Sustainable Energy, Grids and Networks, vol.28, pp.100561-1-100561-14, December, 2021.

Assessment of electricity network investment for the integration of high RES shares : a Spanish-like case study

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Abstract-

In the course of the energy transition, the EU member states’ National Energy and Climate Plans seek to install significant amounts of intermittent renewable generation capacity over this decade. Previous studies underline the social, political, and economic benefits of the electricity sector decarbonisation. The economic analysis of renewable energy sources (RES) integration is commonly performed with single-bus generation expansion models that seek the cost-optimal expansion of RES generation capacity to reduce operational expenses. However, electricity grids will require investments to adapt to the integration of high amounts of RES capacity. This paper contrasts the cost-optimal generation capacity mix obtained from a single-bus expansion model with a conservative estimation of electricity network investment requirements for an exemplary Spanish-like case study. RES network investment costs are put in context with an alternative non-RES generation expansion pathway. Network investment costs considered include expansion costs for both transmission and distribution grids. Electricity network expansion costs represent 6 to 10% of the corresponding generation capacity investment. Despite increasing network investment costs, the integration of high RES shares into electricity grids reduces operating costs when compared to non-RES pathways. Fuel and emission savings exceed total investments (generation capacity, network expansion, and connection costs).

Index Terms- Power sector decarbonisation; Electricity network costs; Renewable energy sources

Citation:

Herding, L.; Cossent, R.; Rivier, M.; Chaves, J.P.; Gómez, T. "Assessment of electricity network investment for the integration of high RES shares : a Spanish-like case study", Sustainable Energy, Grids and Networks, vol.28, pp.100561-1-100561-14, December, 2021.