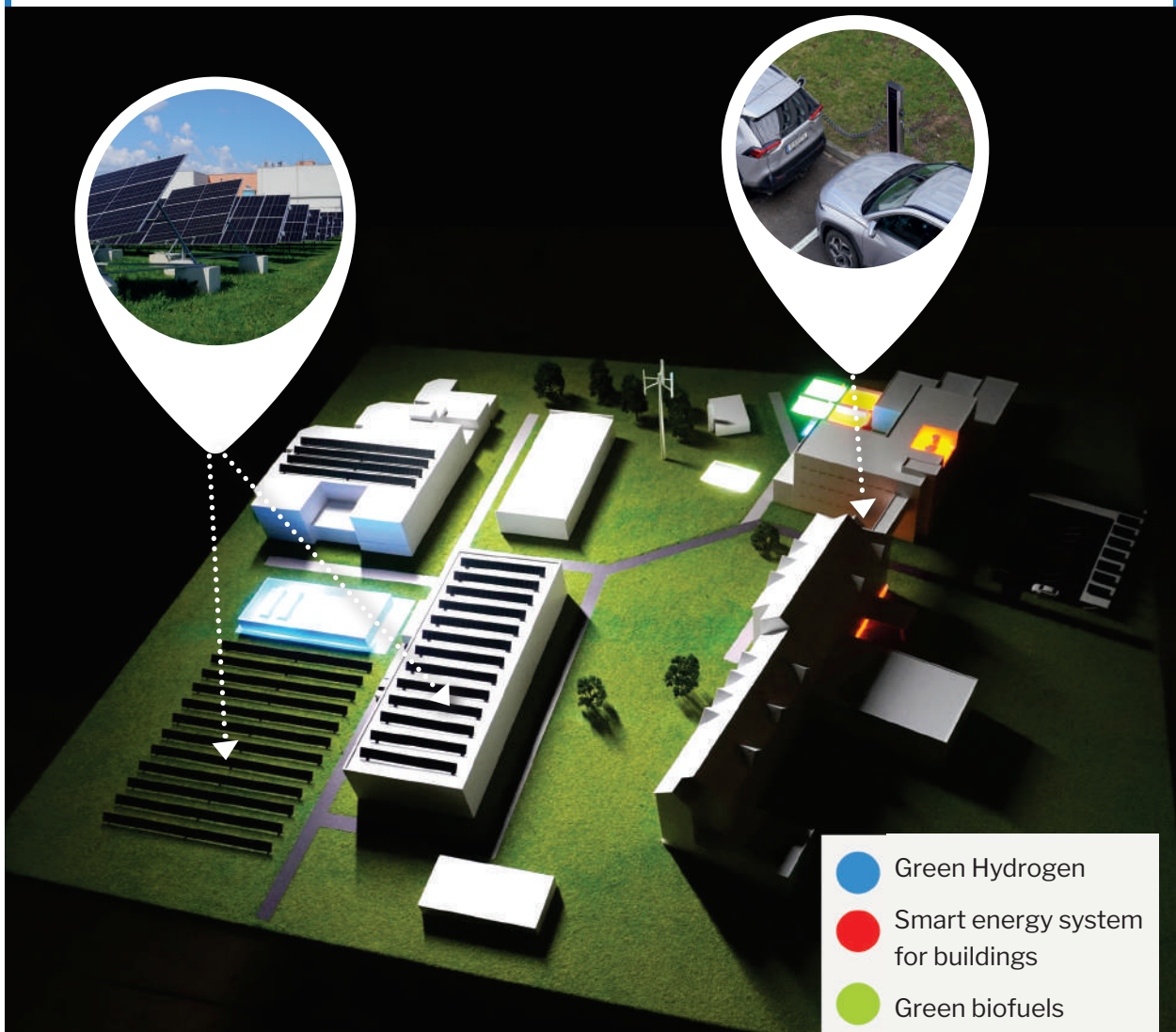
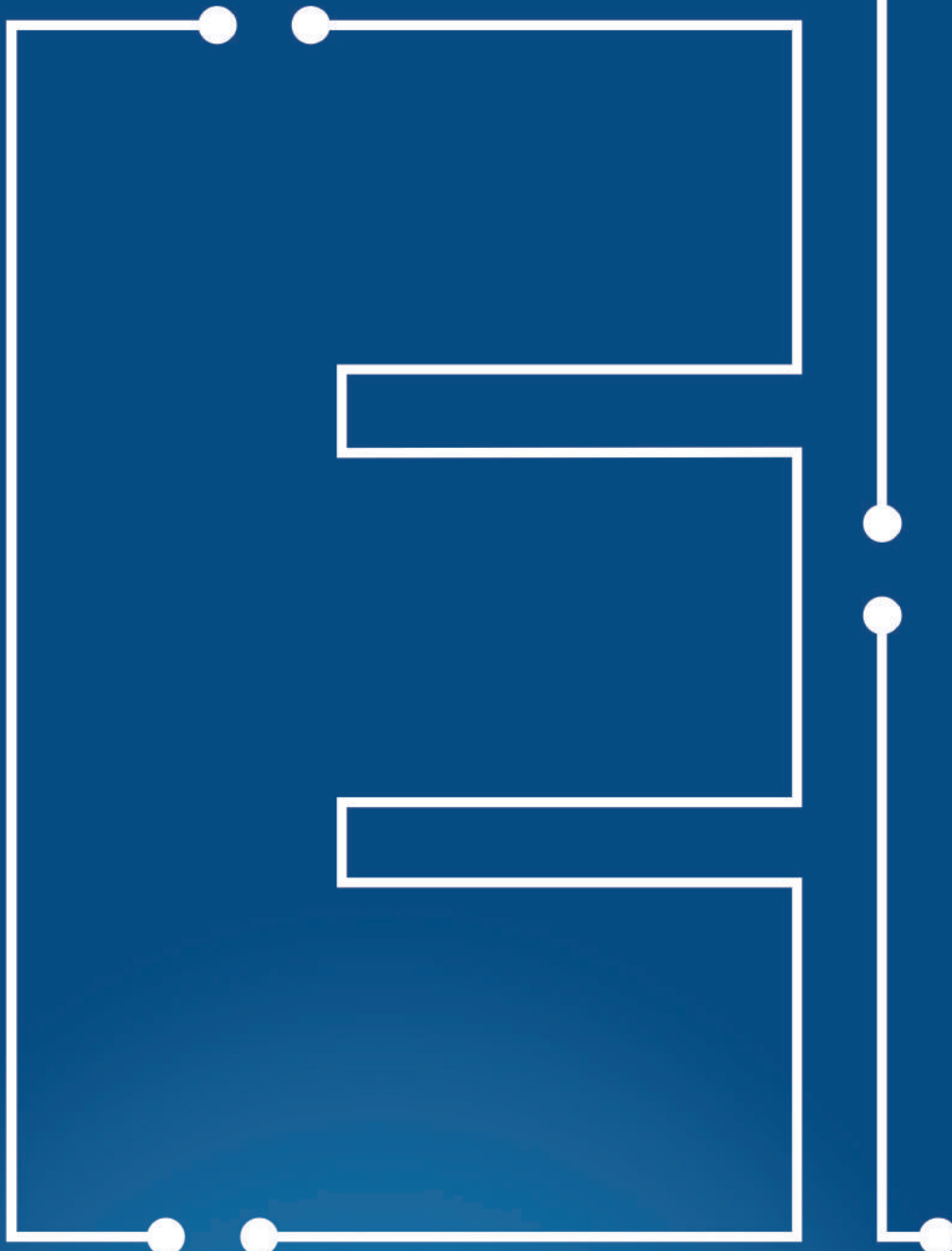


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