

PRESS RELEASE

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LIST RESEARCHER WINS EUROPEAN RESEARCH COUNCIL (ERC) ADVANCED GRANT

The nearly €2.4 million grant will fund research into electricity generation from waste heat.

Dr Emmanuel Defay, Head of the Nanotechnologies Unit at the Luxembourg Institute of Science and Technology (LIST), has received an ERC grant worth €2.36 million over a five-year period to pursue his research project focused on transforming waste heat into electricity.

Using materials to optimize electricity generation from waste heat

Electricity makes up about 20% of all the energy used worldwide, and experts think it will make up 40% by 2050, as an outcome of the need to decrease our dependence on non-renewable energies. Beyond sunlight and wind, heat is another formidable yet poorly exploited source of electrical energy. “Right now, most of the heat we generate in the world gets wasted, but it could actually be used to make enough electricity to power all of Europe,” says Dr Defay. In this context, his team has shown that 40 grams of nonlinear pyroelectric ceramics – materials that generate electricity when they get hot and cold alternately – can make over 10 joules of electricity from wasted heat during a single cycle of temperature change of 100 degrees, which is ten times greater than the closest current technology.

“We also found out that these materials can convert heat into electricity with an efficiency of 40% with respect to the theoretical limit, which is better than what solar panels or thermoelectric devices can do in some specific cases,” Dr Defay adds. The objective of his ERC funded project is now to demonstrate that energy harvesters made from nonlinear pyroelectric materials can generate 100 watts of electrical power from heat, with an energy efficiency of 50%.

“The ultimate goal is to develop a highly efficient technology over the five-year project timeline, and ideally, within 10 years, achieve even greater efficiency,” he says. “Efficiency is crucial in converting heat to electricity, and while some mechanisms already exist, this technology has the potential to be extremely efficient.”

Any industry that generates waste heat could benefit from this technology, especially those with high-quality waste heat, such as high-temperature processes like those found in steel production. But this technology could also address situations where waste heat is not as high, Dr Defay explains, like in many industries and households where temperatures are lower than 100 degrees Celsius. With a 50% efficiency rate, this technology could significantly improve the utilization of lower temperature waste heat, making it more versatile and applicable to a wider range of industries.

Second ERC grant for LIST

ERC grants are awarded to Europe’s top researchers, and the process of obtaining an ERC Grant is highly competitive. The Advanced Grant, according to the ERC, “is amongst the most prestigious and competitive EU funding schemes (...) awarded to established, leading researchers with a proven track-record of significant research achievements over the past decade.”

This is the first time a LIST researcher has received an Advanced Grant, and it represents the second ERC for LIST as an institution.

Dr Damien Lenoble, Director of the materials department at LIST has said: “In Europe, 1608 industrial sites, encompassing steel, cement, glass, aluminium, etc., collectively emit 425 PJ (PentaJoule) of excess heat at 95°C, equivalent to over 118 TWh (TeraWatt-hour), which presents a significant energy resource for advancing the electrification of the economy. Over the past five years, LIST has been dedicated to developing various

technologies for harnessing multiple energy sources such as fluid flow, sea waves, and electromagnetic waves to generate electricity. Among these initiatives, Dr Emmanuel Defay has pioneered the use of pyroelectric materials, leveraging the multidisciplinary skills of the materials department. We are honoured that the ERC panel has recognized and supported Emmanuel's disruptive approach, enabled by LIST's unique combination of advanced thermal modelling, materials science, and prototype engineering capabilities.”

About LIST

The Luxembourg Institute of Science and Technology (LIST) is a research and technology organization (RTO) under the auspices of the Ministry of Higher Education and Research, and its mission is to develop competitive and market-oriented prototypes of products and services for public and private stakeholders.

With nearly 680 employees, 77% of whom are researchers or innovators from all over the world, LIST is active in the fields of information technology, materials, space resources and the environment, and works across the entire innovation chain, from basic and applied research to technology incubation and transfer.

By transforming scientific knowledge into intelligent technologies, data and tools, LIST:

- helps European citizens make informed choices
- helps public authorities make decisions
- encourages companies to develop

For more information about the Luxembourg Institute of Science and Technology, please visit: <https://www.list.lu/>

PRESS CONTACT

LIST

Paramita Chakraborty

Communication Officer

Tel: (+352) 275 888 2237

Email: communication@list.lu