

power procurement is approximately 50% of the total system costs. Since the TSO is the most important player in relation to power supply, its objective should be weighted the highest. This results in higher total costs than in the case of assigning a higher weight to the objective of the DSOs.

Acknowledgments: We acknowledge the Centre for Intelligent Electricity Distribution (FME CINELDI) hosted by SINTEF. The centre is funded by the Research Council of Norway through the scheme of the Centres for Environment-friendly Energy Research (FME) and centre partners.

REFERENCES

- [1] N. Damsgaard, G. Papaefthymiou, K. Grave, J. Helbrink, V. Giordano, and P. Gentili, "Study on the effective integration of Distributed Energy Resources for providing flexibility to the electricity system. Final report to The European Commission," Tech. Rep., June 2015.
- [2] P. Crespo del Granado, R. H. van Nieuwkoop, E. G. Kardakos, and C. Schaffner, "Modelling the energy transition: A nexus of energy system and economic models," *Energy Strategy Reviews*, vol. 20, pp. 229–235, Apr. 2018.
- [3] S. Backe, P. Crespo del Granado, A. Tomasgard, D. Pinel, M. Korpast, and K. B. Lindberg, "Towards zero emission neighbourhoods: Implications for the power system," in *2018 15th International Conference on the European Energy Market (EEM)*, June 2018, pp. 1–6.
- [4] J. Tran, R. Madlener, and A. Fuchs, "Economic optimization of electricity supply security in light of the interplay between TSO and DSO," *FCN Working Paper No. 21/2016*, pp. 1–35, Dec. 2016.
- [5] Z. Yuan and M. R. Hesamzadeh, "Hierarchical coordination of tso-dso economic dispatch considering large-scale integration of distributed energy resources," *Applied Energy*, vol. 195, pp. 600–615, June 2017.
- [6] W. A. Bukhsh, C. Zhang, and P. Pinson, "An integrated multiperiod opf model with demand response and renewable generation uncertainty," *IEEE Transactions on Smart Grid*, vol. 7, pp. 1495–1503, Dec. 2015.
- [7] E. Mahboubi Moghaddam, M. Nayeripour, J. Aghaei, A. Khodaei, and E. Waffenschmidt, "Interactive robust model for energy service providers integrating demand response programs in wholesale markets," *IEEE Transactions on Smart Grid*, vol. 3053, pp. 2681–2690, Oct. 2016.
- [8] A. Nikoobakht, J. Aghaei, M. Shafie-khah, and J. P.S. Catalo, "Interval based robust chance constrained allocation of demand response programs in wind integrated power systems," *IET Renewable Power Generation*, vol. 13, pp. 930–939, Apr. 2019.
- [9] P. Crespo Del Granado, Z. Pang, and S. W. Wallace, "Synergy of smart grids and hybrid distributed generation on the value of energy storage," *Applied Energy*, vol. 170, pp. 476–488, May 2016.
- [10] J. Löfberg, "YALMIP: a toolbox for modeling and optimization in MATLAB," *2004 IEEE International Conference on Robotics and Automation (IEEE Cat. No.04CH37508)*, pp. 284–289.