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Abstract

The ongoing digitalization of the energy sector opens up opportunities for novel business models, which can help to overcome challenges that accompany the transition towards a sustainable energy supply. One necessity in a more decentralized energy system with high shares of renewables is the provision of flexibility. This paper uses the business model generation approach of Osterwalder and Pigneur (2010) to understand the challenges of the transition towards distributed power generation for energy suppliers. The insights gained indicate that the focus of business models in the electricity supply market has to switch to an offer-driven perspective. To this end, the business model of an "Energy Supplier 2.0" as a dedicated aggregator of flexible capacities on the household level is investigated. It is found that the aggregation of flexibilities can provide additional revenue streams, extra customer comfort, support for grid operators, and reduce society's costs for the sustainable energy transition process. Despite these promising advantages, and even though early movers indicate economic interest, we find that the current regulation and policies bear obstacles for a broad diffusion of this type of business models in the energy sector. We identify several obstacles and suggest solutions how to overcome legislative hurdles where possible.

Keywords: Energy Supplier 2.0; Utility of the Future; Business Model Generation; Flexibility; Distributed Energy; Virtual Power Plant

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1 Introduction

The sustainable energy transition towards renewable, distributed resources raises new challenges regarding grid stability and expansion needs (Lopes et al., 2007). However, assets such as home battery storage, battery electric vehicles or combined heat and power plants host flexibility potentials that are vastly unused as of today and could potentially solve many of the posed issues (Agora, 2016; IEA; PWC, 2015). A key to the exploitation of these distributed flexibility potentials is presumably the digitalization of the energy sector as an enabler for the smart integration of distributed resources into the energy system.

The technological needs to use distributed assets – e.g. in a grid-friendly manner to minimize grid expansion needs, for ancillary services, or to handle the intermittency of photovoltaics (PV) and wind power – have been pointed out repeatedly in the literature, sometimes also indicating promising business cases (e.g. Caldon et al., 2004; Deilami et al., 2011; Nykamp et al., 2012). However, this potential was hardly realized in the past due to a lack of actual business models that would allow to link asset owners, energy suppliers and grid operators in a way that is beneficial for all. Therefore, the focus in many, more recent studies shifted to the field of business models and the question of how the market participants could adapt to the new energy world in order to better utilize their unused flexibility potentials. For example, the MIT introduced the conceptual framework "Utility of the Future" as an aggregator of flexibilities for electricity services (MIT, 2016). Similarly, but slightly more focused on digitalization as a key enabler, the "Utility 4.0" concept was introduced by Doleski (2016) and entered especially the German literature as the successor of utilities as monopolistic suppliers (Utility 1.0), liberalized utilities (Utility 2.0), and energy service companies (Utility 3.0).

However, the suggestions until now remained at a rather abstract level on general conceptual frameworks. The scientific discourse on explicit, practice-oriented business models for the utilities just took off recently and is still insufficient and lagging behind (Helms, 2016), while early movers have already entered the market and started to change the electricity system (Lavrijssen et al., 2016). This bears risks, since these high-pace, market driven real-world developments have to be closely governed by policy, the latter of which again relies on a solid research base.

This paper tackles this lack on discourse regarding concrete business models with a structured investigation. The aim is to understand the changing market environment and provide advice for policy makers on how to support the diffusion of concepts that increase the overall social welfare.

To this end an outline of the rapidly evolving field of business model theory is given in section 2. We find, that Osterwalder and Pigneur (2010) provide a promising approach for a structured and goal-oriented business model generation process. In section 3, we apply this technique to the electricity market with the focus on energy utilities and find that their old business model does not suit the future electricity system increasingly characterized by decentralized generation. Further, section 3 presents the findings of a business environment analysis that uncovers the underlying reasons to the troubles of energy utilities and also points at issues that other stakeholders – namely grid operators, household customers and policy makers – increasingly have to face. Following the suggestions of Osterwalder and Pigneur, offer-driven types of business models are identified as a promising replacement for incumbent, resource-driven business models. Based on this insight, section 4 introduces one concrete, exemplary business model that might offer advantages to all stakeholders involved. However, business models of this kind currently only develop slowly. Therefore, section 5 uncovers some legislative barriers hindering the diffusion of new business models and makes suggestions on how to potentially overcome those obstacles where possible. Section 7 gathers the findings regarding market and policy implications and draws some conclusions

2 Methodology and conceptual framework

2.1 The Business Model concept

The notion of Business Models roots back to the mid-20th Century, but became widely used only since the mid-1990s in the context of e-commerce and internet-based business activities. This was the time when the interest of both practitioners and also researchers massively increased (Burkhart et al., 2011; Zott et al., 2010).

Probably due to the rapid development, no consistent definition could emerge. Instead, many authors developed their own interpretation of the term. Magretta (2002), for example, states that a good Business Model answers Peter Drucker's age-old questions: "*Who is the customer? And what does the customer value? It also answers the fundamental questions every manager must ask: How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?"* (Drucker, 2011; Magretta, 2002).

Burkhart et al. (2011) refined the following definition from the literature: "*The business model concept is linked but still distinct to the concept of business strategy. It describes—mainly textual on a highly aggregated level—the business logic of an underlying company by a combination of* *interdependent offering, market, internal as well as economical business model components in a static and dynamic way beyond the company's borders. […]"* This definition gathers most aspects from the relevant literature but is therefore also rather extensive. It can be noted, that Burkhart et al. (2011) still focus on a textual description but already extend the prior definition beyond the company's borders and thus include other stakeholders.

Veit et al. (2014) summarized the concept somewhat more concisely: "*The business model is seen as a tool for depicting, innovating and evaluating business logics in startups and in existing organizations, especially in IT-enabled or digital industries"* and this way include the topic of innovation. Massa and Tucci (2013) even go a step further by characterizing the business model as a vehicle, and even a "*source of innovation in and on itself*" (Massa and Tucci, 2013). The authors further identify business model innovation as a supporting instrument in incumbent markets that undergo a radical change (e.g. through government policy or regulation) thus opening up new opportunities.

Osterwalder and Pigneur (2010) finally developed a systematic approach for Business Model Generation (BMG) that combines most of the aforementioned aspects. The BMG technique not only considers the company itself but also takes key partners in the industry into account. Further, it includes the aspects of innovative progress and offers guidance for companies in a changing market environment. Finally, it allows the visualization of the textual description in form of a Business Model Canvas (BMC). For these reasons the BMG was chosen as framework for the analysis in this paper and will therefore be introduced in more detail in the next section.

2.2 The Business Model Generation technique by Osterwalder and Pigneur

The BMG technique developed in Osterwalder (2004) and sharpened in Osterwalder and Pigneur (2010) offers a useful framework for assessing existing business models and for developing new ones. The authors suggest a process of five phases that comprise: (1) Mobilize, (2) Understand, (3) Design, (4) Implement, and (5) Manage. The first phase focuses on setting up the right team and phases four and five deal with the actual realization, which will not be subject of this study. Instead, the analysis here will focus on phase two, the understanding of the underlying developments in the energy sector, and phase three, i.e. shaping of a business model that is potentially more suitable for the new market environment.

Osterwalder and Pigneur also refined a Business Model Canvas (BMC) from the broad literature. This BMC consists of 9 building blocks as core elements of a business as depicted in Figure

1.The special order in the form of a “canvas” allows for a comprehensive but yet conclusive depiction and furthermore states a guide-line for the design process. This paper will even go one step further beyond current work by using the BMC as starting point for the policy environment analysis in section 5.

<table>
<tr><td rowspan="2">(1) Key Partners</td><td>(2) Key Activities</td><td rowspan="2" colspan="2">(4) Value Proposition</td><td>(5) Customer Relationship</td><td rowspan="2">(7) Customer Segments</td></tr>
<tr><td>(3) Key Resources</td><td>(6) Channels</td></tr>
<tr><td colspan="3">(8) Cost Structure</td><td colspan="3">(9) Revenue Streams</td></tr>
</table>

Figure 1: Business Model Canvas
Source: Own illustration, based on Osterwalder and Pigneur (2010), p.44

3 Understanding the relevant developments in the energy market

Osterwalder and Pigneur (2010) suggest a broad set of measures that can help to understand the target market before beginning the design process of a new business model. Using the BMG, our analysis begins with the evaluation of the incumbent business model with a focus on the so-called “Big 4” who dominated the energy market in Germany in the last decades. After that, the results of a Business Environment Analysis (BEA) are presented, with a focus on fundamental changes in the energy system. Finally, we conclude what these changes mean for business model patterns in the energy sector.

3.1 The incumbent business model of the electricity utilities

In the past, energy utilities, and especially the “Big 4”, operated a broad variety of different business models. The activities, however, focused on the “companies’ side”, i.e. on the left two columns of the BMC (cf. Figure 1), what Osterwalder and Pigneur (2010) identify as “Resource-Driven” (we will come back to this in section 3.3). Next, we want to investigate the former strength of this incumbent business model using the nine elements of the BMC.

The *value proposition* of the incumbent energy suppliers and their main source of recurring *revenue stream* comprised the provision of electricity to its private and industrial customers. Due to regulation, these revenues could only be influenced to a limited extent by means of increases in the electricity price. Therefore, the maximization of the profits focused primarily on minimizing the production *cost structure*. Because of this, the most important factor for the big four energy utilities were apparently their huge thermal power plants as *key resources*. These plants were able to generate electricity at lower costs than the smaller plants of competitors such as municipal power suppliers (Becker, 2010). The capital-intensive construction and the challenging operation of e.g. nuclear power plants requiring comprehensive, continuously grown expertise as well as a close linkage to the policy as *key activities* and also constituted a high barrier for potential new entrants. The high degree of vertical integration minimized actual competition and led to a low dependency from other *key partners*.

Since each energy utility was the sole operator of its supply area before liberalization, customers had no chance to choose and had to give in to the local supply monopoly. This allowed the utilities for a long time to neglect the activities on the customers' side of the BMC. The *customer relationship* was more or less perfunctory, considering households rather as "recipients" than as valuable "customers" (EnBW, 2013). Image cultivation only took place on a very high level, for instance in TV campaigns or by tricot sponsoring. The special situation of the monopoly on electricity as an indispensable good also allowed to minimize the efforts spent on distribution *channels* – potential buyers in need for electricity would have low claims and were satisfied when contacted via ordinary mail. The *customer segments* included basically everyone in need for electricity, including in particular households, industry, trade and commerce, and public institutions.

However, this old business model seems to be over its prime since around the year 2008. From then on, the stock market values of most large utilities in Europe collapsed. While some of the utilities in neighboring countries were able to regain some of their lost ground, Germany's biggest utilities RWE and E.ON lost more than 80% of their stock market valuation in the last ten years and could hardly recover to this day.[1] Some authors see the incumbent energy utilities' profitability, and maybe even the sheer existence, as being massively threatened (Bontrup and Marquardt, 2015).

[1] RWE's highest valuation at XETRA exchange was €102.2 per share on January 7, 2008 and was rated €17.78 ten years later on January 8, 2018, while E.ON's maximum valuation of €45.47 was reached only few days later on January 11, 2008 and was valued €8.90 on January 11, 2018. The stock value of EnBW "only" halved; however, note that only a small share of EnBW stocks is in free float. Vattenfall is publicly owned by the Swedish state and therefore not listed.

3.2 Energy market insights gained by the Business Environment Analysis

As the second part of the understanding phase of the BMG analysis, a BEA was conducted, as suggested in Osterwalder and Pigneur (2010). The strength of this BEA is that it allows to include other actors and stakeholders in the investigation. For this analysis we decided to focus on changes in the market environment regarding four key actors, which are (1) grid operators, (2) the society represented by the policy makers, (3) the private customers and, of course, the (4) energy utilities themselves. To gain the necessary market insights for the BEA, we conducted semi-structured interviews with 17 energy experts (5 from academia and 12 from industry and society) as well as a broad literature research.

3.2.1 Developments in the grid operation

In Germany, and also in many other countries, the electric grid, and especially the distribution grids, are facing huge challenges caused by the transition towards renewable energies (Anaya and Pollitt, 2015; Appen et al., 2013). Most of the Distributed Electricity Resources (DERs) are connected to low- and medium-voltage levels (BMWi et al., 2014), and the main role on the generation side is played by photovoltaics (PV) and wind power (*EEG 2017*, Deutscher Bundestag, 2016a). Both are characterized by a high difference between average production and potential peak production, which leads to rare but nevertheless distinct peak loads.

Currently, the increasing production peaks, especially in rural areas, are the major concern. In the future, however, demand peaks might become at least an problem of similar extent, presumably affecting especially urban grids. These demand peaks could result from the rollout of electricity-intensive assets, such as electric vehicles or heat pumps, going along with the integration of the mobility and heat sectors into the electricity sector (Alberts et al., 2016; Deilami et al., 2011; Siano, 2014; Wood and Funk, 2017). Today, power peaks in Germany – as in most other countries in Europe – are dealt with mainly by an expansion of the grid. On the down side, this expansion is considered to cost between €23 bn and €49 bn until 2032 alone (BMWi et al., 2014) and goes along with severe acceptance issues (Steinbach, 2013).

Also, as we will describe in the next section, the regulator in Germany is currently increasing the pressure on DSOs to cut costs and become more cost-efficient. One promising, potentially more cost-efficient alternative to hardware grid expansion could be the aggregation and utilization of distributed flexible energy assets in a more grid-friendly (Heussen et al., 2013; Zhang et al., 2013).

3.2.2 Developments in the policy landscape

In the first decade of the German energy transition process, the target was primarily set on a quick roll-out of renewable energy sources (RES) technologies to also boost economies of scale in production as well as technical improvements and learning (Beveridge and Kern, 2013). This worked quite well in Germany but led to high levies that were added to customers' electricity bills (end-use electricity prices nearly doubled between 2000 and 2012 to 30.48 ct/kWh and are currently among the highest in Europe (after Denmark, at 30.49 ct/kWh, BDEW, 2017; Destatis, 2018b). This brought political awareness to the cost side and caused policy makers to repeatedly amend the Renewable Energy Sources Act (EEG) to put more weight on the aspect of cost efficiency and thus to curb the growth of the levies (Fischer et al., 2016; Karneyeva and Wüstenhagen, 2017). The measures taken were able to limit the increase of end-consumer prices, though at the cost of slowing down the diffusion dynamics of RES in the electricity market (Fischer et al., 2016).

However, it seems that this victory might rather be temporary since a second wave of price charges resulting from the grid expansion costs described above might be pending. Therefore, policy-makers are currently investigating grid policy measures in order to limit the grid expansion costs similar to those of the RES expansion. A first step in this direction was made with the implementation of the incentive regulation ordinance (ARegV, 2016), which was enacted to boost competition between the grid operators. To this end, a benchmarking system was implemented that includes periodic efficiency targets (BNetzA, 2015).

A controversial topic in this respect was the smart meter roll-out. The installation of new counters in the first instance brings additional installation costs, but could lead to overall savings in the long run. After long considerations in Germany (and long after most other European countries), the smart meter roll-out was finally stipulated in 2016 with the act on the digitalization of the energy transition (Deutscher Bundestag, 2016b). This recent decision on the smart meter obligation indicates the intention to pave the way for an increased involvement of electricity customers.

3.2.3 Developments in the private customer sector

In the past, household customers had a very passive role in the energy system both from the technical and the economic perspective. The economic passivity originated from the fact that customers were bound to their local energy utility as monopolistic supplier of energy in the region. However, this changed over the last two decades and the number of households that make use of their right to freely choose their supplier grew from 678 thousand in 2006 to more than 4.6 million in 2016 (BNetzA and BKartA, 2017).

A similar development also took place from a technical perspective. Customers, who were pure consumers before, began purchasing own assets for power generation such as photovoltaics (PV), combined heat and power (CHP) plants or storage and thus became so-called “Prosumers” (Flaute et al., 2017; Oberst and Madlener, 2015). The ongoing development of technical improvements or even new technologies such as fuel cells, a massive decrease in prices for PV, home battery storage and electric vehicles, as well as the smart meter roll-out enable private households to play a more active role in the future energy system.

Nonetheless, problems exist. The first wave of renewable energy assets was mainly based on pioneers. Those pioneers improved and refined the new technologies rather for personal interest and ideology than for pure economic reasons, as e.g. Kairies et al. (2016) found for home battery storage, which is also in compliance with the general theory on innovators and early adopters (Geels, 2011).

However, this focus on early adopters could constitute an obstacle for a mass diffusion of RES technologies since this mass diffusion would also require an involvement of the (early and late) majorities of the market. Strupeit and Palm (2016) identify “*consumer inertia, high up-front cost, long payback periods, efforts associated with the planning and installation steps, various informational gaps and customer concerns about PV reliability*” as the main additional barriers when targeting the mass market for PV systems. This might become a problem not only for PV but also for home energy systems in general in the near future in Germany. Renewable assets still constitute a significant investment, especially when hybrid systems (such as PV and battery storage) are considered. At the same time, the ongoing reduction in subsidies (esp. feed-in tariffs) keeps the payback times on a high level.

Additional value streams generated by serving multiple use cases can be an option to shorten the payback time and to ensure profitability in the first place. Furthermore, the development of an optimal portfolio of real assets for a household becomes more and more complex. Different types of PV modules can be combined with battery storage of various technologies and/or types of CHP plants, all again offering multiple characteristics and specifications. The last barrier to be mentioned is the complex legislative and financing framework in Germany, especially when it comes to tenements (cf. Behr and Großklos, 2017). In summary, the diffusion of prosumer technologies could significantly be increased by some goal-oriented support, resolving those barriers.

3.2.4 Developments in the energy supply

In 1998, the electricity supply industry in Germany was liberalized. In the following years, four big energy utilities were formed through several mergers and take-overs: E.ON, RWE, Vattenfall, and EnBW. These companies, often referred to as the “Big 4”, prospered in the first decade of the millennium and dominated the electricity market both in terms of company value and also regarding their production and market shares (Becker, 2010; Kungl and Geels, 2017). However, with the nuclear energy phase-out in Germany, crumbling profits from wholesale trading, and the missed chance to develop a viable business model especially for small RES, the foundation began to slide (Richter). Even though the total revenues in the energy sector massively grew over the last decade[2], the “Big 4” lost significant market shares to new entrants, had to report record losses, and lost some 80% of their stock value (Fratzscher, 2015).

This is so, because the former strength described in section 3.1, which was founded on economies of scale, started to pay off less and less. The ability to operate huge centralized power plants was devaluated by competitive medium- and small-scale assets that allow more and more actors, down to the scale of households, to become electricity producers or prosumers.

At the electricity exchange market, electricity prices constantly decreased over the last years. The “Phelix peak year futures” price declined from its maximum of 99.4 €/MWh in 2008 to about a third, at 33.51 €/MWh in 2016 (BNetzA and BKartA, 2017). The low market prices caused by the merit order effect of renewables endanger even the profitability of central power plants operating with low-cost fuels such as lignite or nuclear, not to mention the OPEX-intensive gas, hard coal or oil plants.

Other companies took the lead in emerging markets for, e.g., the provision of explicit green electricity (e.g. Naturstrom, Lichtblick, several municipal energy utilities, and others) or the aggregation of medium-sized wind and biomass plants to profit from the legislative changes regarding direct marketing (*Direktvermarktung*) introduced with the 2009 and 2012 EEG amendments (such as Nextkraftwerke”, “Gesy”, “Clean Energy Sourcing” or “Energy2Market”). In recent years, aggregators began to enter other markets, such as those for balancing power, by adding flexible assets (e.g. uninterruptible power supply generators) or exploiting unused flexibility potentials of the assets in their portfolio (Söchtig, 2013; WEF, 2016). Recently, a new generation of

[2] The turnover in the electricity sector in Germany increased from €154 bn in 2005 to over €500 bn in 2013 followed by a slight decline to €462 bn in 2015 Destatis (2018a).

start-up projects - such as Beegy, Carterva, Buzzn, Sonnen or LichtBlick - are beginning to pool households and utilize the distributed flexibility for additional, value-creating purposes.

These developments indicate a transition away from the old commodity-based business model towards customer-relationship-centered business strategies (Flaherty et al., 2017). This new strategic direction should not only aim to maximize the holistic mutual benefit of the energy suppliers alone, but also of customers, DSOs and the society (cf. Burger and Luke, 2017).

It seems that top management of the Big 4 has finally widely accepted the pending changes of the energy transition and is trying to adapt their old business model. Phrases such as "customer proximity" (EnBW) and "customer solutions" (E.ON) have found a place in the strategies of the Big 4 (E.ON SE, 2016; EnBW, 2016). To this end, a sustainable new business model that allows the new strategy to be realized seems to be in great demand both for new and established energy utilities.

3.3 Consequences regarding business model patterns

The changes in the business environment might require more than a slight adaption of the incumbent business model. Instead, a fundamental change in the overall orientation of the strategy could be necessary. In their BMG-framework, Osterwalder and Pigneur (2010) distinguish four epicenters for business models to categorize the underlying orientation of business models. These epicenters are (1) resource-driven, (2) offer-driven, (3) customer-driven, and (4) finance-driven.

According to our BEA, the incumbent business model clearly falls into the first category as being resource-driven (cf. Figure 2). This was sensible in times of huge centralized power plants, but is probably not contemporary any more. The reduction of production costs through economies of scale lost in gravity with the introduction of compatible small-scale production- and storage assets and customer loyalty can no longer be considered presumed.

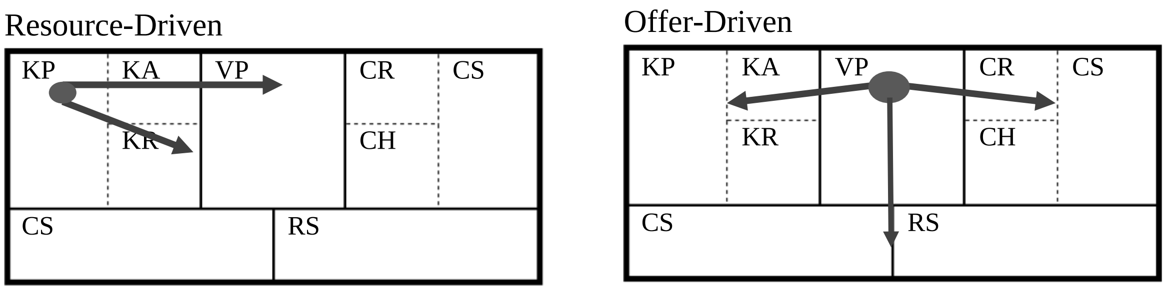

Figure 2: Epicenters of innovation; visualization in the Business Model Canvas of the Resource-Driven and the Offer-Driven perspective.
Source: Own illustration, based on Osterwalder and Pigneur (2010), p.138

At the same time, the diffusion of distributed energy assets brings a vast potential for flexibility and services, which is hardly utilized at present. The development of these potentials could bring benefits to customers, grid-operators, the society and eventually the energy suppliers themselves. For this, the energy suppliers would have to become much more involved with its customers and offer new services and support. This indicates a reorientation of the business model towards an offer-driven epicenter. Summing up, the prospective business model to be developed in section 4 should pick up current developments found in the BEA and focus on how energy suppliers could expand their offer.

4 Designing a business model to fit in a distributed energy system

Our goal in this section now is to make the next step onwards, based on the broad number of studies pointing out individual use cases and flexibility potentials on the one hand (e.g. Seidl et al., 2017; Vasconcelos et al., 2012), and those pointing out general business trends on the other hand (e.g. Burger and Luke, 2017; Helms, 2016), by designing one exemplary, feasible business model. This business model should take up the insights from the BEA and focus on offer and value, as discussed in section 3.3. This model, which we will call the "Energy Supplier 2.0", is of course not intended to be the ultimate truth. Instead, it is proposed to represents a broad variety business models, all going in a similar direction in the investigation of policy issues later on.

The Energy Supplier 2.0 (ES 2.0), as we imagine it, is in several aspects an advancement of the existing energy supply contracting. As pointed out in section 3.3, the new business model should focus on an offer-driven approach by providing additional value to the customer, based on the findings of the BEA. Therefore, the key question to answer is: What can the ES 2.0 offer and how can it improve the customers' utility?

For us, this vision begins with an ES 2.0 actively supporting the customer in acquiring own renewable assets. A household could be approached with one (or a few) proposals, offering an individually optimized bundle of RES and related assets. The individual optimization can be conducted based on information available to the ES 2.0, such as the load profile, the geographical location (important for solar irradiation), the roof's orientation and angle, etc.

The ES 2.0 would provide the asset combination free of charge and then sell the locally generated electricity to the household. It guarantees the functionality of the assets and promises that the household will have to pay less for its energy consumption than before. Further-reaching offers, such as uninterruptable power supply or smart home energy services, can be thought of.

For the household this offer should state a pretty convincing deal. The household has no (or only very low) up-front investment costs since the ES 2.0 conducts the planning and provides the assets. The ES 2.0 might also have exclusive branded products as well as a good knowledge of, and contracts with, reliable local installers. The guarantees minimize the risk for the customer, both regarding technical and also financial aspects. The customer is provided with green electricity produced on his/her own roof (or basement, e.g., regarding CHP solutions) and hardly any burden is imposed on him/her regarding planning and information gathering.

The big question yet to answer is, of course, how this calculation can work out for the ES 2.0. The biggest revenue position is the provision of the household with electricity. Many renewable assets already achieved grid parity to this day (Karneyeva and Wüstenhagen, 2017), so that the revenues from electricity sale to the household should contribute the lion's share of the financing, especially when the ES 2.0 can purchase and install the asset bundle for a smaller price than the cost a customer him- or herself would face due to economies of scale and learning effects of the ES 2.0. However, this pure contracting solution is probably not enough to ensure a sufficient profitability for the ES 2.0 itself.

The solution to this and the key element is that the ES 2.0 gains remote access to control its assets in the customer's premises ("direct load control", cf. Siano, 2014). This allows to utilize the flexibility potential of the assets for numerous additional business cases, a selection of which we briefly introduce next.

(1) The first additional value proposition is to pool flexibilities, e.g. provided by home storage systems, into a bigger swarm and to sell unused flexibility as balancing power. This might be of special interest in the winter months, when home battery storage is hardly used to store PV electricity anyway. The potential of this single use case was proved by Caterva in 2015 when the company was the first aggregator of household assets to become prequalified for the provision of primary reserve (Consentec GmbH, 2014; Lessner, 2016; Rosenberger, 2016).

(2) Conventional energy utilities as well as the ES 2.0 have to purchase electricity at the electricity exchange for varying prices[3] but must sell it at a fixed tariff to their customers (fixed price per kWh). The ES 2.0, however, is able to influence the schedule of its operated production and storage assets within the household in order to optimize its procurement strategy by shifting its

[3] Another solution could be flexible power prices for the households, which however are reported to be of rather low customer acceptance (Dütschke and Paetz , 2013).

electricity procurement to times of low exchange prices as well as to avoid penalties for violating its accounting grid loyalty.

(3) The ES 2.0 can also operate sophisticated algorithms to reduce asset aging. Battery cells, for example, age quicker when either charged to their maximum or discharged completely (Ecker et al., 2014). In winter, it might therefore make sense to maintain some residual load within the battery and only use the middle state of charge levels. Similarly, a high charging or discharging speed leads to thermal exposure and potentially avoidable battery stress. While these aspects are probably too difficult to consider for a household alone, an ES 2.0 should be able to consider those in the scheduling, for example by applying self-learning algorithms on the massive amount of data (including aging patterns) that it gets from its numerous customers.

(4) A pool of thousands of assets can be used as cloud storage to optimize the self-consumption of all participants, utilizing savings in grid fees and levies (Madlener and Broering, 2016).

Opportunities (1) - (4) give the reader a rough idea of business cases but still miss one important aspect, which is building the bridge to the DSO and the macroeconomic perspective. As mentioned above, the growing number of distributed generating, consuming or storing assets have no incentive to operate in a grid-friendly way. Therefore, DSOs currently have to face growing production and demand peaks. Today, this issue is resolved with hardware grid extensions or production curtailments. However, both solutions are expensive both for the DSOs and the whole society, which leads to our fifth advantage.

(5) A smarter and more cost-efficient solution might be that the DSO pays a future ES 2.0 to operate its assets in a grid-friendly manner on the few occasions of pending, extraordinary peaks (as suggested e.g. in Heussen et al., 2013; Zhang et al., 2013). On a very sunny day with high PV peak loads, the ES 2.0 could delay the charging of its customer's home batteries to the noon-hours in order to support the grid by peak-shaving and avoidance of the activation of its CHP assets. Vice versa, the ES 2.0 can apply Demand Side Management (DSM), e.g. by slowing down or delaying the charging of its customer's electric vehicles beyond the times of peak demands (and similarly the demand of heat pumps, freezers or other devices accessible for direct load control). Furthermore, the assets can provide several ancillary services (e.g. voltage control or reactive power provision) right in the distribution grid where they are needed most.

An important constraint in our vision is that the customer should perceive almost no comfort reduction. For some grid-friendly operation measures this is possible at hardly any opportunity costs e.g. when the battery is filled at noon-hours instead of morning hours. For other measures such as delayed car charging, this might seem more difficult, since no customer will like to encounter an empty car battery when planning a trip. However, self-learning algorithms in combination with a sufficient reserve should allow to minimize these comfort reductions. As an example, consider a car that is only charged to 50% state of charge after 6 p.m., with the second half being subject to DSM by means of direct load control.

This concept of simultaneously fulfill the interest of several interdependent customer groups' needs is typically referred to as "multi-sided platform". The business model canvas presented in Figure 3 visualizes the business model of the ES 2.0 and illustrates the value added for customers, grid operators and energy suppliers.

Key Partners

Energy Supplier:
- Grid operators
- Households with flexible assets
- Local installers of green assets
- Joint ventures with renown manufacturers
- Joint ventures with other aggregators to provide more holistic services

Key Activities

Energy Supplier:
- Efficient algorithm to find the economically most efficient schedule under multiple restrictions

Key Resources

Energy Supplier:
- Platform/ Algorithm to aggregate decentralized flexibilities and match the potential of this swarm with the needs of grid operators

Value Proposition

Energy Supplier profits from:
- The utilization of flexible assets to optimize the procurement strategy and avoid costs and penalties for failing accounting grid loyalty

Grid operators profit from:
- Grid friendly asset scheduling reduces the need for grid extensions and thus costs
- Ancillary services being provided by local flexibilities instead of big central plants

Private Customers profit from:
- A high share of green electricity, provided by their own assets
- Electricity cost reduction
- Support with planning, financing and management
- An increased asset life span
- Smart home services
- Access to the green electricity community

Customer Relation

Private Customers:
- Online platform offering information and statistics on consumption patterns
- Community of the swarm
- Trusted local partners for the installation of assets

Grid operators:
- Individual key-account managers

Channels

Private Customers:
- Green media/magazines, word of mouth
- Existing customers in case of incumbent ES
- Comparison portals

Grid operators:
- Focused acquisition

Customer Segments

Private Customers:
- Private Customers with existing RES
- Private Customers with an interest in RES
- Tenements and other customers where difficult regulation applies
- Small industry customers without own energy management

Grid operators:
- Urban DSOs with expansion needs due to peak consumption
- Rural DSOs with expansion needs due to production peaks

Cost Structure

Energy Supplier:
- Platform management
- pre-qualification processes
- Computing capacity to solve the swarm optimization
- Management of the contracts with a huge number of customers as well as grid operators

Revenue Streams

Private Customers:
- Residual electricity supply
- Optional: Rent for provided RES assets
- Optional: Premium offers and smart home services

Grid operators:
- Regular payments to contribute for grid relief
- Grid support compensation

Energy Supplier:
- Procurement optimization
- Increase in accounting grid loyalty

Figure 3: Business Model Canvas of the introduced Energy Supplier 2.0. A shift from a “Resource-Driven” BM focused on the left-hand side towards an “Offer-Driven” BM can be observed.

Source: Own illustration based on the structure provided in Osterwalder and Pigneur (2010).

5 Legislative and systematic barriers

In the previous section, we demonstrated that a model similar to the one introduced as the Energy Supplier 2.0 could be of interest for prosumers, grid operators, and utilities. Furthermore, these advantages also correspond to the policy goals on the macro-economic perspective, since their utilization of unused potentials could decrease the costs linked to the energy transition (especially in terms of grid expansion). Therefore, legislative support for business models of this sort seems sensible.

And in fact, the general legislative trend seems to be on a good way in Germany. The smart-meter rollout enforced through the Act on the Digitisation of the Energy Transition is a first important step that paves the way for the accessibility of distributed assets. The growing focus on cost efficiency, e.g. leading to the prioritization of market-based solutions to a capacity market in the amendment of the renewable energy sources act from 2017 (EEG 2017), point in the right direction. In the same amendment, it was furthermore attempted to enable tenants to participate in the energy transition by introducing a landlord-to-tenant electricity scheme. This is generally an important point since it aims at involving the big share of customers who do not own their house. Finally, the attempts to incentivize grid operators to efficiency in general is positive.

However, many of these advances are either inconsistent, incomplete, or immature. The barriers and uncertainties resulting thereof state unnecessary barriers for new concepts and business models that should be reconsidered and removed if necessary. We will point out some of these obstacles concerning the proposed concept of the Energy Supplier 2.0. We used the BMC to structure legislative problem zones according to the four centers of the "Value Proposition", the "Company Side ", the "Customer Side" as well as the "Financial Aspects" (Osterwalder and Pigneur, 2010), cf. Figure 4.

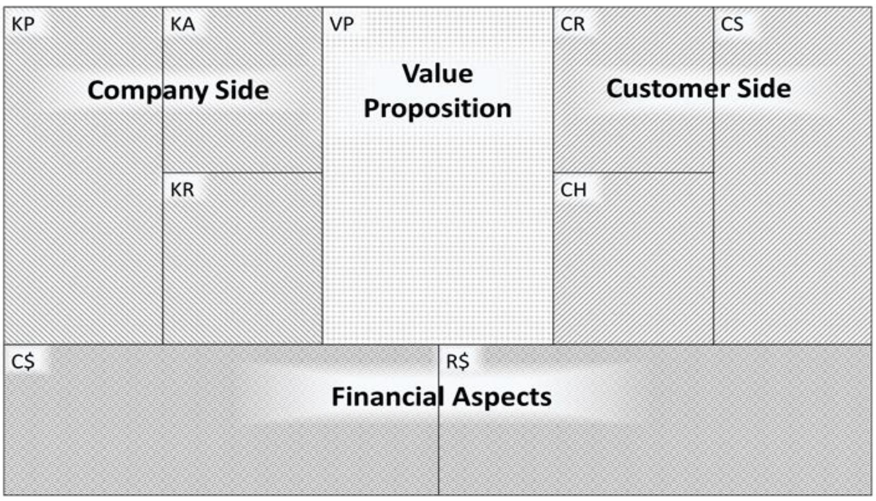

Figure 4: Division of the BMC in the four centers (1) Value Proposition, (2) Company Side, (3) Customer Side and (4) Financial Aspects following the epicenters of business models introduced in section 3.3. Source: Own illustration based on the structure provided in Osterwalder and Pigneur (2010).

5.1 Value Proposition

We want to start our analysis of the legislation with issues regarding the value proposition, since the idea of hidden values for a new business model was the main motivation for the analysis overall.

First, the maxim to deal with grid capacity issues is still vastly seen in hardware grid expansion, as especially our interview partners from academia and the middle-sized DSO pointed out. As an example, the energy industry law (EnWG) prescribes that the market always finds its efficient solution for electricity supply first and only then, secondly, the grid becomes adjusted need-based if necessary (cf. Art. 1 II, Art. 1a IV and Art. 17 I EnWG). This strict segregation of power production and distribution neglects the potential of an interplay of both and thus the option that a more active grid management could substitute capital investment (Bell and Gill, 2018). However, this potential is hard to estimate since DSOs in Germany do not share the data about their grid, which makes a representative estimation of potentials on national level nearly impossible.

Furthermore, the generally good intention of the incentive regulation ordinance in praxis is still rather feeble. For example, the efficiency analysis of the DSOs is based on a "best-of-four" principle, so that only the best out of four different key figures is used to evaluate the economic efficiency (Andor, 2009; Elsenbast et al., 2017). Also, grid expansion is still seen as a pure matter of putting copper cable in the ground (cf. Art. 12, EEG 2017) and, therefore, focuses solely on refunding the capital expenditures (CAPEX) of grid operators. However, new technologies, such as the utilization of distributed flexibilities to support local grids, come with rather low capital expenditures but high operational expenditures. Even though total costs might be significantly lower, this hardly incentivizes grid operators to develop new approaches in this direction. In contrast, the unbundling laws even limit the options of grid operators, for example, to operate their own storage devices for grid support and develop solutions in this direction (a more in-depth discussion can be found in Sauer et al., 2016).

Secondly, the potential value of pooled flexibilities as a source for frequency regulation faces several issues. Primary reserve (also referred to as "frequency containment reserve") for instance is only auctioned in blocks of one-week' duration at a stretch and for at least 1 MW of power. Technically, it should not be a problem to reduce the interval length and to distinguish between different time blocks (e.g. morning-, afternoon-, and night-time). A second problem with the pre-qualification process is that a huge safety margin is required, since battery storage units have to reproach capacity for at least 30 minutes of their full, contracted power, even though their service should be replaced by secondary reserve after 5, and at the latest 15 minutes (ÜNB, 2015). While this is not that much of a problem for conventional reserve assets, for batteries this implies that they have to reproach twice the capacity, leading to high opportunity costs.

Finally, the quite complex topic of accounting grid loyalty at least should be mentioned. This method is used in Germany, Austria and Switzerland for the monitoring of whether every energy supplier purchased precisely the amount of power that its customers consumed. Here, DSM at larger scale can become a problem, when a large-scale request of balancing power as well as a DSM measure could potentially bring a local equilibrium of production and demand out of balance. To prevent this, a regulation between balancing group manager and DSM managers (such as an ES 2.0 as aggregator of flexibility) has to be established. Instead of endangering the system's stability, a good cooperation between both parties can potentially massively help in ensuring accounting grid loyalty.

5.2 The Company Side

The value potentials uncovered above can still only be exploited if a *key partnership* between ES 2.0, DSOs and prosumers can be established. However, the cooperation with the DSOs could probably be hampered by the fact that about 880 different DSOs exist in Germany, many of which are using different data standards or not having a modern digital grid administration at all. A situation with such a big number of players requires the regulator to closely guide the process by defining consistent standards and obliging everyone to provide a defined set of information e.g. regarding their grid structure or feed-in measures performed in their grid.

A *key resource* for the ES 2.0 concept is thus the establishment of a data connection to the customers in order to allow for the activation of their distributed flexibility potential. A major step here is the roll-out of smart metering technology as being crucial in determining the opportunities for the next decades. Solutions that are simply cheap and inhomogeneous might come with high opportunity costs in the long run. In this context, Art. 29 (3) of the 2017 Act on the Digitization of the Energy Transition, for example, distinguishes between "modern measuring devices" and "intelligent measuring devices" (*moderne- und intelligente Messeinrichtungen*), the latter only being suggested for customers with more than 6000 kWh of energy consumption and/or prosumers. Normal households only receive the "modern devices", which basically are digital meter *without* the functional scope of a smart meter gateway (with the ability to communicate to the outside world). This two-class system causes several problems. When a household becomes a prosumer, then the gateway has to be retrofitted. While this itself is not too complex, the policymakers probably ignored that later upgraded gateways' calibration times are shifted compared to the one of the meter itself, as our interviewed experts from a small DSO explained. This means that recalibrations or the exchange of the devices has to be conducted individually, which causes more work. Also, even though the rollout should have begun at the beginning of 2017, as of today the authorities still have not even licensed models to actually begin the rollout. Overall, it has to be reconsidered whether today's half-hearted solution of exchanging old analog meters at high costs against new “digital counters” that still have to be read out manually and without any smart capabilities, is of any use, or if in this case only a real smart solution or a simple preservation of the old status does make sense.

A *Key Activity* for the ES 2.0 concept is the use of a multi-sided platform concept, allowing to utilize the distributed flexibilities provided *inter alia* by prosumers in a grid-friendly manner. We already mentioned the problem that the DSOs are, on the one hand, dependent on a reliable provision of flexibility if requested, while households, on the other hand, expect to maintain their high comfort level in terms of not having to become active in person nor having to waive any desires. As described before, in our mind this could best be done by a smart, self-learning algorithm that optimizes the use of flexibility, minimizing losses in comfort while guaranteeing availability and quick response to the DSO’s requests by use of direct load control. This, however, raises issues regarding data privacy and data traffic. Especially our experts from the small DSO pointed out that they have to pay for the data transmission from their own revenues. This of course limits their interest in participating in any data-intensive new technology. The problem is even worsened by the fact that the huge number of meter operators goes along with a very weak bargaining position towards the big communication companies. Here, again, legislative support might be necessary to achieve fair data communication prices to ensure that communication does not become a bottleneck.

5.3 The Customer Side

In terms of *Customer Relationship*, the topic of direct load control via a smart meter gateway opens the door for a broad variety of potential smart energy services. The actual utilization with respect to customer (data-) rights will require a steady, intensive but nevertheless balanced political discourse that, on the one hand, guarantees customer protection but, on the other hand, avoids scaremongering by overstating rather irrational fears.

Another aspect is the contracting for the green supply assets. We argued that the ES 2.0 could provide assets for a small rental rate, or even free of charge, to its customers who again only contribute some space in their house for the installation. This so-called “energy supply contracting” itself is not new, but in praxis, there are still unresolved issues concerning, for instance: (1) how can the access to the devices for the contractor as the owner of the assets be guaranteed even though they are on the ground or even in the building of the customer, or (2) who is responsible for damage caused by, or done to, the assets.

5.4 Financial Aspects

Regarding C*ost Structure* and *Revenue Streams*, long-term planning perspective is necessary for companies to evolve and start-ups to establish. Policy-makers in Germany attempt to bring transparency in their goals, however, in many cases the long-term intentions are hard to interpret. One current example is the idea of pooling a bigger number of prosumers in an "energy cloud", which became very popular in Germany since it utilizes the storage capacities within the cloud more efficiently than the individuals could on their own (Madlener and Broering, 2016). This business model bases on an exemption from grid charges for storage plants, which is temporarily limited until 2026 (cf. EnWG Art. 118 VI). Today, it is uncertain whether the application for cloud storage is an accepted consequence of a law that will become permanent legislation, or if this gap will be closed, terminating the small industry, which is currently building around this business model.

Another example for a disputed legislation in Germany is the levy to promote renewable energy sources according to the EEG. Today, this levy constitutes a significant share of the total electricity costs (about 6.8 ct/kWh, cf. ÜNB, 2017). The EEG levy in general applies to all final electricity consumption with the exception of a *de minimis* limit for the self-consumption of households (Art. 61a I EEG 2017; Deutscher Bundestag, 2016a). However, the term "self-consumption" requires that the asset is operated by the consumer himself (§ 3 XIX EEG 2017). How this is to be interpreted in praxis is still vague, and loopholes were already found, but the general idea seems to be that the full levy has to be paid if the asset is operated by a contractor. Since one of the intentions of the ES 2.0 concept was to reduce the system's overall costs by grid-friendly operation, this legislation seems rather counterproductive from a holistic perspective. Apart from this, the general idea to include renewable electricity in the funding scheme for its own promotion seems questionable by itself.

As a last aspect regarding the *Revenue Streams* notice that, while the orientation towards an economically feasible energy transition is basically decent, many young technologies and business models will need funding, legislative support, and simply time to mature before they become profitable.

6 Conclusion and policy implications

This paper used the Business Model Generation (BMG) technique of Osterwalder and Pigneur (2010) to analyze the transition process of business models in the energy supply industry and to identify legislative obstacles.

The BMG technique was chosen as method for the investigation due to its capability to capture the needs of multiple stakeholders in a market, to actively support the innovation process regarding new business models, and to allow a structured presentation of the concept developed. Using this methodology, it was first found that the old energy utilities especially in Germany are in a sever turmoil with their incumbent business model being unsuited to face the new challenges of an electricity supply based on distributed energy system. An analysis of the business environment showed that customers, grid operators and policy makers also face multiple issues caused by this transition and could need support in overcoming these obstacles.

Based on this insight we proposed a new, offer-driven business model for future energy suppliers, which we called the Energy Supplier 2.0. This ES 2.0 would act both as an energy supply-contractor and an aggregator of energy assets for its customers and would use their flexibility to generate additional revenue streams by solving issues for the other market participants. Grid operators could profit from an additional way to provide their ancillary services in a future without big thermal power plants and could potentially delay or reduce grid expansion costs. Households would be massively supported the process of becoming prosumers without having to take any risks or having to engage a lot themselves or suffer from a decrease in comfort in their daily life. For the energy suppliers themselves, the introduced concept points out a way towards a new, service-oriented type of business model, both with increased customer proximity and loyalty. The potential efficiency increases in terms of grid operation and energy usage finally also make the introduced concept a matter for policy-makers, who are currently in need of options to limit the cost increase in electricity prices.

While we pointed out why we consider the developed business model advancement for all parties involved, we also found that several legislative obstacles hinder its diffusion. For the first time, the Business Model Canvas was used to systematically gather these obstacles and pointed out which building blocks of the concept are affected in detail. We also formulated advice as how these issues could be resolved. As it turned out, two aspects are of special importance: (1) A secure communication channel to the distributed assets within the households has to be ensured to allow direct load control and (2) the old focus on hardware grid expansion solution for grid shortages has to be replaced by complemented by operational solutions to ensure cost efficiency.

An important task for future research is a quantitative assessment regarding the economic potential of the introduced business cases that utilize the flexibility of the distributed assets.

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