

Large-scale estimation of electricity distribution grid reinforcement requirements for the energy transition – A 2030 Spanish case study

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Abstract-

The increasing interest in distributed energy resources (DER) challenges electricity distribution grids to host the required distributed generation (DG) capacities and the expected load increase from electrification. However, a large-scale estimation of costs for integrating DER into low, medium, and high voltage distribution networks has yet to be addressed. This paper contributes a model for the large-scale estimation of the impact of distributed generation, electric vehicles and heat pumps on network reinforcement requirements. The model allocates future DER geographically to 8000 Spanish peninsular municipalities. The large-scale model considers low, medium and high voltage distribution grids. The resulting distribution grid investment is determined via individualised reinforcement costs for each of the 47 peninsular Spanish provinces, distinguishing between urban, semi-urban, rural concentrated and rural dispersed configurations of distribution networks. A 2030 case study shows that the geographical allocation of DG is not aligned with the allocation of load electrification, leading to total investment requirements of 2627 MEUR. This finding points out that distribution system operators covering different parts of the territory are likely to face a variety of challenges that are not aligned across the territories, requiring regulation to account for a variation of distribution grid expansion requirements for the energy transition.

Index Terms- Distribution grids; Distributed generation; Electric vehicles; Heat pumps

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