BUSINESS MODELS FOR DEMAND RESPONSE RELATED TO SMALL- AND MEDIUM-SIZED PROSUMERS – NEW STAKEHOLDERS AND THE ROLE OF DSOs

Guntram Pressmair[1], Klemens Leutgöb[1], Christof Amann[1], Dimitrios Tzovaras[2], Dimosthenis Ioannidis[2]*

[1]*e7 energy innovation & engineering , Vienna, Austria*
[2]*Centre for Research & Technology Hellas (CERTH/ITI), Thessaloniki, Greece*
* guntram.pressmair@e-sieben.at

Keywords: DEMAND RESPONSE, BUSINESS MODELS, DSO, AGGREGATOR

Abstract

The concept of demand response (DR) is considered a promising approach for covering increasing demand for flexibility in our electricity system. In this paper, firstly an overview of relevant flexibility markets for DR is given and the role of distribution system operators (DSOs) is highlighted. Then, novel business models making use of demand side flexibility at small- and medium-sized prosumers are identified and assessed by carrying out a business model canvas analysis. In this context, new market players in the field of DR are discussed, including aggregators and flexibility service companies. Also, organisations potentially assuming those roles are mentioned such as facility managers, technology providers, energy retailers and microgrid managers. Finally, the implications on DSOs arising from such business models are considered. The paper concludes, that the decisive factor for economic viability of DR business models targeting small- and medium sized prosumers are transaction costs. Those need to be strictly minimised by applying automated aggregation platforms and by making use of existing customer channels. DSOs need to maintain a neutral position, providing meter data and procuring local flexibility demand. More active roles of DSOs dispatching loads at prosumers' sites and therefore gaining local flexibility need to be further specified by the regulatory framework.

1. Introduction

The energy transition leads to an increasing share of fluctuating renewable energy sources in our energy mix and as a result also implies a significant need for rising flexibility in the electricity system. A promising approach for coping with this challenge is the concept of demand response (DR). For large power consuming companies various DR schemes are already in place in some economies, but could the concept of DR also work for small and medium-sized customers from the residential or tertiary sector? Technical solutions facilitating this application are already existing, but there is still a need for developing appropriate business models. In this paper, several possible business models are identified and assessed concerning their practical feasibility by applying a business model canvas analysis. Against this backdrop, the roles and responsibilities of different market players need to be defined and clarified in order to create a sound DR environment. Here, novel market players and especially the involvement of DSOs will be discussed. At first an overview of various heterogenic flexibility markets is given and the potential perspectives for DSOs are described. Then each of the potential business models is discussed in brief, highlighting the roles of relevant stakeholders. Finally, conclusions for future market development are derived.

2. Flexibility markets for DR

In this section, a practical classification of flexibility markets is presented, describing those markets that are potentially relevant for DR. For developing business models, it is important to understand the heterogeneity of these markets. With different market players involved, they follow different, sometimes contrary reasoning and try to solve different technical problems.

2.1 Wholesale market

On the wholesale market larger consumers (e.g. energy intensive industry), energy retailers and DR aggregators can trade electricity. This can happen either on the European Energy Exchange (EEX) or bilaterally (over the counter - OTC). The EEX is a standardised and organised market and is divided into the forward and the spot market (Day-ahead and Intraday). On the wholesale market actual dispatched loads are traded. Therefore, flexibility can be traded in terms of positive energy (supply of energy/reduction of consumption) or negative energy (consumption of energy/reduction of supply). Prices on the wholesale market take into account flexibility needs from the perspective of power generation (e.g. due to fluctuating renewable energy sources). The wholesale market does not directly consider the status of the grid, but may cause serious grid issues.

2.2 Balance groups

All market participants on the electricity market (producers, traders, consumers) have to be members of a commercial balance group (BG). These balance groups are financially responsible for their own balance, i.e. the balance between production and consumption. Deviations from the schedule to be reported to the transmission system operator (TSO) or control area manager (CAM) result in costs for imbalance and hence, BGs are interested in minimising imbalances. In the context of DR, flexibility can be sold within or between balance groups bilaterally (OTC). On this market, participants are focussing on the reduction of imbalance costs by avoiding deviations from reported schedules. As balance groups are not physically connected, grid conditions are not considered but may be affected.

2.3 Ancillary Services/Balancing Market

According to the definition in [1], ancillary services include a range of products supporting grid operation and balancing of the grid. Frequency control can be referred to as one of the most important ancillary services with respect to DR and it is traded on the control energy or balancing market, where the responsible TSO/CAM procures balancing services. Market players can generate revenues from keeping capacities available that can provide frequency control in a given timeframe and from each actual dispatch. Therefore, ancillary services markets are tackling grid imbalances, but mainly on TSO level.

2.4 Retail Market

Final consumers are facing an increasing amount of dynamic tariff offers. Therefore, flexibility can also be generated through the retail market, when consumers try to minimise costs within their dynamic tariff. This can be referred to as implicit DR. Due to regulatory steps, e.g. related to Art. 11 of the EU Internal Electricity Market Directive [2], it is expected that the size of this market will grow significantly in the coming years. Flexibility triggered on this market serves the perspective of power generation. On retail level, grid constraints could be only taken into account through dynamic grid tariffs charged by the DSO. However, only a few examples exist for this aspect.

2.5 Local Flexibility Market (LFM)

According to [3], an LFM is an electricity trading platform to sell and buy flexibility within a local (energy) community. In this context flexibility can be traded either in terms of peer-to-peer energy exchange among community members or via an aggregator offering demand-side flexibility to parties such as TSO, DSOs or BGs [4]. LFMs can be seen especially as promising providers of ancillary services for DSOs, namely for local congestion management and voltage control. Therefore, LFMs may allow DSOs to prevent grid issues and postpone grid reinforcements [3].

3 DSOs’ role at flexibility markets

From the viewpoint of the Council of European Energy Regulators (CEER), DSOs generally must act as neutral market facilitators and in the public interest. Therefore, they should not be allowed to operate in areas that are, in principle, open to competition among market participants. This includes the provision of flexibility services [5]. According to that, there are two major roles for DSOs in the future. Firstly, DSOs should be involved in flexibility markets only by procuring flexibility services in the distribution system in order to maintain grid operation on the local level [5]. Such ancillary services include mainly local congestion management and voltage control [6]. However, there are examples where DSOs are managing direct load control at consumers’ sites, for instance in programmes from the US as well as in European R&D projects [7]. Against this backdrop, CEER finds it important, that network users can always take their own decisions on how to provide flexibility services to either DSOs or the electricity market [5]. In the concept proposed by [3], the marketing of local flexibility resources should be generally conducted by independent aggregators. Only in critical situations, the DSO could override existing contracts and request flexibility from prosumers to stabilise the distribution grid. Secondly, a core task of DSOs is to provide energy companies with raw meter data, where they are responsible for metering. With the roll out of smart meters and the according consent of consumers, high quality data should be made available to service providers such as suppliers or aggregators, facilitating new products like dynamic retail energy prices [8].

4 DR Business Models

In this chapter, for each of the identified DR business models the results of a Business Model Canvas Analysis are discussed, highlighting the roles of new market players and DSOs.

4.1 Independent Aggregator

In this business model, a DR aggregator as an independent market participant is bundling loads and marketing DR potentials from a large number of prosumers, which are too small to offer their loads individually on the various flexibility markets (Fig. 1). This can be referred to as explicit DR.

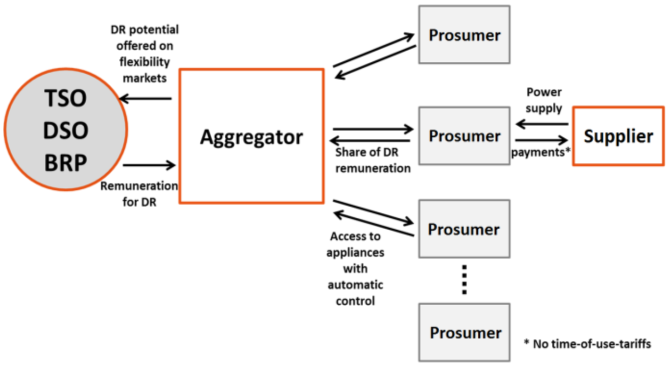

Fig. 1 Roles in the Independent Aggregator business model

The aggregator has to strictly minimise and automate customer interaction, as profits from single prosumers are expected to be very low and therefore only economies of scale can facilitate an economically viable business model. For this purpose, a highly automated aggregation platform needs to be available. Furthermore, for an independent aggregator as a novel market participant, there are no existing channels that can be used to identify relevant prosumers. The potential of prosumers to provide flexibility depends on their general level of energy consumption/production as well as on the individual DR potential of their devices operated. To reduce customer acquisition costs, aggregators therefore need to build up strong partnerships with players that already have existing channels in place (such as facility managers) or even merge their business model with these players as proposed in some of the following models.

4.2 DR & Energy Efficiency Service

Eventually an aggregator can improve its position if he engages in a partnership or a fusion with an ESCO, that provides energy efficiency services such as energy performance contracting (EPC). In this way, synergies between the business models of ESCO and aggregator can be exploited, for instance related to on-site visits and communication with the client. Here, the customer segment is the same as for energy efficiency service projects and therefore is limited to customers with energy cost beyond 20,000 to 30,000 €/a in most European markets. However, there exists a trade-off between energy efficiency and demand response, as load shifts in many cases will lead to an increase of energy consumption. Therefore, the main challenge of this business model is to find an optimised solution for this trade-off on a daily basis supported by an automated platform.

4.3 Optimal Use of Dynamic Tariffs

The time-dependent component of a dynamic tariff may relate to the electricity supplied or to the utilisation of the grid, where the latter is defined by regulation. Currently, for small- and medium-sized prosumers, the only available tariffs are time-of-use (ToU) tariffs, incorporating different prices during different time periods within a day, but there is good reason to expect that more dynamic tariff models will appear in coming years. Novel market players that may arise in this context are so-called Flexibility Service Companies (FLESCOs), enabling implicit DR. A FLESCO can take care of load shifts at prosumers' equipment, maximising their benefit from a dynamic tariff. The FLESCO's remuneration may be either a fixed or performance-based service fee (Fig. 2).

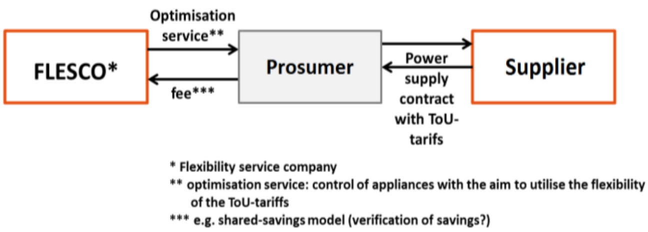

Fig. 2 Roles in the Optimal Use of Dynamic Tariffs model

The economic feasibility of the business model is depending on the spread between high and low prices in the tariff structure. Only if the spread is sufficiently high the achievable savings will be attractive for clients to engage a FLESCO. To address small- and medium-sized prosumers, this service needs to be embedded in existing service packages. The FLESCO needs to have available a platform for automated control of the devices to adjust the current load according to the current price in the prosumer's tariff. For a FLESCO this is more important than the aggregation functionality.

4.4 DR & Electricity Supply

In this business model the retailer is shifting loads at the prosumers' sites through an aggregation platform in order to optimise its supply portfolio. For a supplier, using this DR potential may lead to savings both in wholesale prices and in balancing energy payments. This is particularly attractive for retailers that are also producers with a high share of fluctuating renewable energy sources (wind, PV). In return, prosumers benefit from a more attractive electricity tariff when engaging in such a DR scheme. Especially related to household prosumers, a retailer has the best existing channels as there is already a large number of prosumers under supply contracts. From a technical perspective, the aggregation platform has to automatically synchronise the use of DR potentials with the retailer's production patterns and the wholesale market prices.

4.5 DR & Equipment Provision

Another group of players that could newly enter the DR business are equipment providers. They can be either typical manufacturers of specific devices such as heat pumps, or providers of device coupling systems such as building energy management systems. Potentially, they can act as DR aggregators or as FLESCOs. However, it is more likely for an independent equipment provider to assume the role of a FLESCO, as the aggregator role implies higher complexity and requires experience with respect to explicit flexibility markets. Their main advantage in this business model is twofold. Firstly, when selling products with high DR potential (e.g. heat pumps, battery storage), they can additionally offer their DR service and therefore accurately target prosumers with suitable DR capacities. For an aggregator or a FLESCO it is highly relevant to know the exact shiftability and DR potential of the devices. Secondly, synergies can be created resulting in reduced transaction costs, for instance concerning on-site works.

4.6 Microgrid Management

A microgrid can be defined as a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the (macro)grid [9]. Related to DR, microgrids are promising players for future market uptake. A professional software solution for managing and dispatching the various loads is a "must" for microgrid managers. Therefore, from a technical point of view microgrids are in a good position to make use of their demand side flexibility resources. This is also true in terms of relationships and channels to the final flexibility providers, who may be anyways controlled by (e.g. university campus) or at least under a specific service contract with the microgrid manager (e.g. residential microgrid). Generally, a microgrid manager can act as a FLESCO or as an aggregator. Promising future microgrid operators are so-called Citizens or Renewable Energy Communities, that are going to emerge based on the national implementation of the EU Directives for Internal Electricity Market and Renewable Energy. In the case this business model is applied by a microgrid according to the definition provided above, there are only limited implications for the DSO, as the microgrid acts as a single prosumer. This "single prosumer" might be even better balanced than a normal prosumer due to the optimised self-consumption in the microgrid.

4.7 Implications for DSOs

New business models arising in the field of DR generally affect DSOs in multiple ways. When demand side flexibility is provided to other parties requesting flexibility, such as TSO/CAMs, BRPs or market participants on the wholesale market, it is possible that the need for local congestion management increases: for instance, temporarily low prices on the wholesale market can lead to particularly high demand in a certain area, causing exceptional loads in the distribution grid. As a result, DSOs necessarily need to step in to gain flexibility for themselves in order to secure grid operation. Firstly, this can happen through procurement of an increasing amount of local flexibility, probably via independent aggregators or local microgrids and energy communities. Secondly, a DSO could be legally granted the right to override DR contracts in order to gain flexibility for solving grid constraints in emergency situations. Thirdly and finally, a DSO could be empowered to incur dynamic and eventually also locally differentiated grid tariffs, stimulating implicit DR. On the one hand, rigorous dynamic grid pricing could contradict the price signals from e.g. the wholesale market, but on the other hand, also the explicit procurement of flexibility by the DSO has to be reflected in grid tariffs. Furthermore, the DSO's role of a data provider becomes more relevant with increasing DR market uptake for small and medium loads. All of the novel market players assuming the role of DR aggregators need to be provided with meter data of prosumers involved in a DR scheme. In this context, the DSOs need to be able to safeguard personal data and make sure all market participants are treated equally with respect to access to data.

5 Conclusion

The profit margin in DR business models for small- and medium sized prosumers is expected to be rather small for single users. In order to establish economically feasible DR business models, it is thus crucial to strictly minimise transaction costs, including costs for customer acquisition, contracting and on-site works. From that perspective, only approaches will be successful that make use of existing channels to potential clients, reduce contracting costs by efficiently deploying "smart contracts" and implement highly automated aggregation platforms, enabling economy of scale. Potentially, there are several novel market players in the field of DR that have been described in this paper. They may act either as independent aggregators or so-called FLESCOs, or may assume one of these roles and therefore extend the scope of their core business. All these players are facing different starting positions for entering the DR market. Generally, the authors conclude that embedding the service of an aggregator or FLESCO into existing service packages, such as energy efficiency services, facility management or technology provision, could create promising business models. For households, currently only the retailer model seems to be promising on the long run due to small profit margins and the privileged position of retailers towards household customers. For DSOs, market uptake of these business models implies a more active role as a data provider and potentially an increasing need for local flexibility to ensure grid stability. In this context, the future improvements of the regulatory framework will further define the options of a DSO related to demand side flexibility.

6 Acknowledgements

This paper has been prepared in close connection with the DELTA project (www.delta-h2020.eu), which received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 773960. The authors are grateful to the whole project team for fruitful collaboration and valuable inputs with respect to business model development for DR markets.

7 References

[1] Agricola, A.-C., Seidl, H., Rehtanz, C. et al.: 'dena Ancillary Services Study 2030' (German Energy Ag., 2014)

[2] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU

[3] Olivella-Rosell, P., Lloret-Gallego, P., Munné-Collado, I. et al.: 'Local Flexibility Market Design for Aggregators Providing Multiple Flexibility Services at Distribution Network Level', Energies, 2018, 11(4), 822

[4] Klaassen, E., van der Laan, M.: 'USEF White Paper Energy and Flexibility Services' (USEF Fdn., 2019)

[5] CEER: 'New Services and DSO Involvement – A CEER Conclusion paper' (CEER, 2019)

[6] USEF: 'The Framework Explained' (USEF Fdn., 2015)

[7] Cobelo, I., García, E., Gil, S. et al.: 'D2.2 Report On Services Provided By DSOs To The Retail Market' (H2020 UPGRID project, 2016)

[8] CEER: 'Review of Current and Future Data Management Models (CEER, 2016)

[9] 'Microgrids at Berkley Lab', https://building-microgrid.lbl.gov/microgrid-definitions, accessed 16 March 2020