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Assessing Renewables Pull and Industrial Relocation Risk in Steel and Chemical Value Chains: A Comprehensive Sensitivity Analysis

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Extended Abstract

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Abstract Summary

This paper examines the risk of industrial relocation in European steel and chemical value chains driven by the so-called “renewables pull” effect, whereby energy-intensive production shifts to regions with more favorable renewable energy conditions. While such relocation may reduce overall system costs, it can undermine domestic industrial activity, competitiveness, and strategic autonomy.

To address gaps in existing literature on energy system modeling, which often focuses on limited technology pathways or relies on exogenous relocation assumptions, this study adopts a broader perspective. It evaluates multiple production routes for three critical products (steel, ethylene, and urea) using the AIDRES technology database, extended to include relocation options through intermediate and final product imports.

A global sensitivity analysis is conducted to determine the most cost-efficient technology routes under varying electricity and natural gas prices, as well as different import price assumptions reflecting relocation pressures. The analysis also incorporates three scenarios: cost-optimal, biomass-restricted, and biomass & CCS-restricted, alongside different hydrogen supply options.

Results indicate that European steel production is nearing a competitiveness tipping point, requiring policy support such as low energy price guarantees, CCS investments, or trade measures to remain viable. For ethylene and urea, biomass and CCS pathways emerge as key strategies to maintain competitiveness and mitigate relocation risks. In their absence, relocation or continued conventional production with carbon costs becomes more likely.

Overall, the findings highlight the critical role of biomass availability, CCS deployment, and targeted policy instruments, such as the Carbon Border Adjustment Mechanism, in shaping the future of European industrial competitiveness. The results provide insights for policymakers aiming to balance decarbonisation, economic resilience, and trade dynamics.

Presenting Author Biography

Enya Lenaerts is in her second year of her PhD at KU Leuven, Belgium, specializing in energy system modeling with a focus on energy-economy interactions. Their doctoral research, conducted in collaboration with VITO/EnergyVille, explores innovative approaches to integrate macroeconomics into long-term energy system models. Enya is dedicated to advancing tools and methodologies that address the challenge of balancing European competitivity with and climate goals.