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INNOVATIVE TOOL TO HELP INDUSTRIES OPTIMIZE STEAM AND ELECTRICITY GENERATION FROM LOST HEAT

Heat2Power® is the result of a 3-year research collaboration between LIST and ArcelorMittal Foundation Luxembourg.

Heat2Power®, an innovative tool developed by the Luxembourg Institute of Science and Technology (LIST) in collaboration with ArcelorMittal Foundation Luxembourg, will help companies make the best of their waste heat and convert it into valuable electrical energy. LIST, whose vocation is to transfer scientific and innovative solutions to economic and industrial stakeholders, has been bringing its expertise to the operational teams at ArcelorMittal's industrial sites in Luxembourg for the past four years, centred around the concept of the "Forge", where ideas and possible project leads are developed and tested as part of ArcelorMittal's transition process towards circular and decarbonized steel production. The collaboration agreement, signed in October 2019, provided the space and time for both organizations to exchange ideas and develop new concepts, ultimately leading to the creation of Heat2Power®. The tool aims to address and optimize waste heat recovery during the production process, ultimately enhancing energy efficiency and the decarbonization of the plants.

In the framework of the National Research Fund funded project Heat2Power, LIST and ArcelorMittal collaborated to address waste heat recovery for steam and electricity production. Methods of process integration and mathematical optimization, considering production constraints encountered in steelmaking, were set up to select the best waste heat recovery, transfer and valorisation schemes. These approaches were then structured as an optimization software to maximise electricity and steam generation for a whole plant.

Heat Recovery and Power Generation

Heat recovery is a well-established concept that involves extracting waste heat from industrial processes and using it for other purposes. In the case of ArcelorMittal and similar industries, the cooling waters and off-gases produced during various thermal processes are major sources of heat, so far wasted in the environment. The heat can indeed be recovered by heat exchangers, which allows the energy to be transferred as hot water or steam to other processes in the plant.

Power generation involves using turbines to convert the water or pressurized steam into electricity. The turbines operate based on the principle of expansion, where the heated fluid (water, CO₂ or an organic fluid) is passed through the turbine, causing it to rotate and generate electricity. The electricity can then be used to power various industrial processes or injected into the grid.

How does Heat2Power® work?

Heat2Power® optimizes the heat recovery process using specific technologies at different pressure levels. The core of the tool lies in its specific technology data (standard steam turbines, various types of organic Rankine cycles turbines) and sophisticated optimization algorithm that consider numerous variables and parameters to determine the most efficient and economically viable solutions.

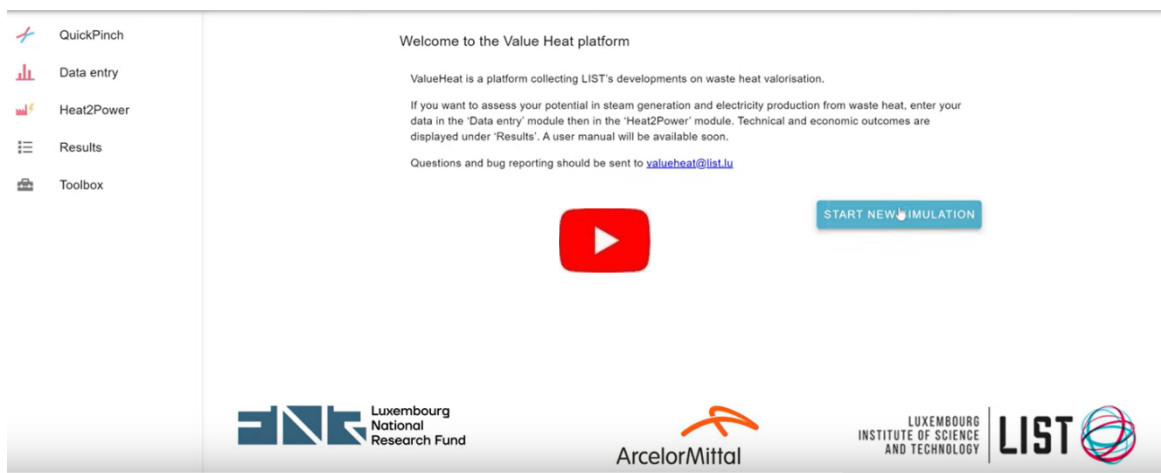
"What makes this project interesting and important is its complexity, which involves a wide range of variables to consider. For instance, in the basic model we are examining, which involves the processes of ArcelorMittal in Luxembourg, there are approximately 600,000 variables that need to be quantified. The challenge lies in the fact that as an engineer or a group of engineers, it is not feasible to manually calculate and determine the best solution by going through the entire list of solutions," says Alexandre Bertrand, researcher at LIST.

To address this issue, the team of researchers employed methods of process integration and mathematical programming. “By leveraging these techniques, we can effectively handle the complexity associated with the numerous variables with the goal being to design and select optimal values for all the variables involved,” he adds. “For example, when implementing heat recovery, we need to consider factors such as the technology type, pressure level and the equipment size.”

This is where Heat2Power® comes into play. The software identifies the best combinations of technologies and operating conditions to achieve maximum efficiency and profitability to recuperate waste heat and convert it into power.

The tool has an intuitive interface wherein users enter data regarding their waste heat streams, economic values and other relevant parameters. The tool then processes this data through the algorithm to provide users with the optimized design of the system. As a last step, the user can then manually fine tune the results, using the tool as an energy and cost calculator.

This short video shows exactly how the tool works:



After three years of research and development, Heat2Power® is about to be deployed as a Software as a Service (SaaS) and holds the promise of optimizing the transformation of waste heat into a valuable energy resource, contributing to a greener and more sustainable future for industrial processes.

“Waste heat is a piece of the decarbonization puzzle. With Heat2Power®, process engineers have a tool that addresses the inherent complexity of such projects, supporting them in making the best out of their excess energy,” concluded Bertrand.

Dirk Fransaer, CEO ad-interim of LIST said, “One of the key objectives of a research and technology organization like LIST is to transfer knowledge to and provide support for the industry, working closely with companies. ArcelorMittal and LIST have built a strong relationship over the years and their input to Heat2Power® was thus equally central for the development of the tool.”

“The materialisation of this partnership through Heat2Power® opens up exciting possibilities for energy production. Firstly, because the source of this energy - heat - is abundant in our facilities, and also because this tool is in line with our decarbonization objectives”, underlined Henri Reding, Country Head ArcelorMittal Luxembourg. “Decarbonization is a central challenge for ArcelorMittal and we are actively working on reducing our emissions. Tools like Heat2Power® allow us to deploy solutions towards carbon-free steel making,” he added.

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/>

Luxembourg

ArcelorMittal has its global headquarters in Luxembourg. At the national level, the group has 8 sites throughout the country, including the administrative centers in Luxembourg City and Esch-sur-Alzette, various steel production units for long and wire products as well as distribution and steel service centers. ArcelorMittal also runs a R&D Centre in Esch-sur-Alzette.

ArcelorMittal Luxembourg is a leading producer of long products, such as steel beams and sheet piles, which are sources of innovation in the modern construction sector. Heavy Jumbo sections and high-performance steel grades from ArcelorMittal in Differdange have a worldwide reputation for use in high-rise buildings and allow a reduction in weight (and thus CO₂ emissions) of up to 40%. The high quality and reliability of ArcelorMittal Belval's steel sheet piles have made them the benchmark in this market.

Specialized in the production of rails of various profiles, ArcelorMittal Rodange offers the world's widest range of rails for overhead cranes and a selection of rails for tramways made of ultra-resistant steels, as well as the world's largest angle irons, widely used for the construction of electric pylons to transport energy over long distances.

Finally, ArcelorMittal Bissen operates in three market segments: wire for fencing and agriculture (vineyard wire), industrial wire (wire for gabions, cable reinforcement) and metal fibers for reinforcing concrete for floors, tunnels and prefabricated buildings.

For more information on ArcelorMittal in Luxembourg, please visit: <http://luxembourg.arcelormittal.com> and follow us on Twitter [@ArcelorMittal_L](https://twitter.com/ArcelorMittal_L) and Instagram [@arcelormittalluxembourg](https://www.instagram.com/arcelormittalluxembourg)

Worldwide presence

About ArcelorMittal

ArcelorMittal is the world's leading steel and mining company, with a presence in 60 countries and primary steelmaking facilities in 16 countries. In 2022, ArcelorMittal had revenues of \$79.8 billion and crude steel production of 59.0 million metric tonnes, while iron ore production reached 45.3 million metric tonnes.

Our purpose is to produce ever smarter steels that have a positive benefit for people and planet. Steels made using innovative processes which use less energy, emit significantly less carbon and reduce costs. Steels that are cleaner, stronger and reusable. Steels for electric vehicles and renewable energy infrastructure that will support societies as they transform through this century.

With steel at our core, our inventive people and an entrepreneurial culture at heart, we will support the world in making that change. This is what we believe it takes to be the steel company of the future.

ArcelorMittal is listed on the stock exchanges of New York (MT), Amsterdam (MT), Paris (MT), Luxembourg (MT) and on the Spanish stock exchanges of Barcelona, Bilbao, Madrid and Valencia (MTS).

For more information about ArcelorMittal please visit: <http://corporate.arcelormittal.com/>

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