Electricity

Active Distribution System Management: Need to Adapt the Regulation of Electricity DSOs

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Technological advances are reshaping today's electricity markets. More mature technologies for local renewable generation, joint with national support schemes, led to a significant market penetration of distributed generation in many EU countries. A newly emerging broad range of distributed energy resources (DER), including also local storage, electric vehicles and demand response, are driving significant changes in the operation of power systems.

The market penetration of DER opens possibilities for decentralized trade of energy and allows for new business models, mainly related to the aggregation and marketing of DER. Also distribution system operators (DSOs) can profit from employing local energy resources in their daily tasks of ensuring system functioning and grid investments. However, to exploit the full range of potentials that DER offer, DSOs have to undertake significant upfront investments in grid (and related) infrastructures. For DER to flourish and to enable them to compete with resources connected to the transmission grid, DSOs also have to provide adequate conditions for network access and usage. New business models may potentially even lead to a paradigm shift that can shake up the traditional value chain and cause a radical change of the power market architecture as we know it today, replacing traditional downstream marketing of power by increasing reliance on local sources.

As a consequence, existing regulation needs to be reviewed in its full spectrum, considering the DSO's function as a network operator as well as its function as a market facilitator along the value chain (see Figure 1). Reviewing DSO incentives as a network operator implies revisiting regulatory schemes for allowed remuneration and resulting incentives to invest and innovate, as well as revisiting network tariff design, as the allowed revenue is collected via grid charges and the structure and format of these charges will have an important impact on grid users' behavior. In contrast, reviewing DSO incentives as a key player along the value chain implies revisiting the regulatory base of DSOs both vis-à-vis the transmission system operator and vis-à-vis competitive activities.

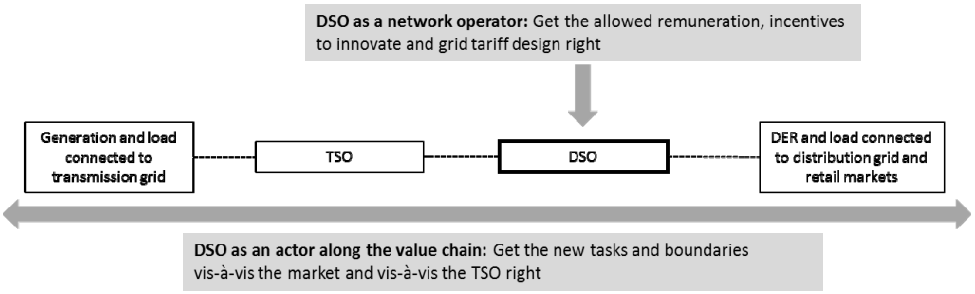

Figure 1: Relevant areas of regulation

The current regulation of DSOs needs updates to allow for welfare-enhancing DER technologies to be adapted efficiently and in a timely fashion. A major challenge is to revisit regulation such that distribution companies are not negatively affected by the development of DER and are incentivized to foster the integration of viable new technologies into the market. Moreover, updates are needed to provide the right regulatory tools to DSOs such that they can benefit from the services DER can offer for system operation and planning. Ultimately, the priority task of regulation is not to try to predict what the future will be, but to design incentives that make possible all welfare-enhancing business models under any future market development.

DSO remuneration: For high amounts of DER connected to distribution systems, the total costs of business-as-usual management of distribution networks (that is, a continued "fit-and-forget" grid management) will likely increase in most systems. Yet, increasing amounts of DER have a twofold impact on DSOs' cost structures: On the one hand, substantial investments are required to connect all new resources, to enable the system to deal with increased volatility of net demand, and to set up ICT infrastructure that empowers DSOs to employ DER for their daily grid operations. On the other hand, DER at the same time offer a new set of instruments for grid operation and thereby a tool for DSOs to perform their tasks of ensuring a reliable, secure and efficient electricity distribution.

Therefore, incentive regulation for DSOs has to allow for overall higher compensation of DSOs, but at the same time set sufficient incentives to invest in ICT

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and grid infrastructures in order to exploit the full potentials that DER offer for system services. Future regulation has to take account of i) changing OPEX and CAPEX structures, ii) the optimal choice among both, and of iii) how to incentivize DSOs to deploy innovative solutions.

Distribution grid tariff design: The present design of network tariffs does not provide a level-playing field among all agents that use the distribution network. With an increasing penetration of DER, business models exploiting, for instance, inefficient arbitrage possibilities caused by differentiated treatments of different DER technologies, or of certain types of producers and consumers, might flourish in the absence of sound tarification procedures. Moreover, grid users are becoming complex, sophisticated agents, which can have very diverse consumption and production patterns. The current paradigm, exclusively designed for pure consuming agents and where distributed generation was considered a minor exception, does not hold anymore.

Therefore, grid tariffs, on top of guaranteeing full cost recovery, should be able to convey efficient economic signals to the entire diversity of agents that may connect to the distribution grid. Tariffs should reflect the true costs (or benefits) of different types of load and generation for the distribution system, which will depend on an agent's geographic location in the system as well as on the profile of injection/withdrawal from the connection point. Any hidden subsidies should be removed and replaced by sufficient but direct subsidies that do not turn into inefficient signals.

DSO boundary vis-à-vis the market: There are a number of areas in the newly emerging market environment where there is no consensus about whether the respective tasks should be under the responsibility of the DSO or not. Different proposed (regulated as well as liberalized) models for e.g. the ownership and management of metering equipment, or data handling, all have their advantages and disadvantages. For all new infrastructure services it holds that when regulators opt for implementing these new tasks via DSOs, possible repercussions on energy and power markets have to be ruled out. With an increasing penetration of DER and the accompanying advent of new market actors and business relations, the negative effects of limited unbundling might become aggravated. When mandatory ownership unbundling is politically not enforceable, or is economically counterproductive for the customers' choice (through a drastic reduction of suppliers on the market) or for the customers' bill (through duplication of costs in separated entities or loss of synergy with other local utility functions), stricter implementation of unbundling requirements and market transparency measures should be mandated as more responsibilities are given to DSOs.

DSO boundary vis-à-vis the transmission system operator (TSO): When moving from 'passive distribution networks' towards 'active distribution system management', DSOs become agents that manage local markets for network services or directly purchase services with commercial value from other agents, and their role and organization will have an important impact on (retail) market functioning. Some of the products which DER can offer are relevant for either the TSO or the DSO, whereas other types of services might be of interest for both types of network operators. Hence, coordination and information exchange between TSOs and DSOs, from planning stage to operation, will play a particular role as the amount of DER increases and as DSOs become more active and exploit DER services closer to real-time delivery.

In the European context, regulation has to be in line with the three EU energy policy pillars and be kept at minimum level, respecting the principle of subsidiarity. Accordingly, we see neither the need nor a solid justification for an EU-wide comprehensive harmonization of the regulation of DSOs, although we recommend setting clear minimum requirements in a few key regulatory aspects, as well as the publication of EU guidelines to spread, encourage, and monitor good regulatory practices in some of the critical areas that have been identified in our paper.