EVOLVING ROLE OF DISTRIBUTION SYSTEM OPERATORS IN END USER ENGAGEMENT

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ABSTRACT

The European Commission communication on delivering a new deal for energy consumers places the citizens at the centre of the Energy Union, "where they take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected". Smart metering infrastructure is an enabling technology towards consumer empowerment, allowing for consumers' active participation in the energy market and promoting system flexibility through demand response schemes and other innovative services. It is the consumer's use of the smart metering systems however - and not the infrastructure in itself - that will improve system efficiency and ultimately lead to energy savings. In this context, the present paper will provide an overview of some surveys carried out at European level to help shedding light on which attitudes, preferences and concerns drive the consumption behaviour of European consumers and influence their engagement with new smart grid technologies. These insights will be taken into account to analyse the distribution system operator's (DSO) position in the future development of local distribution grids and energy related services. In particular, the role of technology acceptance and consumer engagement with the new technologies and solutions will be highlighted. Finally, conclusions on the need to further investigate different solutions, putting consumers at centre stage of their development, will be drawn.

INTRODUCTION

The increasing penetration of local renewable generation and the emergence of demand response enabling technologies are acting as main transformative forces in the power sector, making the distribution grids the primary recipient of all the new interactions initiated by these numerous distributed units. End users, both as prosumers and as active consumers, will increasingly be at centre stage of this transformation, taking advantage of the new possibilities enabled by smart metering systems. The role of consumers as the driving force of change in the transition to the new electricity system is increasingly acknowledged in policy documents1 as well as in the literature [1][2][3][4]. However, for consumers to successfully assume their new role as active participants in the electricity system and competitive retail market, engagement strategies need to be developed. This will also allow the DSOs to balance their networks more efficiently, in particular in presence of increasing amount of intermittent renewables. The current relationship between end users and the DSO, however, does not seem to fully capture the potential of demand side services and their role in active network management. Customer involvement necessitates understanding consumers' needs and DSOs will need to take greater effort in empowering customers and offering value propositions in order to secure the underlying end user engagement.

In this context, this paper will provide an overview of the new DSO's roles increasingly being investigated in pilot projects across Europe, highlighting the need for a consumer engagement strategy since the early stages of projects' development. In particular, the role and involvement of the DSO in consumer engagement strategies will be discussed and supported with representative examples of pilot projects from the JRC smart grid projects database [5].

Conclusions on the need to further investigate different solutions, putting consumers at centre stage of their development, will be drawn.

ENERGY CONSUMERS' ATTITUDES, PREFERENCES AND CONCERNS: A CLOSER LOOK FROM EUROPEAN SURVEYS

In recent years, several studies have been carried out to investigate consumers' awareness, perceptions and concerns of smart grid technologies [6][3][7]. These studies have acknowledged the positive attitude of consumers towards the new technologies, but they have also highlighted the need to address erroneous beliefs and misconceptions and to strive for trust, transparency and feedback to gain consumer involvement and acceptance. Few studies have focused specifically on the deployment of smart metering systems and on the factors that can promote or deter acceptance of the new technology [8][9]. More specifically, at European level, a number of surveys has been carried out to better understand the energy consumption behaviour of European consumers and to take their pulse regarding the adoption of smart metering systems. We have reviewed the results portrayed by the surveys carried out within three EU co-funded projects, *i.e.* Advanced, E-balance and USmartConsumer all focusing on consumers as active players of the new energy system. Even if not all Member States are covered by the analyses, the surveyed countries are representative of

1 COM/2015/080 final; COM(2015) 339 final; SEC(2010) 1407 final

different geographical areas and can give some useful information on the general trends occurring at European level. Among the common findings of the different surveys, the following are particularly interesting for the development and acceptance of smart metering systems, and in particular for demand side management solutions. Gaining more control over the electricity bill and monetary saving seem to be the most important drivers for the acceptance of the new technology in most of the surveyed countries. Another important motivation supporting technology acceptance is the preservation of the environment, particularly from the consequences of climate change.

As for the way of presenting smart meter data, the surveyed population shows a high interest in web portals, IHDs and smart apps, while the interest in text messages and paper bills is quite low. The surveyed consumers confirmed that smart meter data can be difficult to understand and that for better understanding they should be presented in several ways, e.g. through charts and tables. Finally, the surveys' results confirm that privacy and data security are still a major concern for consumers. All these findings need to be taken into consideration in the development of new smart grid solutions. Consumers' acceptance of the technology will play a crucial role for the actual deployment of smart grid solutions, but in order to grasp the benefits they enable, we need to move from technology acceptance to consumer engagement.

DSO ROLE IN ENABLING END USER ENGAGEMENT AND SUPPORTING ENERGY COMMUNITIES

In this section, we analyse the potential role DSOs may play in promoting end user engagement and development of smart energy communities. To substantiate the discussion on the new roles of DSOs, we looked into some of the recent projects included in the JRC database [5], which to date represents the most comprehensive and updated database of smart grid projects in Europe.

The Internal Energy Market Communication [10] initiated the discussion on the future role of DSOs and in particular the decoupling of their regulated activities and the new services made possible by new technologies in the transition to smarter electricity networks.

In particular, this discussion focused on the DSO's position in the future development of local distribution grids and energy related services [11]. Figure 1 depicts the potential direction of evolving DSOs' roles, highlighting the increasing degree of end user engagement they require.

Four main activities characterise the area of potential DSOs' roles: i) Provision of smart grid infrastructure, ii) data handling, iii) promotion of end user services and iv) support to the development of consumer-centred energy communities.

In all these areas end users play an increasingly important role, spanning from technology acceptance to engagement with the new technology. The need for end users involvement calls upon change in the way the DSOs interact with their customers.

In the rest of this section, we will provide examples from EU pilot project where DSOs are directly involved in deploying these services or contributing towards their evolvement.

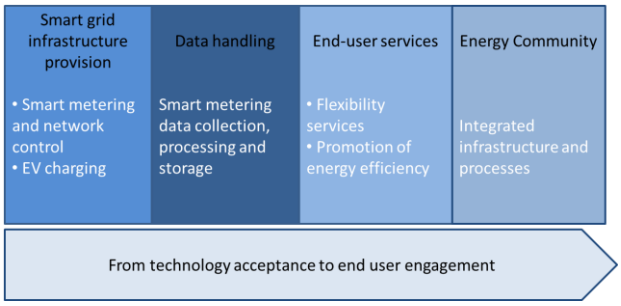

Figure 1. Evolving roles of DSOs in the interaction with end users

Smart grid infrastructure provision

Provision of energy smart metering infrastructure is encouraged by the EU Third Energy Package, targeting at least 80% of electricity smart metering deployment by 2020 of the positively assessed cases. Additionally, the Energy Efficiency Directive 2012/27/EU supports the development of energy services based on data from smart meters. In most of the EU countries, the DSOs appear as entities responsible for installation and operation of smart metering systems, as one of the core activities of their regulated business. Smart meters provide more accurate information to energy end users on their energy consumption. Besides, they allow for easier supplier switching, cost savings in meter operation due to remote meter reading, and savings of call centre costs. Furthermore, smart meters facilitate the exploitation of demand response and potential generation flexibility behind the meter. Recognising this potential, regulatory frameworks in several EU Member States, such as the Netherlands, called upon consumer involvement at early stages of smart metering national roll-out plans, in order to ensure wide end user technology acceptance [12]. Additionally to the smart metering infrastructure, DSOs may also appear as providers of charging infrastructure for electric vehicles. Electric mobility will strongly affect the distribution network operation and planning, in terms of new consumption patterns and network congestions.

Increasing focus of DSOs in EV projects has been observed in the last years and in particular on exploiting the potential of smart charging strategies as a flexibility source and alternative to distribution network reinforcement costs. For instance, the **MOBI.Europe project** focused on development of services through user-desired technologies and with a clear added value to the users and the community when compared to non-green mobility solutions. Similarly, four European DSOs

investigate the impact of smart charging strategies as response to high grid reinforcement costs in the recently concluded **Green eMotion project**. The consortium recognises the importance of social acceptance and investigates the social profitability with regard to actual benefits and costs. Also, the **I2EV project** delivers essential learning on managing the strain on the distribution network from the anticipated increased uptake of EVs, while outlining lessons learned for effective end user engagement. **Open ECOSPhERE project** goes one step further, aiming to deliver customer-oriented services such as new payment methods for optimal integration of electric vehicles in the energy systems using renewable energies.

Data handling

Development of new end user services within the smart grid environment depends on availability of data provided by metering equipment, both in the electricity network itself and at the customer premises. The data can be utilized by commercial actors, e.g. to realize energy savings through demand response as well as by grid operators for both short term system management as well as long-term grid planning. Ultimately, secure and effective data exchange among smart grid actors fosters the evolution of the energy retail market. The EC Smart Grid Task Force initiated the discussion on different models for handling smart grid data [13]. Many EU Member States, such as Spain and Italy adopted the model of DSO being the neutral entity managing and storing energy metering data, thus serving the role of a market facilitator. Evidence also shows an increasing number of projects with DSO's involvement focusing on the development of service-oriented platforms available to a wider spectrum of smart grid stakeholders (end users, DSOs, retailers, etc.). Such platforms offer the DSOs the possibility of data management by providing data analytics and aggregation services used to forecast the load and get enhanced insight into consumers 'load profiles (upon end user consent). An interesting example in this area is offered by the **Gridbox project,** which seeks to develop a highly distributed network of real-time measurement devices synchronized by GPS and used by the DSOs in their asset management, while at the same time allowing (local) market participation for prosumers and consumers. The project **EMPOWERING** provides scalable open source Big Data Analytics System coupled with the DSO's information systems, which delivers a range of value adding services for the customer, such as: comparison with similar households, indications of performance improvements over time, consumption-weather dependence, detailed consumption visualization and breakdown, personalized energy saving tips, alerts (high consumption, high bill, extreme temperature, etc.).
Provision of such information proves crucial in the process of end user engagement, where the DSOs are evolving towards information hubs, sharing information in an efficient and non-discriminatory manner with other parties while not compromising consumers' data privacy.

End users services

The EC New Deal for energy consumers places end user at the core of the Energy Union, "*where citizens take ownership of the energy transition, benefit from new technologies to reduce their bills, participate actively in the market, and where vulnerable consumers are protected"* This opens up new opportunities and perspectives for energy consumers to assume a completely new role as active participants in the energy market. On the other hand, DSOs, as entities responsible for ensuring secure and efficient operation of the distribution networks, could use this end user potential as a source of flexibility to enhance the operation and planning of their networks and ultimately respond to infrastructure investments needs. Flexibility services are related to the ability of power system actors to adapt and anticipate to uncertain and changing power system conditions, in a swift, secure and cost efficient manner [11]. The success of flexibility services, in the form of demand response, will ultimately depend on end users' willingness to change generation and demand patterns in exchange for financial or other types of incentive. Therefore, the crucial aspect of tapping into the potential of flexibility is presenting end users with a proposition which can be clearly understood and related to their use of energy. The UK DSO participates in the **Sunshine tariff project**, where it seeks to develop and trial the feasibility of an "*offset connection agreement*". These agreements will enable additional renewable generation customers to connect to the grid (which otherwise would need to be curtailed) on the basis that the additional demand can be sourced to offset the generation. The **Flex4Grid project** aims at creating an open data and service framework that enables a novel concept of prosumer flexibility management, based on cloud service platform, able to offer new services to DSOs and prosumers. DSOs benefit from data analytics to forecast and influence the load on the grid avoiding blackouts caused by network overloads or lack of power supplies. Similarly, the **Flexiciency project** explores the role of DSOs as market facilitators for enabling novel services in the electricity retail markets, such as advanced monitoring, local energy control and flexibility services, based on the provision of "real time" data. Two EU DSOa have a central role in the **Smart-HG project**, which aims to develop a service-oriented platform for: i) enabling optimization of the distribution network operation and generating individualized power profiles for all users of a single substation and ii) forecasting residential user behaviour for developing tailor-made advises for each end user on energy/cost savings.
In addition to the flexibility services, DSOs play relevant role in promoting energy efficiency. Smart grids in

combination with smart metering can provide detailed information on usage in order to (i) inform consumers; (ii) help identifying cost effective options for energy savings and creating new business opportunities for investments in energy savings.

The **EvolveDSO project** recognize the importance of DSOs as market facilitators in promoting and offering energy efficiency services and thus seeks to explore future roles of DSOs. In this context, the Spanish integrated utility GNF leads the **3e-HOUSES project** focusing on integration of ICT technologies in social housing in order to provide an innovative service for energy efficiency. Similarly, UK Power Networks leads the **Vulnerable Customers and Energy Efficiency project** with overarching aim to enhance the DSO's insight into the needs of customers classified as vulnerable and fuel poor, and to explore how to engage with them to facilitate their increased participation in energy efficiency and time-of-use tariffs.

DSO role in supporting the emergence of energy communities

In several projects in the JRC database, DSOs have partnered with local actors to support the emergence of energy communities. For example, the Scottish DSO in **Ashton Hayes Smart Village** aimed to closely work with an engaged community to better understand how increased small scale generation would affect the network while also helping Ashton Hayes reduce its carbon footprint. It also explored the relationship between the DSO and the community, establishing a blueprint for community engagement that could be adopted for projects across the country and integrated into normal business practice of the DSO at a much larger scale.

Another example is the **RESILIENT project** which aimed at the development of an open energetic ecosystem, based on integrated combination of the micro grid and energy hub concepts applied at district level. Similarly, other smart grid projects, such as **Hook Norton low carbon community, Cloud power Texel, Energy neutral Heijplaat,** focus on the deployment of advanced distribution network communication and control infrastructure, as a backbone to sustainable energy communities. The **e-Gotham project** goes one step further in exploring dynamic microgrid tariffs designed to take into account load in the secondary substation and consumption at consumer's/prosumer's level.

CONCLUSIONS

In the coming years DSOs will be faced with new challenges and opportunities in relation to the increasingly important role the end users will play. The pilot projects in the JRC database show that DSOs have been very active in testing and validating new technical solutions and forms of interaction with end users. These projects are testing new concepts and stakeholders' roles and as such present relevant source in informing future sector regulation. DSO is likely to play a vital role in facilitating consumers' market participation and uptake of the energy retail market; however, there is still a need to further investigate different solutions, putting consumers at centre stage of their development.

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