

RDI DEPARTMENT

ENVIRONMENTAL RESEARCH AND INNOVATION (ERIN)



LIST's "Environmental Research & Innovation" (ERIN) department develops strategies, technologies and tools to better monitor, assess, use and safeguard natural and renewable resources. Our research topics are water security and safety, plants for biomass, biopolymers and bioenergy, life cycle sustainability and risk assessment, and e-Science for environmental and biological applications.

More information at [LIST.lu/erin](https://www.list.lu/erin)



LUXEMBOURG
INSTITUTE
OF SCIENCE
AND TECHNOLOGY



WHAT WE DO

Leveraging the complementary expertise of the former departments “Environment and Agro-biotechnologies” (EVA) and “Informatics, Systems and Collaboration” (ISC) of the CRP-Gabriel Lippmann, as well as of the “Resource Centre for Environmental Technologies” (CRTE) of the CRP Henri Tudor, ERIN’s ambition is to implement a **smart green vision**, striving for scientific excellence in the understanding of complex environmental and biological systems and their interaction with the technosphere, in order to accelerate innovation towards the sustainable management of natural resources and the transition towards a circular economy.

ERIN advises governments on determining sustainable policies for the future and provides innovative and high-quality environmental solutions at national and international levels, whereby small and large companies can gain a competitive advantage and create green jobs.

Climate change mitigation, ecosystem resilience, sustainable energy systems, efficient use of renewable resources, environmental pollution prevention and control, ... The “Environmental Research and Innovation” (ERIN) department of the Luxembourg Institute of Science and Technology (LIST) brings together the necessary **interdisciplinary knowledge and skills** to tackle major environmental challenges that our society is facing today.

Our interdisciplinary team of **170 life, environmental, and IT scientists and engineers** develops strategies, technologies and tools to better monitor, assess, use and safeguard natural and renewable resources. The portfolio of our RDI activities ranges from laboratory and field experiments, environmental model and software development, process control and automation to environmental technologies. The understanding, analysis and evaluation of complex natural and anthropic systems are supported by advanced tools for big data analytics, visualization and management.

Our **RDI activities** embrace **four thematic domains**:

- ▶ Water security and safety;
- ▶ Plants for biomass, biopolymers and bioenergy;
- ▶ Life cycle sustainability and risk assessment;
- ▶ e-Science for environmental and biological applications.

Furthermore specific needs and innovation challenges of public authorities and companies, in particular SMEs at national level, are addressed through our **Environmental Resource Centre**, offering science-based policy and technology support for:

- ▶ Control and prevention of industrial emissions and employment of best available techniques;
- ▶ Chemical substance management (national REACH&CLP Helpdesk);
- ▶ Crop protection in agriculture and viticulture;
- ▶ Environmental (air, soil, water, biodiversity) and climate monitoring and data management.

OUR RESEARCH TOPICS

1. Water security and safety

World-wide, water resources are increasingly put under pressure by climate and land use change as well as anthropogenic pollution. We strive to:

- ▶ Better understand how catchments store and release water and pollutants, using new generations of environmental tracers and remote sensing methods;
- ▶ Identify the sources and fate of microbes in the water cycle;
- ▶ Develop innovative technological solutions and new real-time decision support tools for keeping our water resources safe and secure.

2. Plants for biomass, biopolymers and bioenergy

Natural biological raw materials are crucial for our economic system, but they are increasingly overexploited for the provision of food, materials and energy. Lignocellulosic biomass, mainly composed of plant cell walls, is the most abundant biological raw material on Earth. Our aim is to:

- ▶ Elucidate underlying mechanisms of plant cell wall biopolymer formation and deconstruction using integrative biology and green biotechnologies;
- ▶ Valorize plant biomass as a source for bioenergy and biopolymers for innovative and commercially interesting applications.

3. Life cycle sustainability and risk assessment

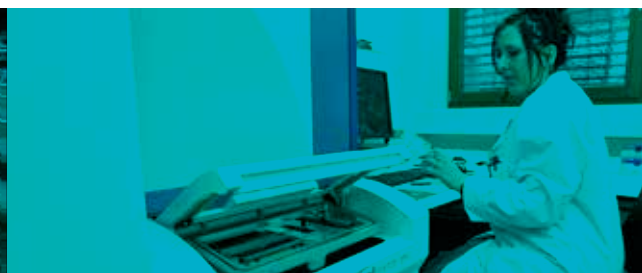
Industrial activities and human consumption patterns put considerable pressure on ecosystems and natural resources but also impact our health. Our goal is to develop:

- ▶ Methods and transferable tools for integrative sustainability assessment of products, technologies and policies leading to the definition and implementation of resource and energy efficient strategies;
- ▶ Applicable and reliable tools for environmental and human risk assessment for (mixtures of) chemicals with a focus on nanomaterials present in water, air or soil.

4. e-Science for environmental and biological applications

High throughput analytical technologies, high-frequency sensor networks as well as powerful simulators generate large quantities of environmental and biological data challenging our capacity for validation, analysis, visualization or storage. Our ambition is to:

- ▶ Design and implement new software tools and infrastructures;
- ▶ Propose new data processing techniques for big data management;
- ▶ Explore new visualization methods and theories to support data-driven scientific advancement.



OUR SERVICES AND TECHNOLOGY OFFER

ERIN's services and technology offer relies on the scientific and technological core competencies within the four RDI domains and the Environmental Resource Centre. We propose **multiple opportunities and set-ups for collaboration with industry and public stakeholders**, aiming at the production and transfer of knowledge, methods and products to markets and society.

Our valorization and partnership team ensures a well-structured and efficient interaction with external partners, including a transparent and professional IP handling, supporting the technology and knowledge transfer, key account and customer relationship management, extensive networking and matchmaking of interests.

We make state-of-the-art monitoring, analytical, computational and modelling resources accessible via collaboration with our research laboratories and research support platforms, ecotechnology facilities and environmental monitoring resources.

Examples of our services, products and methods include:

- ▶ Air quality monitoring and modelling;
- ▶ Bio-based materials and products for industrial applications;
- ▶ Biodiversity monitoring, bioindication of environmental quality;
- ▶ Biomethane potential determination of energy crops and organic waste products;
- ▶ Data analytics and visualization software, image processing, GIS-based analyses, land cover mapping and validation;
- ▶ Development of hydrologic and hydraulic prediction tools;
- ▶ High throughput genomic, transcriptomic and proteomic analyses and their bioinformatic treatment;
- ▶ Identification and quantification of xenobiotics (pesticides, heavy metals, PCBs, pharmaceutical residuals, mycotoxins, nanomaterials) and microorganisms in water, biota, food and feed, including risk assessment;
- ▶ *In situ* and space-borne high resolution and high frequency monitoring of environmental variables;
- ▶ Life cycle sustainability assessment and ecodesign tools for decision support;
- ▶ Pest and disease identification and monitoring, resistance monitoring;
- ▶ Prototypes for innovative ecotechnologies (bioenergy, water treatment), including automation and control.



EQUIPMENT AND TOOLS

ERIN operates a comprehensive set of monitoring, analytical and modelling resources. Besides laboratory infrastructures in biochemistry, isotope hydrology, microscopy, microbiology, toxicology, as well as for the culture and maintenance of living organisms (cell culture models, viruses, bacteria, fungi, *in vitro* plants, insects), we host three technology platforms:

- ▶ The **Analytical Chemistry Platform** allows the identification and qualification of a wide array of inorganic and organic chemical substances (metabolites, biopolymers, major to trace elements, xenobiotics, ...) in various environmental and biological matrices.
- ▶ The **Genomics, Proteomics, and Metabolomics Analysis Platform** offers technologies to fully characterize the molecular profiles of biological samples (with a specialization in plants), including genetic sequencing and genotyping, gene expression, different protein expression analysis approaches, as well as cellular metabolite fingerprinting.
- ▶ The **High Performance Computing Platform** consists of a Linux cluster plus peripheral hardware and is dedicated to parallel computing and modelling, centralized storage as well as data pre-/postprocessing and visualization of results.

The **department's ecotechnology facilities** comprise fully automated bioreactors and pilots of different scales for the optimization of bioenergy and wastewater treatment processes, including on-line analytical sensors for measuring water quality and gases such as CH₄, CO₂, H₂S, and N₂O.

The environmental monitoring resources of the department span a wide range of applications – including sampling and *in situ* analysis of biological, chemical, hydro-meteorological, and geophysical parameters. The **Observatory for Climate and Environment** runs a unique hydro-meteorological instrument network in the Alzette River basin – covering a wide array of geological, topographical and land use characteristics. The department's environmental monitoring vehicle is fully equipped for the combined acquisition of air quality and meteorological data. An airborne thermal hyperspectral camera with its associated spectral lab and field equipment allows to retrieve quantitative attributes over natural surfaces at field to landscape scales.

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ABOUT LIST

A key player in research and innovation in Luxembourg, the Luxembourg Institute of Science and Technology (LIST) covers with its 630 employees the domains of materials, environment and IT. As an RTO (Research and Technology Organisation) and with its interdisciplinary impact-driven approach, LIST contributes to the development of Luxembourg's economy and society.

More information: LIST.lu

OUR RDI DEPARTMENTS AND THEIR COMPETENCE DOMAINS

ENVIRONMENTAL RESEARCH AND INNOVATION (ERIN)

- Water security and safety
- Plants for biomass, biopolymers and bioenergy
- Life cycle sustainability and risk assessment
- e-Science for environmental and biological applications

MATERIALS RESEARCH AND TECHNOLOGY (MRT)

- Nanomaterials and nanotechnologies
- Composite and advanced materials

IT FOR INNOVATIVE SERVICES (ITIS)

- Decisional knowledge dynamics
- Trusted service systems
- Service engineering with impact

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