HEX ECO: Sustainable manufacturing of heat exchangers for Carbon-free Heating and Cooling Systems

Abstract:

HEXECO will develop a new generation of aluminium heat exchangers for carbon-free heating and cooling systems, using friction stir welding (FSW) to achieve high thermal efficiency and sustainable manufacture. Integrating vacuum insulated panels (VIPs), the components will support fan-less evaporators and slim, lightweight radiant heat panels optimised for air source heat pumps. The project will deliver demonstrator systems, validate high-speed FSW, and reduce lifecycle emissions through energy-efficient processes, reusable materials, and lower transport costs, helping accelerate Europe's transition to net-zero heating.

Countries involved

Application sectors
Heating and cooling

Research and innovation domains
Advanced manufacturing processes, Sustainable manufacturing

Total cost in M€ (millions)
0.7614 M€

Starting date
01/04/2025

Duration (in months)
24 months

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Project participans
StirLight, TSF, INEGI (subcontractor), Comyn Ching & Co. (Solray), University West, DOF Tools, RZ ABAK.

RATIONALE OF THE PROJECT

Heating and cooling represent 50% of EU energy use, with over 70% supplied by fossil fuels. Rapid decarbonisation is essential to meet 2050 climate targets. Air source heat pumps (ASHPs) are a key solution but face barriers including high retrofit costs, bulky components, and poor efficiency in legacy systems. HEXECO addresses this by developing a new class of aluminium heat exchangers manufactured using friction stir welding (FSW), a solid-state process with high energy efficiency and no need for filler wire or shielding gas. The solution combines FSW with vacuum insulated panels (VIPs) to produce thin, lightweight, leak-tight, and thermally efficient components suitable for heating and cooling in compact and aesthetically flexible formats. These panels enhance ASHP performance, lower system costs, and reduce reliance on gas boilers. The project brings together experts in FSW, tooling, machining, and heat system design to deliver and validate a breakthrough in low-carbon heat distribution technologies.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

Current heat exchangers for domestic heating are typically made from steel or copper using casting, brazing, or arc welding. These methods are energy-intensive, involve multiple manufacturing steps, and result in bulky products with limited design flexibility. They are not optimised for low-temperature ASHP systems, where thermal performance, weight, and integration flexibility are critical. Existing vacuum insulated panels (VIPs) are costly and rarely integrated into heat exchanger design.

HEXECO directly addresses these limitations by combining high-speed friction stir welding (FSW) with a novel heat exchanger geometry that integrates VIP cavities. This enables thin, lightweight aluminium panels with 30% improved thermal efficiency, reduced energy losses, and lower transport emissions. FSW, a solid-state, porosity-free joining process, replaces brazing and eliminates consumables—cutting process energy by up to 50%.

The project advances the SoA by:

• Applying FSW to thin-sheet aluminium with integrated vacuum structures

• Demonstrating copper-aluminium hybrid designs to boost heat flux density

• Developing real-time process monitoring with AI-based weld assurance

• Prototyping fan-less evaporators and radiant panels compatible with ASHPs

These innovations reduce lifecycle emissions, improve manufacturability, and open pathways for broader adoption in heating, cooling, hydrogen storage, and automotive systems.

MARKET POTENTIAL

The EU heat pump market is growing rapidly, projected to reach 30 million installations by 2030. HEXECO's solution targets this shift, offering efficient, low-profile heat exchangers better suited for retrofits and low-temperature ASHP systems. In the UK alone, even a 1% penetration of homes installing ASHPs annually could result in over €4.5M revenue. Consortium partners offer direct market access: Solray in radiant heat panels, RZ ABAK in pipe systems, and StirLight and TSF through existing FSW networks. Secondary markets include vacuum-insulated hydrogen tanks, automotive battery cold plates, and double-walled piping for industry. By leveraging FSW expertise and established customer channels, the consortium is well positioned to scale commercial production across multiple sectors.

IMPACT POTENTIAL

HEXECO supports Europe's net-zero goals by enabling clean, scalable production of high-efficiency heating components. The project cuts manufacturing energy use by 50%, reduces component weight for transport savings, and enhances product recyclability. It enables faster ASHP deployment in homes and buildings while strengthening EU manufacturing supply chains. Through digital FSW process control and IP generation, it advances Europe's leadership in sustainable, intelligent production. The consortium includes FSW manufacturers, toolmakers, and end users across the UK, Portugal, and Sweden, ensuring long-term impact and uptake.