NET-ZERO INDUSTRIES
MISSION

Project Title	Decarbonization of Anodizing Plant at Mäkelä Alu Oy
Industry Partner	Mäkelä Alu Oy
Industry Sector	Other Energy Intensives & Hard-to-Abate Sectors (Aluminium industry, surface treatment, anodizing)
Technology Pathway (Primary)	Alternative Materials & More Efficient Process
NIM Pillar	Technology Demonstration
Source	NIM Awards 2024
Description	The anodizing plant decarbonization project is a pioneering initiative focused on transforming a traditionally energy intensive process into a nearly carbon neutral operation. This project involved a comprehensive redesign of the plant's energy system, emphasizing the capture and reuse of waste heat, which significantly reduced total energy usage, lowered significantly reliance on fossil fuels and reduced the overall carbon footprint. Key measures included the installation of an advanced heat recovery system that captures energy from cooling of the anodizing process and also from outside sources. These energy savings facilitate the complete replacement of an inefficient propane fuelled steam boiler used for steam production. The project leveraged also innovative solutions for drying tanks and other processes. These upgrades not only improved energy efficiency but also enhanced process control through updated automation and sensor technologies, ensuring optimal utilization of recovered heat and electricity. Upgrades also increased workplace safety by eliminating pressurized steam as a heating method. As a result, the need for propane has been drastically reduced, with the LPG now reserved primarily for production restarts and for heating the facility. The anticipated annual consumption of propane has dropped from over 300 tons to 66 tons, reflecting a significant reduction in CO2 emissions from over 900 tons annually to under 200 tons. This project stands as a model of industrial innovation, showcasing how energy intensive processes can be transformed to support net-zero objectives. The success of this initiative has also provided valuable insights and expertise, setting a new benchmark for sustainability within the anodizing industry and also internally at Mäkelä Alu. Moreover, it highlights the potential for similar retrofitting projects across other energy intensive sectors.
Innovations Employed	Our project introduces an innovation in process heating and cooling by identifying and efficiently reusing thermal energy within an anodizing facility. Traditionally, process heating relies on fossil fuels to generate steam, while cooling is achieved through compressors. Our innovation lies in the integration of these thermal flows: the heat extracted during the cooling process and from other identified sources is redirected to meet the heating demands of the process itself. This approach together with electrification drastically reduces the need for fossil energy inputs and minimizes greenhouse gas emissions.

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	By implementing an advanced heat pump system and optimizing the heat recovery process, we have enhanced energy efficiency, cut our costs and also demonstrated a novel approach to industrial decarbonization. This solution represents a significant advancement over conventional methods, offering a scalable and economically viable pathway to near net-zero industrial operations.
Dimension of Novelty	It was new for the Company, Country and the International Market
Innovation Collaboration	External: Calefa Oy
Intellectual Properties	
IP Links	Mäkelä Alu
Timetable & Progress	The project was realized in two phases between 2019 and summer 2023
Financing (Public/ Private)	Business Finland
Finance Links	
Project Phase TRL	TRL 9
Problems to be Solved and Risks to be Managed	Big risk was the heat balance optimization, that the amount of heat needed could actually be extracted from the process cooling. One key issue was the integration of a new heat pump system into the existing infrastructure. This required precise engineering to ensure that the system could handle the thermal load and integrate seamlessly with the existing process controls. Another challenge was optimizing the heat recovery from other identified sources, which involved overcoming technical difficulties related to the heat exchangers. The project also required upgrading the plant's electrical system to support the higher energy demands. Risks included potential disruptions to the production process during installation and commissioning. To mitigate this, we carefully planned the implementation phases, which in turn made the project longer. Additionally, the high initial investment posed financial risks, but these were managed through detailed cost analysis and contingency planning.
Preliminary or Final Results Achieved	The project achieved remarkable outcomes across several key areas. First, the integration of advanced heat recovery systems and heat pumps has demonstrated the potential of this technology in an industrial setting. In terms of environmental impact, the project significantly reduced CO2 emissions, cutting them by almost 80%. This represents a dramatic decrease in the carbon footprint of the anodizing process, contributing to the company's overall sustainability goals. Energy savings were another major outcome. The LPG consumption reduced from over 300 tons annually to under 70 tons, still including the heating of the facility. Additionally, overall energy consumption dropped from 2465 kWh to 1608 kWh per anodized ton of aluminium.

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	Due to the reduced need for propane and the improved efficiency of the new systems cost savings are substantial. This makes the project economically very viable. The project has set a new standard for energy efficiency and sustainability in the industry.
CO2 Emissions Reduction Potential - Implementation and Future Market	The project demonstrated substantial potential by reducing CO2 emissions by 733 tons annually at a single facility. In Finland, with five industrial scale anodizing plants, the total potential CO2 reduction could exceed 3,665 tons per year if similar methods were applied across all major facilities. Expanding this analysis globally, with over 226 Qualanod certified plants and thousands more unregistered or smaller facilities, the global impact could be massive with over millions of tons of CO2 annually. Even with conservative estimates, applying these methods across the broader anodizing industry could play a significant role in global decarbonization efforts. This potential underscores the importance of adopting advanced, sustainable technologies in anodizing processes, particularly in regions and industries where such practices are not yet standardized. By scaling these methods, the anodizing industry could contribute significantly to achieving global CO2 reduction targets.
Market Positioning	The project positioned Mäkelä Alu Oy as the near net-zero provider of anodizing in the market. With the possibility of adding renewable biogas as an energy source for gas Mäkelä Alu Oy is on the way to be totally net-zero anodizer. This has positioned Mäkelä Alu as a leading supplier for anodizing in the building and construction sector that aims to be carbon neutral.
Project Location	Finland
Project & Technology Links	Mäkelä Alu Oy Responsible and environmentally friendly aluminium profile production