Energy Economics, vol.72, pp.376-392, May, 2018.

Expansion planning of the North Sea offshore grid: simulation of integrated governance constraints

J. Gorenstein Dedecca; S. Lumbreras Sancho; A. Ramos Galán; R.A. Hakvoort; P. M. Herder

Abstract-

The development of offshore transmission and wind power generation in the North Sea of Europe is advancing fast, but there are significant barriers to an integrated offshore grid in the region. This offshore grid is a multi-level, multi-actor system requiring a governance decision-making approach, but there is currently no proven governance framework for it, or for the expansion planning of the European power system in general. In addition, existing offshore expansion planning models do not endogenously include governance considerations, such as country vetoes to integrated lines. We develop a myopic Mixed-Integer Linear Programming model of offshore generation and transmission expansion planning to study the effect of integrated governance constraints. These constraints limit investments in integrated lines: non-conventional lines linking offshore wind farms to other countries or to other farms. Each constraint affects the system (including the main transmission corridors), transmission technologies and welfare distribution differently. We apply our model to a long-term case study of the 2030-2050 offshore expansion pathways using data from the e-Highway2050 project. Results confirm that the offshore grid is beneficial to society. Integrated governance constraints induce a modest loss of social welfare, but do not change significantly the existing welfare distribution asymmetry between countries and actor groups. They do strongly affect the interaction of line technologies and types (conventional or integrated), so the impact of the integrated governance constraints is more visible on the grid topology than on welfare levels and distribution. We highlight the need to consider technology and type interactions in expansion planning, especially between multiterminal HVDC and integrated transmission lines. Also, an offshore governance framework should address the use of multiterminal HVDC in a non-integrated grid, but this is a second-best option compared to an integrated grid.

Index Terms- Expansion planningGovernanceSimulationNorth SeaOffshore gridOffshore wind

Citation:
Gorenstein Dedecca, J.; Lumbreras, S.; Ramos, A.; Hakvoort, R.A. ; Herder, P. M. "Expansion planning of the North Sea offshore grid: simulation of integrated governance constraints", Energy Economics, vol.72, pp.376-392, May, 2018.