New business models at distribution grids: a stakeholder consultation

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Abstract

In this paper, four business models are presented and discussed from the perspective of different stakeholders or actors in the ecosystem, either because they are involved in their implementation or affected by them. This discussion derives from interviews conducted with 31 representatives from industrial consumers, energy regulators, policymakers, distributed energy resource (DER) owners, TSOs, DSOs, retailers, aggregators, ESCOs, and data service providers. The consultation covered experts from four European countries, namely Portugal, Sweden, Slovenia, and Spain. The business models under consultation included the (i) use of flexibility by DSOs, (ii) aggregation through the Virtual Power Plant (VPP) concept, (iii) consumers (industrial and residential) energy usage optimization and flexibility provision, and (iv) the concept of data service provision through data platform. We conclude by identifying the most relevant drivers and barriers identified for each business model. Barriers are subdivided for each business model according to three categories, namely (i) regulatory, (ii) technological, and (iii) organizational or behavioural.

1 Introduction

The deployment of smart grids, the empowerment of consumers and energy use decarbonization is not only changing the way electricity is produced, distributed, and consumed, but is also opening the possibility for new business models (BMs) [1], [2]. In this paper, we analyse four new BMs at distribution grids. BMs are here understood as a set of strategies chosen by a main actor in order to generate economic benefit. These strategies can combine multiple business plans, and the economic benefits can be generated by different sources of revenue streams and/or cost reductions.

The BMs under consultation included the (i) use of flexibility by DSOs, (ii) aggregation through the Virtual Power Plant (VPP) concept and provision of service to both DSOs and TSOs, (iii) consumers (industrial and residential) energy usage optimization and flexibility provision, and (iv) the concept of data service provision. The latter could be considered the most innovative BM, in which the main actor, new or incumbent (e.g. retailers, ESCOs) would provide data services (e.g. forecasts, energy optimization) based on the metering and other data that could be made available by data hubs. A complete description and discussion of each BM is found in [3].

This paper leverages on the work developed within the H2020 InteGrid project. Additional information on the definition of BMs and the stakeholder consultation process and results can be found in [4] and [5], respectively.

2. Methodology

For this consultation, relevant stakeholder for each BM were identified. For that purpose, a power/attention matrix is used, based on the methodology proposed in [6].

In this paper, authors interviewed representatives from the key actors in four different countries, namely Portugal, Slovenia, Spain and Sweden, following an in-depth personal interviewing methodology. Respondents were asked to discuss the perceived drivers and barriers, as well as other financial, regulatory or social feasibility issues related to these new business models.

In total, 31 personal interviews took place. To preserve anonymity, the role of the actor is reported, rather than personal details that could make the informant identifiable (Table 1). In addition, citation attribution is not made per nationality if this might make the informant identifiable.

Table 1: Description of interviewees

| Stakeholder                          | PT | SI | ES | SE | Total |
|--------------------------------------|----|----|----|----|-------|
| End users (industrial association, prosumers representatives, DER owner) | 2  | 5  | 1  | 1  | 9     |
| System operators (DSO/TSO)           | 1/1| 1/1| 2/1| 2/1| 10    |
| Retailer and energy service providers (ESCOs, Aggregator, Retailers) | 1  | 2  | 2  | 1  | 6     |
| Regulators/policy-makers             | 1  | 1  | 2  | 2  | 6     |
| Total country                        | 6  | 10 | 8  | 7  | 31    |


Interviews followed a semi-structured approach. The analysis of the interviews led to the identification of drivers and barriers for each BM. Barriers were classified into regulatory, technological and organizational/behavioural. Additionally, the “level of agreement” was also observed. A high level of agreement means that most or all participants agree with the driver/barrier, while a medium level of agreement means that two or more participants mentioned/agreed on the same barrier. However, most drivers/barriers were mentioned by only one respondent, thus no level of agreement can be inferred.

3 Results per Business Model

3.1 DSO procuring local flexibility for grid management

This BM is defined as the procurement of local flexibility from distributed energy resources (DER) by the DSO (main actor) as a means to help manage the grid (e.g. solving local congestions or voltage problems). By doing so, the DSO could potentially benefit from reinforcement deferral or even avoidance.

DSOs agree that procuring flexibility services will be part of their future, as a means to defer or avoid network reinforcements. However, they believe that regulation does not provide the certainty or incentives DSOs need to proceed. Firstly, they mentioned that the necessary economic incentives to promote the use of flexibility are missing. Secondly, they currently bear the full risk in case flexibility providers fail to provide the service, leading to grid problems and/or interruptions. Lastly, on the institutional realm, DSOs mentioned that they may face some internal resistance to adopt this BM.

Regulators generally agree that promoting the use of flexibility by DSOs is necessary if DERs keep increasing as expected. They mentioned that the current CAPEX-oriented regulation is an important barrier for DSOs, but did not have a clear view of where future regulation should go. Interviewees also mentioned the lack of local flexibility mechanisms as an important barrier. Some participants mentioned public consultations and pilots as a way to overcome this, while one interviewee remarked the importance to coordinate local flexibility procurement with tariff schemes.

TSOs expressed their concerns about the inefficiencies of local mechanisms, especially market-based ones, due to their lack of liquidity. From the grid operation standpoint, TSOs mentioned that congestions in the grid should be the exception, and not the norm. Additionally, they mentioned that forecasting will become more difficult for the TSO, and that TSOs and DSOs will have to share the responsibility of the security of supply.

Other stakeholders also commented on this BM. For instance, one DER owner deemed it difficult to provide the service to the DSO as they have no visibility over where and when flexibility will be needed, and the absence of clear pricing schemes. One policy maker mentioned that incentives are missing for both the DSO and the consumers. Retailers and ESCOs stated that additional hardware and communication would be necessary from their side. Likewise, aggregators were concerned about the lack of harmonization of local flexibility products and procedures across Europe, jeopardizing the scalability potential of aggregation tools and operations.

Table 2: List of drivers and barriers for the local flexibility procurement by DSOs

| Stakeholder | Driver or Barrier |
|-------------|-------------------|
| **(D)**     | This BM is considered relevant and DSOs are already considering it internally (***). |
| **(B-R)**   | Lack of economic incentives and financial compensation for flexibility procurement (***). |
| **(B-R)**   | DSOs’ role in demand flexibility buying is not enabled by current regulation (***). |
| **(B-T)**   | Missing communication and interoperability mechanisms facilitating flexibility. |
| **(B-I/B)** | Corporate inertia |
| **(D)**     | Local flexibility procurement will be necessary in a scenario with DER penetration (***). |
| **(B-R)**   | Lack of local flexibility mechanisms (coordinated with grid tariffs). |
| **(B-R)**   | Efficiency of local markets for congestion management (***). |
| **(B-R)**   | Split of liquidity between TSO and DSO markets (**). |
| **(B-R)**   | Forecasting becomes more difficult for the TSO (***). |
| **(B-R)**   | Sharing security of supply responsibility between TSO and DSO (**). |
| **(B-R)**   | Lack of appropriate information regarding grid constraints. |
| **(B-R)**   | Lack of proper local flexibility pricing |
| **(B-R)**   | Lack of proper local flexibility pricing |
| **(B-LB)**  | Little economic incentives for consumers to provide flexibility |
| **(B-T)**   | Additional infrastructure is required to provide local flexibility to DSOs |
| **(B-R)**   | Different solutions across Europe may limit the replicability of solutions developed by aggregators |

Legend: **(D)** Driver; **(B-R)** Barrier, Regulatory; **(B-T)** Barrier, Technological; **(B-I/B)** Barrier, Organizational/Behavioural; Level of agreement: (***) high, (**) medium

3.2 Data services and platforms

In this BM, a new (or incumbent) agent, here referred as a data service provider (DSP, main actor), uses metering data stored in central data hubs, if authorized to do so, to provide data services (e.g. forecasting, energy management, portfolio optimization for aggregators), either in B2B or B2C modalities.

This BM captured different stakeholders’ attention, including DSOs, industrial consumers, policy makers, retailers/ESCOs, aggregators, regulators, and a possible DSP. They emphasized the innovative approach that this BM implies.
Whilst they all agree that data platforms will necessarily develop and some stakeholders believe this will be useful, some stakeholders are sceptical of the value data platforms will create. The most relevant barrier, on which there is a general consensus, is the difficulties in accessing the data as required to provide data-driven energy services. The first reason may be the refusal or lack of interest of many end consumers to share their data. This can lead to a vicious circle in which consumers are not offered value due to the limited access to data, and consumers not accepting to sharing the data due to the low perceived value. As a possible solution, one DSP believed that some early consumers, who allow for using their data, could be offered cheaper retail deals in exchange, progressively leading to a change in behaviour. Nevertheless, another reason, which draws a very high level of agreement across stakeholders, is that data protection regulation seriously limits innovative data service opportunities.

Besides the data access problem, interviewees identified two other important barriers. Firstly, a potential DSP mentioned that the EU is unlikely to harmonize the data access and procedures. That means that the DSP will have to create different solutions in different countries, which constitutes a major barrier, considering that data service provision will be a low-margin business and needs to be scalable to be profitable.

Another risk for this BM identified by one stakeholder is that IT companies are already gathering electricity-related data (or inferring this data) outside the metering infrastructure. That means that these companies could soon be able to offer very similar services in a much more dynamic business model, as they are less bounded by energy regulations.

Table 3: List of drivers and barriers for data services and platforms

| Stakeholder | Driver or Barrier                                                                 |
|-------------|-----------------------------------------------------------------------------------|
| DSOs        | (B-R) Prohibition of data use and data sharing (***)                             |
|             | (B-I/B) Limited value of data services for DSOs                                  |
|             | (B-R) The “data hub” should not be a single platform, but rather an environment of multiple interoperable platforms. |
| DER Owner   | (B-T) Interoperable protocols that can link different platforms Communication and settlements (P2P) |
|             | (B-I/B) Other players (e.g. data companies) may take this market over with faster and more dynamic BMs |
| Policy Maker| (B-R) Prohibition and security reasons block data use and data sharing, even at a non-individual level |
|             | (B-I/B) Consumers are the only data owners, limiting data access for research, even if not at individual level |
|             | Weak signals of change and opening                                                 |
| Retailers / | (D) Attractiveness of better offers for customers thanks to more information and competition |
| ESCOs       | (B-R) Data protection policy                                                      |
|             | (B-T) Communication infrastructure                                               |
| Aggregators | (B-R) Regulatory uncertainty                                                     |
|             | (B-R) Data protection and privacy barriers                                        |
|             | (B-T) Metering data is insufficient for some data services                       |

On the provision of flexibility to grid operators, the industrial consumers also see different barriers. Some interviewees said they would participate in service markets, and some already do it (e.g. in tertiary reserve). However, others mentioned that they would not participate, as this would imply them changing their production schedules for a small benefit. Additionally, some industrialists mentioned that they could not change their consumption to comply with balancing products requirements (traditionally tailored to centralized generators).

The residential consumer’s association mentioned three main barriers, especially about flexibility provision: i) low price elasticity of consumers, ii) difficulty in understanding electricity markets, and iii) general mistrust in electricity companies. Therefore, consumers would be...
less willing to give away the control of their consumption for what they anticipate is a reduced economic benefit. Other stakeholders also expressed their opinions and concerns. The DG owners, for instance, highlighted that energy and service markets (e.g. balancing) are not completely open yet for DER participation. It was also mentioned the need for advanced infrastructure (communication) for these services to be provided. Aggregators mentioned that individual consumers are less aware or motivated regarding new possibilities, but that it could be more attractive for community users. However, one aggregator sees regulatory uncertainty over energy communities as a barrier.

**Regulators** also commented extensively on this BM, particularly on the need to re-design electricity tariffs to promote an efficient behaviour from end-users. Interviewees recognized that current tariff structures do not promote flexibility, but several mentioned different barriers, such as the lack of sufficient historical metering data to support tariff design changes due to the recent smart metering deployment, fear of causing unintended consequences or complaints from end-users, or even the reluctance from some incumbents or policy-makers to these changes. Additionally, regulators identified aspects already mentioned before, such as the low interest from the consumer’s side to adopt advanced tariff schemes due to the small benefit perceived.

Finally, **TSOs** also expressed their expectations and concerns. They recognize that demand response (DR) participation will be very beneficial to overall efficiency of balancing markets. However, they expressed the possible internal resistance in TSOs due to doubts about the ability of DR to participate in complex and sensitive services for the system, such as fast frequency control (e.g. aFRR, FCR products). Interviewees identified technical requirements about observability, prequalification and product definition as barriers too.

Table 4: List of drivers and barriers for the consumer’s electricity bill reduction and flexibility provision

| Stakeholder       | Driver or Barrier                                                                 |
|-------------------|-----------------------------------------------------------------------------------|
| **Industrial**    | (D) Important business model for large and energy-intensive industry             |
|                   | (B-R) High regulated costs (***).                                                |
|                   | (B-R) Limited incentives and market development for procuring flexibility         |
|                   | (B-T) Missing communication and interoperability mechanisms facilitating flexibility |
| Consumers         | (B-I/B) Limited impact of energy costs on total costs                             |
|                   | (B-I/B) Lack of built-in capacity (e.g. personal)                                 |
|                   | (B-I/B) Distrust of energy operators (including aggregators and ESCOs)           |
|                   | (B-I/B) Reluctance to adapt operations to system needs.                          |
|                   | (B-I/B) Impossibility of operational adaption in certain industries (flexibility activated on a short notice). |
|                   | (B-I/B) Difficulty in understanding electricity markets                           |
| Residential       | (B-I/B) Mistrust in electricity companies                                         |
| Consumers         | (B-R) For balancing participation, markets are not completely open or appropriate for DER |
|                   | (B-R) Misalignment of support schemes                                             |
|                   | (B-T) Communication has to be improved                                            |
|                   | (B-R) Tariff structure that does not promote flexibility                          |
|                   | (B-R) Limited potential for self-generation                                       |
|                   | (B-T) Lack of historical metering data to support tariff design changes           |
| **Regulators**    | (B-I/B) Consumers not interested in changing their behaviour: lack of information, small benefit perceived (**) |
|                   | (B-I/B) Static/conservative retail market and reluctance of incumbents to change   |
|                   | (B-I/B) Limitations to test and implement innovative tariff designs               |
| **TSOs**          | (D) More market players are welcome to increase efficiency                        |
|                   | (B-R) Prequalification needs                                                      |
|                   | (B-R) Product definition                                                          |
|                   | (B-T) Observability of the DR as BSP                                              |
|                   | (B-I/B) Resistance to incorporate DR in sensitive and more complex services (e.g. aFRR, FCR). |

Legend: (D) Driver; (B-I/B) Barrier, Regulatory; (B-T) Barrier, Technological; (B-R) Barrier, Organizational/Behavioural; Level of agreement: (***) high, (**) medium

3.4 Flexibility provision through aggregation

In this BM, the aggregator (main actor) provides services to grid operators (DSOs and TSOs) by aggregating different types of DER, exploring the concept and possibilities of the VPP. This business model explores in particular the VPP in two forms, namely the commercial VPP (cVPP), that provides services to the TSO (e.g. balancing markets), and the technical VPP (tVPP), which provides local flexibility to the DSO. This BM was mostly discussed with an independent aggregators and retailers (potential aggregators), the main actors in this business model, as well as regulators and TSOs.

The **independent aggregator** interviewed acknowledges that service provision to DSOs and TSOs will be a viable business in the future, but not in the short term. They mention the wide variation of national market rules and designs as an important barrier, which limits the potential scalability. In other words, lack of standardization of market access interfaces is also a problem. Finally, they mention the need for real-time data to provide certain services (e.g. balancing).

**Regulators** see different barriers for the cVPP and the tVPP concepts. Regarding the former, they mention that balancing products are still not completely adequate for DR participation. Additionally, that the framework for independent aggregators is underdeveloped, and that revenues from balancing markets may be limited. Regarding the tVPP, the barriers identified by regulators are similar to the ones for the first BM (local flexibility procurement by DSOs). Firstly, the revenue regulation for DSOs is still CAPEX-based, and, secondly, local flexibility mechanisms are not in place yet, limiting the amount of flexibility that DSOs are willing/can procure.
The TSOs also mentioned the lack of role definitions for VPPs, balance responsible parties (BRPs) and balancing service providers (BSPs) as a barrier. In addition, they mention that VPPs may make the forecasting process more difficult, especially if these VPPs are large and resources are scattered across different regions.

The paper presents the actors’ opinions of the different business models. We highlight the agreement and the divergent opinions both within each type of stakeholder (e.g. among different DSOs) and between stakeholders (e.g. DSOs and TSOs). Finally, we conclude by identifying the most relevant drivers and barriers identified for each business model, structured according to three categories, namely (i) regulatory, (ii) technological, and (iii) organizational or behavioural.

The main contribution of this paper is to show the different types of barriers that could hamper new business models emerging in the context of smart grids. Existing analyses focus mostly on technological and/or regulatory barriers to the abovementioned BMs. Nonetheless, whilst technological barriers may be overcome through R&D and pilot projects, and regulatory barriers can be equally lifted through changes in existing policies and regulation in line with the Clean energy for all Europeans package, addressing the organizational and behavioural barriers identified in this paper require other approaches. It is relevant to note that the latter can be, at least, equally determining for the successful development of the BMs discussed in this paper.

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4 Conclusion

The paper presents the actors’ opinions of the different business models. We highlight the agreement and the divergent opinions both within each type of stakeholder (e.g. among different DSOs) and between stakeholders (e.g. DSOs and TSOs). Finally, we conclude by identifying the most relevant drivers and barriers identified for each business model, structured according to three categories, namely (i) regulatory, (ii) technological, and (iii) organizational or behavioural.

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