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Impact of residential demand response on power system operation: a Belgian case study

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Abstract— The future power system is characterized by more renewable and uncontrollable capacity at the supply side and an electrification of energy at the demand side. Both evolutions increase the
26 need for flexibility in the power system. Although this flexibility can be triggered at the supply and demand side, the latter is often overlooked. In this perspective, this paper assesses the impact of the use of flexibility at the demand side, also referred to as demand response, on power system operation. A two?stage modeling approach is used which combines a day?ahead deterministic unit commitment model and an hourly simulation in real?time. This approach is tested for two alternative Belgian generation technology mix scenarios including a detailed representation of residential demand response. Hereby, realistic cycling patterns of white goods and mobility patterns of battery electric vehicles serve as an input. This approach allows to quantify operational benefits of demand response and to assess a potential introduction of demand response in power system operation. Results show that in general demand response contributes to a lower cost, higher reliability, and lower emission level of power system operation. Moreover, a higher amount of uncontrollable capacity increases these benefits and therefore the societal value of demand response.

Index Terms— Battery electric vehicles, demand shifting, demand response, renewables integration, system operation, white goods

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