Unlocking the potential of the grid edge for DSOs

Brussels, July 2022

1. INTRODUCTION

The ongoing energy transition, which has kept accelerating in the last years, is leading to new challenges related to the participation of active customers in the energy market. The diffusion of smart metering systems enables customers to have access to data about the connected devices and respective consumption, thus, managing their consumption more efficiently. But more importantly, DSOs have better observability of their networks ensuring grid reliability and security of supply. In this context, the interface between the grid and distributed supply/demand end-users referred in this document as "grid edge" – including electric vehicles, heat pumps, solar panels, home batteries etc. – will become increasingly important.

The access to data is essential in the energy sector, as it allows a closer monitoring of energy uses and flexibility needs and potentials by customers, operators and other third parties involved. In the case of grid operators, data from smart meters are critical to support the operations of electricity markets and improve the ability to observe electricity uses and the resulting impact on grid operation. Additionally, with the emergence and adoption of new uses of energy, it becomes mandatory to further implement solutions that lead to greater precision in the forecast of interactions with the grid, leading to a growing dependency and need to access data from the distributed resources. These interactions with the grid may be more conventional in nature (energy consumption/injection) or may result in active user participation in flexibility markets.

These data needs have several consequences, requiring precision and accuracy in the measures that support market operations and network management. It further provides access to a set of additional data from distributed and smart devices, that are fundamental for the correct forecast of system needs, all in an environment that must accommodate and guarantee cyber-physical security of the network.

Any regulatory intervention that encourages access and exchange to behind-the-meter data through open protocols and shared communication standards, might be appropriate. It is the only way for the DSOs' central role in the distribution network to be preserved.

The present paper elaborates on the above-mentioned themes, explaining, notably opportunities and risks deriving from the diffusion of the grid edge, emphasising the key role that can be played by smart meters and DSOs, and for which targeted regulatory interventions will be needed.

2. GRID EDGE DATA AND SMART METERS

2.1. DER and grid edge as game changers of the grid management paradigm

The decarbonisation of European energy system – with increasing penetration of distributed renewables, the electrification of heating, transport, and consequent active role of prosumers – is driving a radical change in the way in which distribution grids are managed, from both operational and planning perspectives.

The traditional grid investment models – of making investments to meet (almost) all customers' needs without congestion – is transitioning to one in which distribution network investments and stable grid operation are balanced against active congestion management, with DSOs deploying active system operation (i.e. *local flexibility services procurement and activation*) through the use of distributed energy resources (DER) connected to the grid. The potential savings in distribution grid investment and management arising from smart and flexible operations could be massive, depending on the local scenario.

In this context, the interface between the grid and distributed supply/demand end-users ("the grid edge") will become increasingly important to enhance the DSOs' capacity to observe energy users and related impacts, grid monitoring to improve electrical flows forecast, long term and short-term planning so as near real-time operation.

The grid edge includes a wide range of technologies and services able to collect, elaborate and transmit consumption/generation data with high level of detail under the grid-user interface: from electric vehicles to heat pumps, from solar panels to home batteries, and from smart meters to building control systems. The behind the meter detail can allow proper model of grid user behaviour based on weather forecast, city traffic data etc.

Such data availability, together with the possibility of using remote active control on generation units and loads by Flexibility Service Providers (e.g. aggregators), enable that distributed energy resources can also be equally used by TSOs and DSOs when operating their own systems, enhancing power system reliability and the integration of renewables, and thus supporting the achievement of decarbonisation targets.

Besides the indisputable potential that derives from an improved data availability provided by the grid edge, several risks arise related with reliability and consistency of such data, notably when generated by multiple third parties' devices, and acquired by DSOs/TSOs is not just used to make more accurate forecasts but it would be used to validate measurements related with the settlement of energy transactions. To that end, solutions must be deployed to guarantee the accuracy and to promote the precision in the forecast of interactions with the grid.

2.2. Smart meters as the reference point for the metering data

If not accordingly certified and verifies, measurements done by multiple devices managed by non-traditional energy service providers can potentially lead to inconsistent grid usage information. To cope with this issue, an official certified measurement method and procedure for aggregating, reconciling, and validating the relevant data is crucial, notably, when dealing with the settlement of energy transactions. Smart meters at grid-user interface (point of connection) are best placed and designed to play this central role.

Sub-meters can be beneficial from an informative point of view, in multiple ways: they can promote knowledge and best use of resources by users and those with whom they have commercial relations; and can improve network operators' visibility of network interactions and consequently optimise system operations.

The measurement function, supporting processes and requirements that are provided for in the regulation, should have a more formal nature, reflecting current practices in the use of smart meters and additional information.

The interaction between the DSOs' systems (smart meters) and the smart metering systems from the distributed resources (sub-meters), may not be narrowed down to the exchange of data on the use of electricity, but can also involve the exchange of other types of data, for example by sending activation signals or commands to the connected devices.

Nevertheless, smart meters may have the facility to deal with multiple channels, allowing separate types of demand to be treated differently. This would enable, for instance, an option for a house to have different suppliers for different aspects of their energy production or consumption, enabling new business models (*for example suppliers who deal exclusively with car charging, heating, or solar PV*).

Moreover, by making behind-the-meter data accessible to DSOs through smart meters, a more efficient forecast of the distribution grid loads would be allowed, from both real-time operation and planning perspective.

To this aim, new regulatory initiatives should be fostered to ensure data reliability, facilitate DSOs' access and exchange of behind-the-meter data, through the definition of minimum measurement standards, secure protocols for data exchange between smart meters and grid edge devices.

2.3. Devices connecting to the network and cybersecurity requirements

The increasing spread of distributed energy resources (DER), which plays an increasingly crucial role within the electricity system, requires adequate protection of behind-the-meter exchanged data.

Sharing data with numerous third parties, although also functional for the operation of grid-connected devices, exposes components of the electrical system to the risk of hacking, and thus to local risks of network instability.

Hence, it is imperative that these interactions are done through secure, certified, and regulation-aligned channels (DSOs' smart meters), that should enable aggregation of useful information for network operation and would allow DSOs to implement measures that guarantee proper use and protection of the data against misuse and cyber-physical threats.

3. CONCLUSIONS

Technological evolution is leading to the diffusion of a broad spectrum of energy measurement systems and intelligence to manage behind-the-meter devices (EMS), which generates a huge amount of data. Access to such detailed data is relevant for DSOs to ensure real-time grid management for adequacy, stability, and resiliency of distribution networks.

Among the plethora of grid edge devices collecting and sharing metering data, official smart meters (at point of connection) should be considered as the reference source of information, providing the only valid measurements of energy flows. Smart meters are and shall remain an irreplaceable tool essential

for DSOs to efficiently monitor the users' energy transactions, manage the network and provide the best services to the end-users, enabling prosumer engagement.

DSOs, as independent parties responsible for the secure management of distribution networks, must have the right to access to behind-the-meter data and to be the only responsible party for its validation in case those data would be used for settlement or even forecasting model. It is therefore necessary for behind-the-meter devices to communicate with smart meters through open protocols and shared communication standards and procedures, facilitating manufacturers of grid edge devices to develop products that are compatible with the widest possible range of existing smart meters.

The current regulatory framework should be enhanced to confirm and enforce the central role of DSOs in terms of data collection, management, and validation also under the light of new market entrants with the upcoming new behind-the-meter applications. This should also enable DSOs to have full control of relevant data on grid usage, being also able to implement adequate cyber-security measures to avoid system breaches, ensuring the safety of the power system.