

## SDEWES Abstract

### Special Session “Industrial decarbonisation pathways as part of sustainable energy system modelling”

#### Decarbonising Industrial Process Heat in New Zealand: The Role of High-Temperature Heat Pumps

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New Zealand has a climate target of net-zero emissions for long-lived gases by 2050, requiring substantial reductions in Industrial Process Heat (IPH) emissions. IPH has been identified as a priority area in government emissions reduction plans. About two-thirds of process heat is used for low (< 100 °C) and medium (100 to 300 °C) temperature requirements.

Decarbonisation efforts have focused on implementing energy efficiency measures and fuel switching to renewable energy sources, predominantly bioenergy and renewable electricity (i.e. solar, wind, hydro, geothermal). With renewable electricity accounting for 85% to 90% of the national generation mix, the electrification of IPH has gained significant traction, leading to the widespread adoption of medium-temperature heat pumps (<100 °C) and electrode boilers.

Electrical-driven high-temperature heat pumps (HTHPs), capable of providing IPH above 100 °C, offer a compelling alternative to electrode boilers for industrial applications. Commercially available and emerging HTHPs, with heating capacities up to 20 MW, align well with the demands of New Zealand’s meat, dairy, food, and pulp & paper industries.

This study quantifies the technical and economic potential of HTHPs for fuel switching in IPH in New Zealand by employing scenario-based modelling and techno-economic analysis. It evaluates their impacts on emissions and the wider electricity system. Key factors influencing HTHP adoption are examined, such as the availability and temperature of heat sources, temperature lift requirements for process heat, and coefficient of performance (COP). In addition, the study also discusses the economic scenarios under which HTHPs become viable and their implications for electricity demand and grid stability. Findings aim to provide a preliminary roadmap for integrating HTHPs into New Zealand’s industrial sector, contributing to the country’s broader decarbonisation goals.