

Transmission expansion simulation for the European Northern Seas offshore grid

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Abstract-

HVDC innovations and the integration of power markets and renewables drive the development of a European Northern Seas offshore grid. This power transmission system performs two functions: interconnecting Northern European onshore power systems, and connecting offshore wind farms. Despite its benefits, the development of an integrated offshore grid combining the two functions is slow. The main reasons are the lack of cooperation and governance frameworks to overcome regional differences and distribute costs and benefits. These barriers were studied so far only qualitatively or through perfect foresight optimization models. We complement this by studying transmission expansion pathways of the grid, which are non-optimal and path dependent, using a novel and open-source simulation model for offshore transmission investments. Different expansion typologies are considered, which we find perform the grid functions with different levels of integration and transmission capacities. Besides these typology factors, modelling and simulation factors also affect the expansion selection. Typology, modelling and simulation factors interact to result in radically different offshore grid pathways, which exhibit strong path dependence. Thus, to avoid locking-out beneficial expansions for the Northern Seas offshore grid, planning should be regional and consider HVDC innovations. Then individual projects can be implemented based on their own merits.

Index Terms- Northern Seas; Offshore grid; Offshore wind; Path dependence; Simulation; Transmission expansion planning

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