

Impact of network regulation on CO₂ value chain participation: A Stackelberg approach

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Extended Abstract

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Abstract Summary

CO₂ value chains in Europe rely on the coordinated development of carbon capture, transport, and storage (T&S) infrastructure. T&S systems are capital-intensive and function as “club goods”, requiring, on the one hand, a critical mass of participants to become economically viable and, on the other hand, creating conditions for market power at the carbon network operator (CNO) side. This, in turn, gives rise to coordination challenges. Without effective regulation, participation in the CO₂ value chain may become locked into inefficient, low-adoption equilibria, thereby deterring industrial CO₂ abatement.

Within this context, this study analyses how profit regulation and tariff design influence the deployment of CO₂ networks in a highly industrialised region covering Belgium, the Netherlands, and North Rhine-Westphalia. It compares a profit-maximising CNO, modelled as a Stackelberg leader, with a welfare-maximising social planner. The results show how different regulatory frameworks affect participation levels, infrastructure routing, and overall system costs.

We contribute to the literature by incorporating detailed network topologies, heterogeneous emitter preferences based on alternative decarbonization options, and endogenous participation decisions without assuming a predefined coalition. It also explicitly models market power on the operator side, offering more realistic insights into CO₂ network development.

Findings indicate that CNOs can exercise significant market power, as some emitters have a high willingness to pay to access the network. This underscores the importance of regulatory oversight to prevent monopolistic behaviour. Moreover, combining profit regulation with location-based pricing is shown to improve efficiency and significantly reduce total system costs. Overall, well-designed regulation is essential to enable sufficient participation, ensure cost-effective deployment, and support Europe’s industrial decarbonisation goals.

Presenting Author Biography

Flore Verbist received an MSc in Sustainable Energy Technology from TU Delft in 2022. She is currently pursuing a PhD at the Energy Systems Integration and Modeling group at KU Leuven in collaboration with VITO and EnergyVille. Her research focuses on the economic, policy and system integration aspects of industrial carbon management and carbon pricing.