Author: Timur Saifutdinov, PhD. Research associate at Newcastle University, UK.

Project: Multi-agent modelling of electricity demand flexibility

Abstract – Ubiquitous electrification of industries and households, as well as the high penetration of Renewable Energy Sources (RESs), require substantial transformations of the existing infrastructure in distribution networks. There exists a number of pathways to shape the power system to be effective in the future world, where the bulk energy comes from intermittent RESs and high electricity demand is expected. Among all options, including substantial network reinforcement and wide adoption of Energy Storage Systems (ESS), demand flexibility is expected to be the most cost-effective [1]. In contrast to the conventional top-down approach in operating power systems, demand flexibility implies dispatching controllable load, while the generation is intermittent and the control is limited. In this project, we propose a two-stage framework for assessing demand flexibility in distribution networks, where flexibility is considered a commodity traded locally within a distribution network. In the first stage, an optimization-based modelling approach is applied to determine the true price of flexibility and available capacity from various flexible assets, i.e., electric vehicles, heat pumps, ESS, non-renewable generation, industrial and commercial demand-side response. In the second stage, a multi-agent framework is proposed to determine equilibrium price under various market clearing mechanisms and competition levels.

[1] – Strbac, G., et al. "Role and value of flexibility in facilitating cost-effective energy system decarbonisation." Progress in Energy 2.4 (2020): 042001.