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Going offshore or not: where to generate hydrogen in future integrated energy systems?

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Abstract-

Hydrogen can be key in the energy system transition. We investigate the role of offshore hydrogen generation in a future integrated energy system. By performing energy system optimisation in a model application of the Northern-central European energy system and the North Sea offshore grid towards 2050, we find that offshore hydrogen generation may likely only play a limited role, and that offshore wind energy has higher value when sent to shore in the form of electricity. Forcing all hydrogen generation offshore would lead to increased energy system costs. Under the assumed scenario conditions, which result in deep decarbonisatiton of the energy system towards 2050, hydrogen generation – both onshore and offshore – follows solar PV generation patterns. Combined with hydrogen storage, this is the most cost-effective solution to satisfy future hydrogen demand. Overall, we find that the role of future offshore hydrogen generation should not simply be derived from minimising costs for the offshore sub-system, but by also considering the economic value that such generation would create for the whole integrated energy system. We find as a no-regret option to enable and promote the integration of offshore wind in onshore energy markets via electrical connections.

Index Terms- Offshore, Hydrogen, Optimisation, Sustainability Transition, Energy System, Modelling

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