Small-scale, Big Impact – Utilities' New Business Models for "Energiewende"

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The European electricity industry looks back on two decades of major change: Liberalization has just been mastered, but the rising diffusion of renewable energy generation, particularly small-scale distributed renewable energy generation (DREG), poses new challenges. Electricity from renewables has priority in the grid and is supported by feed-in-tariffs in many countries. Hence, big power plants must operate under partial load for long periods and therefore do not reach their full efficiency. Consequently, the classic utility business model (UBM) summarized as "invest in a plant, earn a return, and turn the meters" is seriously challenged and additional business models (BM) for DREG seem vital. This paper addresses the major challenges for utilities concerning "Energiewende" and presents five new utility BMs for small-scale DREG focusing on optimized energy solutions for the customers and suitability regarding market potential and utilities' capabilities.

Die europäische Elektrizitätsbranche blickt auf zwei Jahrzehnte wesentlicher Veränderungen zurück: die Marktliberalisierung wurde eben erst bewältigt und schon stellen die steigende Verbreitung erneuerbarer Energieerzeugung, im Speziellen kleiner, dezentraler, erneuerbarer Energieerzeugung (DEEE) die Branche vor neue Herausforderungen. Deren erneuerbarer Strom hat Vorrang im Netz und wird in vielen Staaten durch Einspeisetarife gestützt. Daher können große Kraftwerke (KWs) oft über längere Zeiträume nur unter Teillast gefahren werden, wodurch sie nicht ihre volle Effizienz ausschöpfen. Folglich gerät das klassische EVU-Geschäftsmodell – Investition in zentrale KWs, Stromerzeugung, -transport und -vertrieb über große Distanzen an den Kunden, um Renditen zu erwirtschaften – zunehmend unter Druck; die Entwicklung neuer Geschäftsmodelle erscheint notwendig. Nachfolgend werden die wesentlichen Herausforderungen für EVUs im Zusammenhang mit der Energiewende erläutert und fünf neue Geschäftsmodelle für kleine DEEE mit Fokus auf optimierte, nachhaltige Gesamtenergielösungen für den Kunden als Lösungsansätze vorgestellt.

1. Introduction

"Energiewende"[1] has become a synonym for the process of conversion to renewable energy and the phase-out of fossil and nuclear energy. However, it is not a European phenomenon only; some 120 countries around the world have enacted policies that support renewable energy and most of them are developing countries (*McGinn et al.* 2013). Nevertheless, opinions are divided and the term has become an emotive word, not only in public discussion, but even more in the electricity industry. European utilities[2] have been facing major changes in their markets and environment throughout the last two decades. EU-directives on energy market liberalization have changed the formerly monopolistic market environment completely. Additional major drivers of change were the EU's "20-20-20 targets" and the "EU Roadmap 2050". They both started paving the way for a broad diffusion of renewable energy in the EU ("Energiewende") for two reasons. First, these initiatives enforced the unbundling of electricity production from distribution (ECF 2010a). Second, they promoted the rise of DREG systems (ECF 2010a; *Sawin et al.* 2013).

During the last few years, the situation of the utilities has become increasingly complex. Electricity from (distributed) renewable energy plants (wind power, photovoltaics, etc.) has priority in the grid and is also supported by feed-in-tariffs. The big power plants must operate under partial load for long periods and therefore do not reach their full potential in terms of efficiency and earnings, leading to a rise in specific electricity production costs (€/kWh). Consequently, the classic utility business model (UBM) of producing electricity in large-scale, centralized plants and selling it over long distances to the customer is seriously challenged.

This paper addresses the following questions: How can utilities cope with the challenges of "Energiewende" and benefit from the diffusion of renewable energy? Which roles can utilities play in a combined system of centralized and distributed electricity generation? Which BMs could be suitable for small-scale DREG from the utilities' perspective?

We provide a short introduction into the genesis of business modelling and the theoretical framework (part 2). This follows a presentation of the qualitative research approach of developing BMs via morphological fields (part 3). In part 4, we introduce the major challenges for the utilities and their BM to show the necessity of the integration of small-scale DREG in new BMs, followed by a short overview of the literature on BMs and BM innovation in the electricity industry (part 5). Part 6 presents the outcome of the study's analysis: Firstly, a generic approach for developing BMs based on distributed, renewable energy technologies (business model morphology) and secondly, five BMs for the utilities in the field of small-scale DREG. Finally, we discuss the results, address limitations, and provide suggestions for future research (part 7).

2. Theoretical Framework

2.1 Business Models' Origins, Definitions, and Conceptualizations

The first reference to the term "business model" dates back to the 1950's *(Bellman et al.* 1957). The term has become widely used in media, business and science, especially since

1 The term "Energiewende" can be traced back to a 1980's publication of the German Öko-Institut that depicts scenarios for growth and prosperity without oil and uranium.

2 We define "Utilities" as electricity supply companies, mostly of large-scale company size.

the expansion of internet businesses, but it is still unclear what BMs are and what they should be used for (*Günzel/Krause* 2013; *zu Knyphausen-Aufseß/Meinhardt* 2002). Even the rising number of scientific and non-scientific publications has not changed much about this lack of clarity *(Zott et al.* 2010; *Ghaziani/Ventresca* 2005). Another problem is that different scholars writing about BMs do not mean the same thing (*Linder/Cantrell* 2000; *Osterwalder et al.* 2005). Because of the disagreement about BM definitions, many different conceptualizations exist. Overviews of them are presented by various authors (e.g. *Rauter et al.* 2012; *Bieger/Reinhold* 2011; *Wirtz* 2011).

In our study we followed the definition of *Osterwalder/Pigneur* (2010, 14) ("[..] *a business model describes the rationale of how an organization creates, delivers, and captures value.*") and their "Business Model Canvas" to describe and analyze the basic elements of BMs (*Table 1*).

Author	Definition	Elements of the Business Model
Osterwalder/Pigneur (2010)	A business model describes the rationale of how an organization creates, delivers, and captures value.	▪ *Customer Segments* ▪ *Value Propositions* – Bundle of products and services that create value for a specific customer segment ▪ *Channels* – How a company communicates with and reaches its customer segments to deliver a value proposition ▪ *Customer Relationships* – Types of relationships a company establishes with specific customer segments ▪ *Revenue Streams* – The cash a company generates from each customer segment (costs must be subtracted from revenues to create earnings) ▪ *Key Resources* – Describe the most important assets required to make a business model work ▪ *Key Activities* – Describe the most important things a company must do to make its business model work ▪ *Key Partnerships* – Describes the network of suppliers and partners that make the business model work ▪ *Cost Structure* – Describes all costs incurred to operate a business model

Table 1: Business Model Concepts (extracted from *Rauter et al.* (2012))

2.2 Business Model Innovation

The uncertainty about BM definitions continues in the field of business model innovation (BMI). BMI can be seen as a process (*Liedtka/Meyer* 2009; *Osterwalder/Pigneur* 2010) or as a result of a BM-change. The object of innovation is also defined differently; some see BMI as an innovation of one (*Sinfield et al.* 2012), two, or more BM-elements (*Lindgardt et al.* 2009); others argue that BMI stands for the innovation of the complete BM (*Steenkamp/van der Walt* 2004). There is consensus among the scholars that BMIs are an alternative or complement to product or process innovation (*Amit/Zott* 2012). But a company should not flippantly abolish its BM, because the reinvention can be a huge resource consuming effort. Hence, the potential of the new BM has to be large enough (*Johnson et al.* 2008). For this paper, we interpret BMI as the process of improvement and change of at least one element of the BM.

3. Methodology

We base this paper on the results of a joint research project with partners from academia and a large Austrian utility company. Like the whole electricity industry, this company faces the challenges of renewable energy's boom. Thus, the project consortium was interested in finding solutions to cope with this new situation. In particular, the integration of small-scale DREG units (< 250 kW_{el}) into the value creation and proposition of utilities – two of the core elements of a BM – seemed vital to the project consortium to master the risk of market disruption. Therefore, we investigated the BM situation of selected utilities worldwide, which use renewable energy technologies at micro- or small-scale level (< 250 kW_{el}). We followed the theoretical sampling approach (*Strauss/Corbin* 1998) and analyzed different textual content belonging to the companies (homepages, product info folders, offers, blogs, etc.). We applied the Business Model Canvas (*Osterwalder/Pigneur* 2010) as a framework to explore the real-world BMs in this field. The BM Canvas has been chosen according to practical criteria, namely clear visualization, the possibility to recombine the BM elements, and good transferability into the utility partner's daily business. In addition, we conducted a review of the literature on BMI in the field of renewable energies. We took wind power, photovoltaics, hydropower, combined heat and power generation plants (internal combustion engine, gas turbine, Stirling engine, fuel cell and biomass gasification) as well as thermal and electric storage systems into consideration.

We use the outcome of this analysis (1) to illustrate the challenges of European utilities concerning "Energiewende", (2) to sketch utilities' real-world BMs with the help of the Business Model Canvas (*Osterwalder/Pigneur* 2010) and (3) to develop the different characteristics for the BM morphology, a specific morphological field scheme[3] (*Zwicky/Wilson* 1967). Using this tool, the results of the qualitative real-world BM research (*Table 2*), and the literature base, we (4) developed specific BMs for small-scale DREG. For validation we applied a recursive improvement and refining process based on two intensive workshops with the sales representatives of the aforementioned large Austrian utility company (also responsible for the firm's BM development). We integrated all these insights into the morphology, which provides a comprehensive overview of specific BM characteristics and their expressions for the application with distributed renewable energy BMs for utilities.

3 Morphological fields have already been used to structure and analyze BMs in other industries (*Lay et al.* 2009).

4. Challenges for European Utilities

In the following, we describe major challenges for European utilities to show the necessity of rethinking the classic UBM and we present the integration of small-scale DREG in new BMs as one possible solution.

4.1 Impact of the Development Targets for Renewable Energies

In December 2008, the EU Parliament agreed on the "20-20-20 targets" (Directive 2009/28/EC) – a package with measures on climate protection and renewable energy promotion – to raise the share of renewable energy to 20 % (of primary energy) by 2020. Another driver of change in the field of renewable energy usage is the "EU Roadmap 2050" confirmed on March 8, 2011, which discusses the feasibility and challenges of an 80 % greenhouse gas (GHG) reduction objective (based on 1990's level) and presents practical scenarios and solutions[4] (ECF 2010b). These new regulations have led to a broader usage of renewable energies in the electricity industry and the amount of renewable energy promises to increase even further.

This results in an ongoing change to the utilities' business environment. Electricity from renewable sources (distributed renewable energy plants of micro- and small-scale, as well as large-scale wind-power and PV-parks) has priority in the grid. But the volatility of their generation (wind and solar volatility) confronts the industry with two tasks: (1) balancing the demand with the generation and (2) operating the conventional power plants in part load. To address the first task, the role of generation forecasts for renewables becomes increasingly important; a new capability for grid and power plant operation, and electricity trading is needed (*Graebner/Kleine* 2013). Smart grids and the interaction of generation, storage, grid management and in particular demand-side management are new features of a possible solution. However, there are still some open issues such as data security, ownership of the meter, metering as service, communication between grid and users' individual devices.

The second task is closely connected: When the renewable power plants start producing, the conventional (base load) power plants have to reduce their output. For the utilities, this results in more part load phases, more starting and shutdown cycles, more wear and tear and at the same time, less efficiency and revenue per year. These two issues become increasingly serious when more renewable energy is produced.

4.2 Cost Pressure and Aging of Conventional Power Plants

If the large, conventional (base load) power plants must operate under partial load or shut down for longer periods, they do not reach their full efficiency and their specific electricity production costs (€/kWh) rise. This is because they cannot profit from potential economies of scale of large production facilities. At the same time, the day-ahead trading prices for electricity at the power exchanges (e.g. EPEX – European Power Exchange in Leipzig) decrease, caused by the high amount of nearly zero-cost renewable electricity[5] (*Kemfert* 2013; *Graebner/Kleine* 2013). This puts pressure on the fossil power plants.

4 The authors estimate an increase of electricity consumption in Europe (including Norway and Switzerland) of about 40 % (based on 2010), reaching 4,900 TWh per year. The share of renewable energy in the energy mixes should be between 40 % and 100 % (ECF 2010b).

5 Trading prices follow traditionally variable costs per kWh (e.g. fuel costs.).

Many modern and efficient combined-cycle gas turbine plants (CCGT) are switched off, because the conversion of gas into electricity is too expensive. Energy efficient and lower GHG-emitting power plants have overly high production costs (without even taking carbon capture and storage technology into account). For this reason, already amortized, old, "dirty", difficult adjustable and less efficient coal and lignite power plants or amortized hydropower plants are able to compete only. In Germany the lignite-based electricity-production in 2013 reached the highest amount since 1990 (162 TWh 2013, 171 TWh 1991) (Handelsblatt 2014). This in turn raises other specific problems next to the rising amount of GHG emission: the aging power plants (e.g. Germany, UK, France) and the phasing out of nuclear power plants (e.g. Germany) (*Kemfert* 2013). Hence, the utilities lose their amortized production capacities and are neither able to operate their newer CCGT plants economically, nor to invest in new conventional large-scale power plants. This in fact has already weakened utilities' bond ratings significantly (*Lehr* 2013). The US are also faced with the investment challenge: generation reinvestment of $560 billion will be required over the 2010 – 2030 period (*Fox-Penner et al.* 2008). Thus, the BM of centralized electricity production in big plants is seriously challenged, something that is confirmed by the current Strategy Roadmap of Germany's RWE: "The massive erosion of wholesale prices caused by the growth of German photovoltaics constitutes a serious problem for RWE which may even threaten the company's survival"[6] (*Beckmann* 2013). In fact RWE slid into €2.8bn net loss in 2013 (*Sorge* 2014).

4.3 Change of Customer Interests and Their Bargaining Position

The main goal of the liberalization of electricity markets was to stimulate competition. However, initially, this was not achieved, because in some states a regulatory authority was missing or had a weak position (e.g. Germany, France). Therefore monopolies changed mainly into oligopolies (*Kemfert* 2013). Thus, the consumer did not see any price competition or price advantages, and showed a small interest in changing the electricity supplier. The upcoming development of renewable energies has changed the situation. More players have entered the electricity market; e.g. new investors like pension funds, insurances, other capital investors as well as operators of renewable power plants of different sizes (from a few kW up to MW) This deconstruction phenomenon is leading to more fragmented competition (*Schoettel/Lehmann-Ortega* 2011). The former end-consumer is today often a producer himself (*"prosumer"*), who actively participates in the energy marketplace. Consequently, the bargaining position of the utilities is weakened. The prosumer's main motivations for an investment in a proprietary home power plant are (1) the desire for independence, (2) environmental awareness, (3) technology affinity, (4) energy affinity and (5) the image of the utility (*Fischer* 2003; *Leenheer et al.* 2011). But this is not only true for owners of private houses; townspeople living in apartments also use the opportunities of economic citizen's participation models to become shareholders of e.g. a local solar park. Also smaller business consumers in commerce, trade and small industry have a more emancipative bargaining position. The global commercial solar energy storage market is predicted to overtake the residential and utility-scale by 2017 and will grow from 3.2 MW in 2012 to 2.3 GW 2017 (market share from 5 % in 2012 to 40 % in 2017)

6 This is also a reason why alternative market concepts are currently being discussed, e.g. capacity markets or strategic reserves.

(*Bayar* 2013), which will further strengthen the commercial consumers' position. Competition with new players in electricity business – especially in large-scale renewable energy generation often pension funds – additionally weakens the utilities' position (*Downing* 2013). Consequently, this situation requires adapted approaches in end consumer marketing of utilities, creative and sensible offers (e.g. energy services, service packages) and new value proposition in order to stay in business.

4.4 Industries' Cognitive Barriers Concerning Distributed Renewable Energy Generation

The electricity industry is of high strategic importance for a state and its economy. Therefore, the utilities created a stable system with the security of supply as a main goal next to provision of safe, sustainable, and reasonably priced electric energy at any time. Thus, the aspects influencing the integration of technological innovations and innovative BMs are more complex than in other industries. Now, the utilities are, in addition to their classic role, faced with the emergence of new, disruptive technologies that challenge their BMs. Under these conditions, delivering value from distributed, renewable energy technologies would often require a real paradigm shift. To change its business model from a classic UBM under monopolistic conditions to new forms, can be especially challenging (*Nimmons/Taylor* 2008). Although some renewables are relatively compatible with the traditional UBM (e.g. central large-scale photovoltaics), others require real BMI, e.g. distributed, small-scale biomass combined heat and power generation units (CHP). This shift is not trivial for "large and complex organizations with long and successful history of doing a different kind of business" (*Nimmons/Taylor* 2008, 9). Contrasting research *(Frantzis et al.* 2008; *Nimmons/Taylor* 2008; *Schoettel/Lehmann-Ortega* 2011), practitioners claim that they do not expect the distributed renewables to threaten their current BMs at all (*Richter* 2011). This could be caused by cognitive barriers of the top management team (TMT), which restrict new ideas that do not correspond to the current BM (*Chesbrough/Rosenbloom* 2002; *O'Reilly III/Tushman* 2004; *Richter* 2011). *Tripsas/Gavetti* (2000) showed in an in-depth case study of Polaroid, how TMT cognitions about how Polaroid competed hindered the firm's ability to develop the new capabilities needed for the company to compete selling software rather than hardware (cameras). Interestingly, Polaroid had developed an array of new digital imaging competencies, but the rigidity in existing processes and management's inability to implement a new business model stopped them from successfully entering new markets *(O'Reilly III/Tushman 2008*). But this is not only true for the consumer industry, *Friedrich & Wüstenhagen* (2012) applied the stages theory of grief (*Kübler-Ross* 1969) – a concept originally developed to illustrate the transformational process over time after a disruptive personal event – on an organization level, to describe the reaction of a large German utility to the phase-out of nuclear energy and institutional support for renewable energies. They argue that organizations that under the threat of losing their legitimacy due to disruptive events in the organizational field, go through five stages of grief, from (1) denial to (2) anger to (3) bargaining to (4) depression till they finally reach the stage of (5) acceptance (*Friedrich/Wüstenhagen* 2012). Thus, the TMTs should learn from these insights and from the faults in other industries to lead their enterprises successfully through these times of dramatic change.

5. Status Quo of Utilities' Business Models for Renewable Energy

5.1 Utilities' Business Models in Research Literature

Until now, the utilities' role in DREG is mostly limited to buying and providing the grid connection for transmitting the electricity surplus that is not used locally. The utilities limit themselves to a passive role that simply fulfills the legal requirements. With a growing diffusion of DREG-units, they are losing market share and revenue. Additionally, *Busnelli et al.* (2012) see a very high reduction potential of the domestic energy demand from the grid, because of different technological innovations such as the energy saving nature of buildings and electric devices, energy management, distributed generation. In the most dramatic scenario, the domestic grid demand would decrease to 13 % of what it was in 2010 by the year 2020. Thus, engagement in DREG seems vital. Consequently, a growing interest in BMI (*Rauter et al.* 2012) and in particular BMI in combination with renewable energy technologies can be seen. Some of these publications focus on BMs for specific technologies like photovoltaics *(Nimmons/Taylor* 2008; *Graham et al.* 2008; *Schoettel/Lehmann-Ortega* 2011; *Allan/Trivedi* 2011; *Busnelli et al.* 2012). Others describe the differences between the classic UBM and new, customer-oriented BMs or possible combinations (*Watson* 2004; *Sauter/Watson* 2007; *Richter* 2012). In the following paragraphs we highlight a few papers that are of particular relevance to small-scale energy units.

Sauter/Watson (2007) combine the spectrum of consumer's roles with the utility's roles in installation and operation of small-scale distributed generation. This results in three alternative deployment models ("Plug and Play", "Company Control" and "Community Microgrid"). The "Plug and Play" scenario is based on the willingness of the consumer to invest and operate a micro-scale unit to become partly independent of the utility. The "Company Control" scenario assumes that the utility operates a fleet of micro-generators in order to substitute a large, central power plant (virtual power plant). The consumer provides the site, but has only a passive role. Within the third model "Community Grid", consumers and institutions of a smaller geographical region build a micro grid of small-scale generation units and operate them. They have control over their units and are responsible for balancing production and demand in the grid. These deployment models span a field of opportunities, where the utilities may find their roles as partner for distributed energy supply of the future.

Richter (2012) provides "two generic business models for renewables energies" based on the actual research results. The first is the "utility-side business model" based on the operation of large-scale units (PV, wind power, biomass plants > 1 MW), which is quite similar to the classic UBM and the existing core competences (project management, administration of power plants). The second one is the "customer-side business model", which enables the customer to become a producer as well. It is suitable for micro- and small-scale units that are located on the property of the consumer. These circumstances result in a variety of uncommon value creation opportunities for the utilities. They are in the unusual situation of redefining their roles and value proposition, which can range from "simple consulting services to a full-services package including financing, ownership and operation of the asset" (*Richter* 2012, 2486).

Busnelli et al. (2012) suggest an engagement of utilities in the distributed energy market, because of a high substitution potential of energy savings and distributed energy generation. They present four BMs for utilities: Distributor (leverages customer relationship to distribute energy efficient products and services), After-sales specialist (provides different maintenance services), Lead generator (provides leads to other companies which provide energy efficient product or services for a fee) and Aggregator (single point of contact for the customer, which provides full range of products and services). The authors sketch the BM more than they outline them in detail, but they provide a feeling of possible alternatives to the classic UBM.

So, the basic options and most important boundary conditions for BMs in distributed energy supply have already been sketched, but details for operation and examples in practice are rare. Some of the potential activities in the distributed energy business are obviously closely linked to diffusion of infrastructural systems and technological improvements (e.g. smart meters, smart grids, information systems, storage systems). Also, third party partners might provide services that are not related to utilities' consisting core competences (e.g. financing, installation, maintenance).

5.2 Overview of Real-world Business Models

The second main source for the development of our BM morphology is an analysis of established real-world BM. We identified 11 different firms (n = 11) from the electricity and gas sector that operate BM for renewable energy generation mostly on small-scale level These companies operate all over the world; most of them are located in Europe, but we also considered firms from the USA and Japan. *Table 2* provides an overview of these real-world BMs and their four basic characteristics (*Osterwalder/Pigneur* 2010): the customer interface, the value proposition, the infrastructure management and the financial aspects (cf. business model canvas). The BMs span a wide field of opportunities, which we aimed to include in our morphology for BM development.

Technology	BM-Name	Company	Country	Customer Interface	Value Proposition	Infrastructure Management	Financial Aspects
CHP	"Minikraftwerk"	Wels Strom AG	AUT	Hotel industry, agriculture, trade and small industry, municipalities	Turnkey projects (consulting, planning, installation, operation and servicing/maintenance; even incl. financing partner)	Know-how (operation, market, technology), consulting, planning, installation service/insurance	Consulting, operation, servicing/maintenance, facility provision
CHP	"MiniVersum"	EnVersum	GER	Multiple dwelling, hotel industry, trade and small industry	Heat and power is provided thanks to a combustion engine. Facility belongs to EnVersum, that delivers the primary energy carrier as well as heat (no obligation from end customer to buy the produced electricity)	Know-how (operation, market, technology) and power, heat, service/insurance, planning and installation, ownership/contracting, operation	Partial facility provision + monthly contracting fee (primary energy carrier and servicing included); Heat and power invoiced separately.
CHP	"Ene-Farm"	Tokyo Gas	JPN	One-family dwelling, flat	Compact fuel cell+thermal storage unit run by natural gas that produces heat and power. Tokyo gas sells and installs the facility and delivers primary energy carrier and heat (electricity can be fed-in or consumed in-place)	Technology and market know-how. Technology partner.	Facility provision, primary energy carrier and heat delivery
PV	"PV zum Null-Tarif"	MEA-Solar	AUT	One-family and multiple dwelling, hotel industry, agriculture	Facility belongs to the MEA-Solar during 13 years; after which it is transferred to the customer without cost (financing through feed-in tariff)	Know-how (market and technology), manpower (consulting, operation, service and sales), facility and financing	PV system financed through the feed-in tariff.
PV	"Sonne Rein"	Linz AG	AUT	Mass customers	Planning, construction and operation of big PV-parks, which are financed through a participation model	Know-how (technology), project management, operation, service	Financing through participation model (private persons invest and get a yearly interest rate)
PV	"Solar PV"	British Gas	GBR	One-family dwelling	Planning, installation and servicing of a PV facility. Focus on up/cross-selling to reach synergies with other business lines	Know-how (market and technology), manpower (consulting, operation, service and sales), facilities	Facility provision and maintenance
PV	"Solar-Lease"	Sungevity	USA	One-family dwelling	Sungevity plans, installs, finances (through leasing) and services PV facility.	Know-how (market and technology), manpower (consulting, operation, service and sales), facility and financing	End customer pays contracting fee and reduces his energy costs

Technology	BM-Name	Company	Country	Customer Interface	Value Proposition	Infrastructure Management	Financial Aspects
All	"Integriertes Energie-Contracting"	Grazer Energie Agentur	AUT	Multiple dwelling, hotel industry, trade and small industry, municipalities	Facility contracting financed through the savings resulting from improvements in the supply-side (use of renewable energies) as well as in the consumption side (optimization of the buildings,...)	Know-how (operation, market, technology), primary energy carrier, power, heat, service/insurance, consulting, planning and installation, contracting, operation	Contracting fee covering investment, operating costs, and consumption-related costs (primary energy carrier,...)
All (PV, wind)	"Abnahmemodell"	Alpen Adria Energie (AAE)	AUT	Owners of small-size generating facilities (single dwellings, agriculture, hotel industry,...) based on renewable energy	AAE purchases "green-electricity" from existing facilities (Abnahme), feeds it into the network and resells it. Furthermore AAE covers in-place the demand the own facility is not able to satisfy	Know-how energy management	Base fee and output-related fee
All (PV, Fuel cell, wind)	"Sustainable Communities"	San Diego Gas and Electricity	USA	Multiple dwelling, hotel industry, trade and small industry, municipalities	SDG&E installs, operates and services a heat and power generating facility in a private-owned building (whose owner rents the space and benefits of having a "green image") but on its side of the counter. The heat is consumed in-place and the electricity is fed-in into the network.	Planning, project management, operation, service/maintenance (possibly through a contractor). Energy management and financing.	Feed-in, output-related fee
-	"Sparzähler"	Yello Strom	GER	Single dwelling, flat	Yello Strom offers variable tariffs for customers that use the "smart counter" (which enables to track and control electricity consumption) and are supplied by the company.	Energy management, sales and marketing	Customer retention, output-related fee

Table 2: Real-world Business Models in Distributed Renewable Energy Generation

6. Results

There are two main results of our analysis. First, we developed a generic tool for BM development based on morphological fields, to define BMs in the field of small-scale DREG. Second, we applied this tool to develop five specific BMs, which could be generally applied in the electricity industry.

6.1 Business Model Morphology for Small-Scale Distributed Renewable Energy Generation

We used the morphology field approach to structure and present the constitutional elements of BMs and their variants. Approaches based on morphological fields have already been used for BMs in other industries (*Lay et al.* 2009; *Kley* 2011). We followed *Osterwalder's & Pigneur's* (2010) conceptualization of BM and developed the expressions for the characteristics by analyzing the existing generic BM concepts and real-world BMs. The results were recursively discussed in workshops with the project partners to create the final morphology (see *Figure 1*). We bundled *Osterwalder's & Pigneur's* (2010) conceptualizations into four characteristics (see *Figure 1*) in order to make them easier to understand and more applicable to the daily business of our utility partner. The selection process for the choice of the most important sub-characteristics and their expressions will now be presented in detail.

Customer segments: For the micro- and small-scale distributed energy generation, we distinguish between mass customers (B2C) and individual customers (B2B) and point out different opportunities for each group (*Figure 1*). We are discussing distributed energies not only in the context of electricity supply, but also in the context of heat supply (e.g. micro CHP units). Accordingly, new business opportunities arise, which are a combination of these two. Thus, they are of special interest for combined heat and power generation, as well as dual- or poly-technological energy generation systems (combination of e.g. PV, biogas combustion CHP and electrical storage). Municipalities play a special role in this context. They typically have a pool of different buildings (heat and energy demand), and they also operate different kinds of public facilities (water and wastewater treatment plants, dumps, local heat networks etc.) that could be integrated with energy recovery or waste-to-power systems into an overall distributed energy concept. If they want to follow the trend of regional energy autarchy, they would need integration partners to set up a sustainable local energy system. This could be provided by a utility.

Value proposition: We present these in order of rising complexity (*Figure 1*). The supply of power and heat, as well as providing service & maintenance and insurances for plants can be seen as extensions of the current BM with low complexity. The required economies of scale for service & maintenance could make additional customer acquisition necessary. But also a partnership with a service company could be possible. At the level of medium complexity we classify technical consulting, provision of facilities, planning and installation (turnkey projects). Provision of facilities stands for a model, where the customer can make a choice from a number of preselected standard plants sold and installed by a number of local partners for an attractive price. The responsibility of installation lies in the customers' hands. We assign Ownership / Contracting and Operation to a level of high complexity due to the fact that it encompasses the complete responsibility for planning, financing, installing and operating over the whole life time.

Key activities: Here, we point out activities that differ greatly from current ones (*Figure 1*). The most important competences are related to the operation of large numbers of distributed energy devices (facility operation and energy management): We understand demand dependent controlling of the plants, capacity forecast, virtual power plant (VP) operation and the optimized fitting of energy supply to the individual demand (planning of energy systems) as well as the primary energy carrier management (biomass, biogas logistics) as significant activities for successful BM operation.

Key partners: The utilities have to build up new competences or need to choose the right partners for offering DREG-BMs. Which capabilities should be developed in-house and which should be provided by a partner depends on the individual competence base of the utility and the BMs addressed. We provide an overview of the relevant partners (*Figure 1*). This overview could also be used to brainstorm potential competitors arising from the diffusion of DREG.

Characteristic	Subcharacteristic	Expression								
Customer interface	Customer segments	Mass Customers		Individual Customers						
		One-family dwelling	Flat	Multiple dwelling	Hotel industry	Agriculture	Trade and small Industry	medium-sized Property	Local heat network	Municipality
	Distribution channels	Own						Partner		
		Sales force		Online		Events		Partner stores		Online
	Relationships	Customer acquisition			Customer retention			Upselling		
		Personal assistance	Key Account	Automated	Personal assistance	Key Account	Automated	Personal assistance	Key Account	Automated
Products and services	Value proposition	low complexity				medium complexity			high complexity	
		Power	Heat	Service / Maintenance	Insurance	Consulting	Provision of facilities	Planning and Installation	Ownership/ Contracting	Operation
Infrastructure management	Key activities	Energy management	Primary energy carrier management	Risk pooling		Consulting	Facility sales	Project management	Facility administra-tion	Facility operation
	Key resources	Know-how			Manpower				Facility	Financing and Funding
		Operation	Market	Technology	Consulting	Operations	Services	Sales		
	Key partners	IT companies	Agents / consultants	Financier	Facility manufacturers	Installers	Operators	Service partners		
Financial aspects	Revenue model	Product-related			Product- and service-related			Service-related		
		Feed-in	Base rate	Output-related fee	Facility sale	Facility contracting	Performance contracting	Consulting	Operation	Service/Mainten-ance/ Insurance
	Cost structure	IT costs	Infrastructure costs	Primary energy carrier	Total facility costs	Shared facility costs	Consulting	Operation	Service/ Maintenance/ Insurance	Sales and Marketing

Figure 1 Business Model Morphology for Small-scale Distributed Renewable Energy Generation

6.2 Business Models for Small-scale, Distributed, Renewable Energy Generation

During the project we took a closer look at different renewable technologies and evaluated their technological and economic potential as well as analyzing different customers and generated customer profiles. The customer profiles and the technology evaluation act as "filters" for developing BMs based on the input of the BM morphology, the already existing real-world BMs and BM-literature. As result, five BMs are presented in *Figure 2*, which could be generally applied in the electricity industry .For the BM development we took specific technologies (PV, wind power, CHP, etc.) and technology combinations into consideration. We suggest two BMs for mass customers and three BMs for individual customers, which will be explained in more detail.

Customer Segment / Business Model / Technology	Mass Customers		Individual Customers		
	BM 1 Combined Heat and Power Plant Contracting	BM 2 Fuel Cell Contracting	BM 3 Complete Service Package	BM 4 Heat Intensive	BM 5 Power Intensive
Combined Heat and Power Plant	✔		✔	✔	✔
Fuel cell		✔	✔		
Small Wind Turbine			✔		
Small Hydro Power			✔		
Photovoltaics			✔	✔	✔
Thermal Storage	(✔)	✔	✔	✔	✔
Electric Storage		✔	✔	✔	✔

Figure 2: Small-Scale Distributed Renewable Energy Generation Business Models and their Technology Fit

BM 1 Combined Heat and Power Plant Contracting: This BM is based on the financing of a biomass/biogas fueled CHP plant via a contracting model. The customer pays for the obtained heat and power from the CHP plant operated by himself on his site. The costs for installation, fuel, service and maintenance are included in the price. Thus, the utility gets a long contractual binding with the customer and also reaches economies of scale in primary energy carrier management (purchase and logistics). With regard to the plant operation, we distinguish between customer operation at the first level and automated VP operation variant at higher complexity level. In addition to the technical capabilities, new capabilities in financing and primary energy carrier management would be needed. *Figure 3* shows an accurate description of BM 1 following the characteristics of BM Canvas.

BM 2 Fuel Cell Contracting: This model focuses on customer segments with a higher technological or ecological awareness and the willingness to use a high-tech-device for their heat and power supply. It is also based on a contracting model, but the utility provides a full service including operation, because of the system's technological complexity. For the VP operation, the system should integrate a large thermal storage for buffering the produced heat to allow for an electricity-optimized output. For this BM, a multi-technology system could be possible (FC + PV + electrolyzer (H_2 as buffer material)).

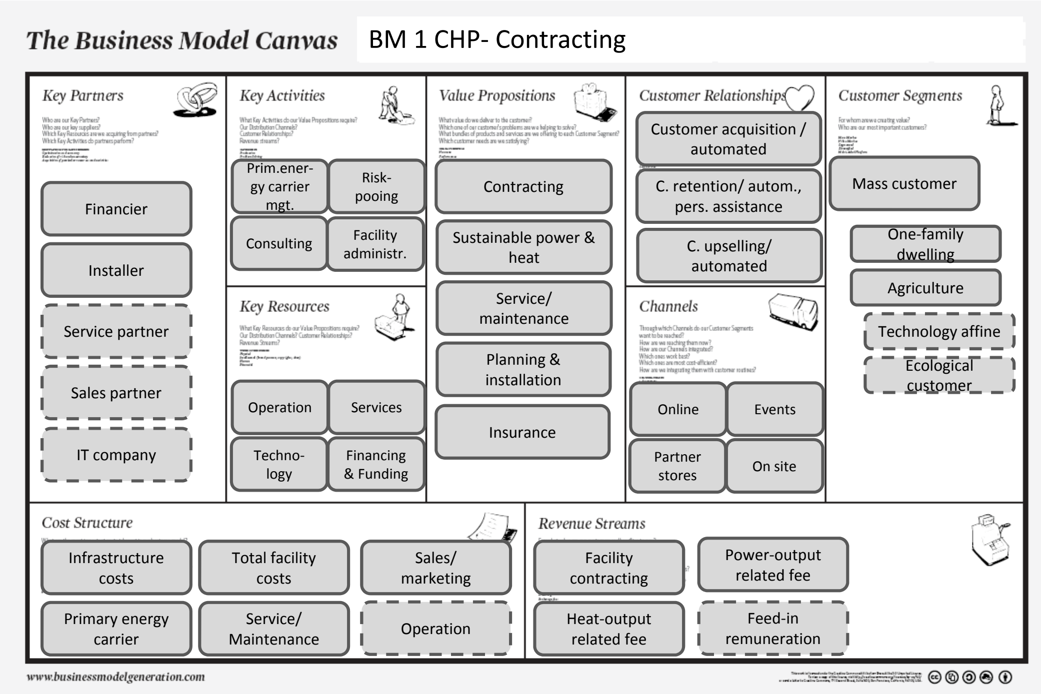

Figure 3: Business Model Canvas for BM 1 Combined Heat and Power Plant Contracting

BM 3 Complete Service Package: This model includes all services from energetic analysis and adequate planning of the energy system, to project management and installation up to operation, monitoring and maintenance. Additionally, consulting activities in the legal, financial and economical field could be offered. However, the package's composition needs to be arranged with the customer individually. The potential customers are companies operating medium-sized properties, multiple dwellings, trade and small-industry as well as municipalities.

BM 4 Heat Intensive: We developed BM 4 for individual customers with a high heat demand and who also produce biomass waste and waste heat (e.g. small or medium timber processing industry, horticulture, commercial laundries). The BM has two basic variants: Firstly, a variant where the utility acts as planner, installer, electricity and additional primary energy carrier supply partner and secondly, a complete service variant (based on plant contracting) with an electricity and heat supply contract (additional contracts for taking the purchase of waste heat or biogas into account). The aim is to set up a distributed multi-technology energy supply system optimized for energy efficiency including storage and energetic waste (heat) usage.

BM 5 Power Intensive: This BM is a concept for electricity intensive businesses in the field of trade and small-industry, as well as commerce. We are thinking of firms operating machine tools, production and handling equipment, but also firms that need process heat mainly powered by electricity (e.g. metal-working industry) as well as bakeries, or department stores and supermarkets (cooling and lighting). For these businesses, the energetic consulting and planning is the basis for a solution with two variants as in BM 4. The usage of waste heat should be addressed in the planning phase. The main advantage for the customer is the optimization of the firm's energy system and the reduction of electricity purchase through self-production.

7. Discussion & Conclusion

Despite the challenges, there are significant opportunities for utilities to capture value from innovations in the distributed energy systems. We have developed five BMs based on technology combinations for providing optimized customers' energy systems. Utilities could extend their classic BM, activate their role as energy partners, get closer to the customer, and consequently encourage customer loyalty. We think that the mass customer market involves greater complexity and more cost drivers (e.g. maintenance of hundreds of single plants), which makes it harder to achieve margins. However, energy intensive firms in trade, small-industry or commerce and municipalities seem to be interesting customers for this broader range of services. We favored the BMs with the highest overall energy efficiency and sustainable potential. For this reason, we do not present solutions where the utility acts more as a bridging partner for other vendors to bring their product and services to the customer. Some of our BMs will require the leverage of existing capabilities and resources into new areas (e.g. small project management, individual consulting); others will necessitate exploring new capabilities to successfully enter unfamiliar businesses (e.g. VP operation, installation and maintenance resources).

We see the presented morphology and the BMs as a concrete answer to the challenges of the classic UBM. It will be necessary to find new ways of staying in business. Thus, we suggested alternative approaches to providing customer's benefit with services around the optimization of their individual energy system and DREG-plants. However, success will not only depend on the right capabilities and partnerships presented in this paper, but also on the ability "to approach the challenge in a systematic fashion, informed by an understanding of the full range of available options" as *Busnelli et al.* (2012, 50) have already noticed.

Finally, two important limitations need to be considered. First, we focused in the BM development phase of the project in the Austrian energy market, where there are some peculiarities in comparison to other European countries: (a) Austria's amount of renewables is already very high (about 65 %) due to the traditional use of large-scale hydropower. (b) Nuclear power has never been used in Austria. (c) The national electricity industry consists of only one big transmission grid operator and the large utilities in Austria are of medium size in comparison to other European countries and do not operate single power plants of many Gigawatts. Additionally, (d) the mind-set of the electricity industry is not as opposed to renewables as is the case elsewhere. Second, it was not aim of the project to develop business cases for the suggested BMs. The situations are very customer and project specific as well as utility specific. The individual market structures in which utilities serve have impacts on what new BMs might be relevant. Thus, the BMs have to be calculated individually and may not be economically feasible in particular circumstances.

The results of our project open some interesting future research lines for studies in this domain: (1) The collection of additional real-world BMs (further technologies e.g. solar thermal energy, solar cooling etc.) could complete the BM Morphology and enhance the practical relevance as a tool for BM generation. (2) In this study the degree of detail was rather low – we concentrated on overall BM suggestions. Thus, further investigations could focus on the detailed design of single BM characteristics e.g. the revenue model or the value proposition. This could lead to completely new settings of key activities and key partnerships. (3) By following an action research approach (*Lewin* 1946; *Kubicek* 1975) the application of the suggested five BMs would provide detailed practical insights that could lead to refinement and finally to more valid BM concepts. (4) The field of BMs in DREG encloses a lot of detailed technical and financial questions to answer: What role do smart grids play for the further distribution of DREG? Which innovative financing instruments could be useful for a combination with DREG-facilities? Which form would BMs for VPs based on DREG take?

This paper makes two important contributions for research as well as for business: First, the provision and application of an easy and fast adoptable tool for BM development in the field of DREG – the BM Morphology. It was developed concerning real-world BM models and insights the analysis of the industry challenges. Second, our suggested five BMs provide proof for the morphology's practical usability and can be seen as a general contribution to business. We chose an approach to BMI which was unique at this time in the energy sector by concentrating on energy optimized technology combinations for the customers' individual energy system. These five BMs provide some ideas for technology and customer segment combinations where utilities can demonstrate their current (and future) competences to stay in business.

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