176

Hydrogen Where It Matters: Regional Industrial Demand and Heat Coupling in Net-Zero Germany

Mehul VIjay, Niklas Hartmann
INES, Offenburg, Germany

Extended Abstract

Download file

Abstract Summary

Decarbonizing heat and industry is central to achieving climate neutrality in Germany, as these sectors account for a large share of final energy demand and are among the most challenging to decarbonize. Current research consistently shows that direct electrification is the most efficient and dominant pathway for low- and medium-temperature heat, particularly in buildings and parts of industry, while hydrogen is primarily required for high-temperature industrial processes and specific feedstock applications. These findings highlight a clear functional distinction between technologies, where electrification and hydrogen act as complementary rather than competing solutions.

However, most existing studies assess these pathways at the national level or in highly aggregated models, thereby overlooking the regional concentration of industrial demand and its interaction with local heat systems. In Germany, industrial activity and process heat demand are unevenly distributed across regions, with energy-intensive industries clustered in specific locations. This leads to significant spatial differences in energy demand structure, infrastructure requirements, and feasible decarbonization pathways.

As a result, the role of hydrogen and electrification cannot be fully understood without considering regional system interactions and sector coupling effects. This paper addresses this gap by analyzing how regional industrial demand interacts with the heat sector, and how electrification and hydrogen compete and complement each other within a spatially resolved net-zero energy system.

Presenting Author Biography

Mehul Vijay is a researcher at the Institute of Sustainable Energy Systems (INES), Offenburg University of Applied Sciences, Germany. He holds a Master of Science degree in Renewable Energy and Data Science and works on energy system modeling with a focus on

sector coupling, hydrogen integration, and spatially resolved energy systems. His research applies optimization models to analyze the interaction between electricity, heat, and industrial sectors in the German energy transition.