Energy Policy 62 (2013) 1226–1237

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Business model innovation for sustainable energy: German utilities and renewable energy

Mario Richter*

Centre for Sustainability Management (CSM), Leuphana Universität Lüneburg, Lüneburg, Germany

HIGHLIGHTS

- The energy transition creates a fundamental business model challenge for utilities.
- German utilities succeed in large-scale and fail in small-scale renewable generation.
- Experiences from other industries are available to inform utility managers.
- Business model innovation capabilities will be crucial to master the energy transition.

ARTICLE INFO

Article history:
Received 8 October 2011
Accepted 13 May 2013
Available online 08 Jul 2013

Keywords:
Renewable energy
Business model innovation
Utility

ABSTRACT

The electric power sector stands at the beginning of a fundamental transformation process towards a more sustainable production based on renewable energies. Consequently, electric utilities as incumbent actors face a massive challenge to find new ways of creating, delivering, and capturing value from renewable energy technologies. This study investigates utilities' business models for renewable energies by analyzing two generic business models based on a series of in-depth interviews with German utility managers. It is found that utilities have developed viable business models for large-scale utility-side renewable energy generation. At the same time, utilities lack adequate business models to commercialize small-scale customer-side renewable energy technologies. By combining the business model concept with innovation and organization theory practical recommendations for utility mangers and policy makers are derived.

1. Introduction

The transformation of the electric power sector towards a more sustainable form of energy production based on renewable energies is a key measure to fight climate change and resource depletion (Ari and Koksal, 2011; IPCC, 2007). Accordingly, the German federal government strives to produce 80% of the country's electricity from renewable energy sources until 2050 (BMWI and BMU, 2010). This transition from fossil fuels and nuclear energy to large-scale deployment of renewable energy technologies will fundamentally affect the structure of the electric power industry and change the way how electricity is produced, transmitted, and sold (Frei, 2008; Klose et al., 2012; Schleicher-Tappeser, 2012; Small and Frantzis, 2010).

Until some years ago, electricity generation had almost exclusively been the sphere of utilities. This is dramatically changing with the increasing expansion of renewable energies. By the end of 2012, Germany had produced 22.9% of its electricity from renewable energy sources (BMU, 2012, 2013). German utilities owned and operated 11.9% of this renewable energy generation capacity (Trendresearch, 2013). This means, they have lost 88.1% of the renewable generation market and correspondingly some 20% of the total German electricity generation market in the last ten to twenty years. The erosion of market share arises from two different sides: On the one hand, financially strong investors have entered the renewable energy market, because large-scale renewable energy projects offer relatively stable returns which are independent from the financial markets. On the other hand, private users of small-scale renewable energy systems, such as solar photovoltaic (PV), have become a noticeable source of electricity generation as well. By the end of 2011, Germany had an installed PV capacity of some 25,000 MW (BSW, 2012). More than 80% of the PV systems are installed on buildings. For example, in the German state of Bavaria 200,000 out of 2,300,000 electricity users own and operate a PV system (Krägenow, 2012). Thus, 8.5% of electricity consumers in this region have become independent power producers. Recent studies on utilities' business models find that the increasing share of renewable energies constitutes a

* Tel.: +49 17626392486; fax: +49 41316772186.
E-mail address: mario.richter@uni.leuphana.de

0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.05.038

threat to the current utility business models (Frantzis et al., 2008; Klose et al., 2010; Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2011). Utilities loose market share to investors from outside the energy industry. Thus, the challenge for utilities is clear: Utilities need to find ways to better commercialize renewable energy technologies. Otherwise, the energy transition will lead to a massive loss of market share, revenues, and profits.

Scholars found that especially established companies often struggle to innovate their business model, which is still profitable, but whose future potential is likely to be undermined by changes in technology or the external environment (Sosna et al., 2010). Most problems occur, when new technologies cannot find immediate application in the market and do not fit with the company's existing business model (Christensen and Bower, 1996). Christensen and Bower (1996: 198) note "[…] *a primary reason why such firms lose their position of industry leadership when faced with certain types of technological change has little to do with technology itself* […]. The business model is found to be at least as important for large-scale adoption of new technologies as the technology itself (Teece, 2010). In this regard, the energy transition creates a fundamental business model challenge for utilities. The research question of this work is: *What are current business model challenges and opportunities for German utilities in the field of electricity generation from renewable sources?*

The present study uses the business model concept[1] to investigate how German utilities position themselves to the challenges of the energy transition. Two generic business models are derived from a literature review and are subsequently analyzed on the basis of in-depth interviews with utility representatives. A surprising result is that most utility managers do not see renewable energy as a threat to their current business model, although utilities have already lost significant market share to investors from outside the industry. The study reveals that utilities clearly favor investments into large-scale projects over small-scale renewable energy projects. The main conclusion is that utilities are bound to their traditional way of business and lack business model innovation capabilities which will be necessary to benefit from the energy transition.

The contribution of this paper is twofold: it adds to the discussion about utilities' business models for renewable energy by pointing out how business model innovation can help utilities to address the challenges associated with the energy transition. Second, the outcome of this paper offers insights for policy makers which can be valuable for designing the regulatory framework for a sustainable future energy landscape.

The study is organized as follows. Section 2 introduces the background and analytical framework. Section 3 describes the methodology, Section 4 displays the results. The essay finishes with a discussion in Section 5 and conclusion in Section 6.

2. Background and analytical framework

2.1. The German energy market

The German energy sector is currently in a major transition towards a more sustainable production of electricity based on renewable energies ("Energiewende"). In 2010, the German federal government agreed to produce 80% of the country's electricity from renewable sources by 2050 (BMWI and BMU, 2010). By the end of 2011, Germany had produced 20% of its electricity from renewable energy sources (BMU, 2012). So, Germany strives to completely restructure its electricity supply within the next 40 years (from 80:20 to 20:80). Undoubtedly, these political targets will have major consequences for the whole energy market.

The main legal framework for the deployment of renewable energies in Germany is the Renewable Energy Sources Act ("Erneuerbare Energien Gesetz"). The Renewable Energy Sources Act grants priority grid access to electricity from renewable sources and provides the owner of the asset with a fixed feed-in tariff per kilowatt hour, usually paid over a period of 20 years.

Until some years ago, electricity generation had almost exclusively been the sphere of utilities. This is dramatically changing. By the end of 2012, the largest share of the installed renewable energy capacity in Germany is owned by private persons (34.9%). Further owners are independent project developers (13.8%), investments funds and banks (12.5%), farmers (11.2%), small and medium-sized companies and others (1.2%). Utilities own 11.9% of the overall renewable generation capacity (Trendresearch, 2013). Owning 11.9% of the renewable energy assets means that utilities have already lost 88.1% of the market for renewable electricity generation to other investors. This equals to some 20% of the total German electricity generation market. With this development continuing and the energy transition just at the beginning, renewable energies create a serious threat to utilities' business models in the next years and decades.

2.2. Business model

The business model can be understood as a structural template that describes the firm's organizational and financial architecture (Chesbrough and Rosenbloom, 2002). Teece (2010: 172) explains that a business model is about defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit. For the purpose of this study a business model is defined as "*the rationale of how an organization creates, delivers, and captures value*" (Osterwalder and Pigneur, 2009: 14). The business model definition and concept of Osterwalder and Pigneur are chosen, because they have been extensively tested in practice and also have been successfully applied to the field of renewable energies (Table 1) (e.g. Okkonen and Suhonen, 2010).

The business model provides a valuable new tool for analysis and management in research and practice (Zott and Amit, 2008; Schaltegger et al., 2012). This is underlined by the growing number of studies in this journal applying the business model concept as an analytic tool (e.g. He et al., 2011; Kley et al., 2011; Loock, 2012; Okkonen and Suhonen, 2010; Shrimali et al., 2011). In terms of analysis, the concept enables the examination and comparison of

Table 1
The Business model conceptualization.
Source: Osterwalder, 2004; Osterwalder and Pigneur, 2009.

Business model pillar	Description
Value proposition	Is the bundle of products and services that creates value for the customer and allows the company to earn revenues.
Customer interface	Comprises the overall interaction with the customer. It consists of customer relationship, customer segments, and distribution channels.
Infrastructure	Describes the architecture of the company's value creation. It includes assets, know how, and partnerships.
Revenue model	Represents the relationship between costs to produce the value proposition and the revenues that are generated by offering the value proposition to the customers.

[1] In this study a business model is defined as "the rationale of how an organization creates, delivers, and captures value" (Osterwalder and Pigneur 2009:14). Following the concept of Osterwalder and Pigneur (2009) a business model comprises four elements: value proposition, customer interface, infrastructure, and revenue model.

companies and markets in a structured way. Using the business model concept as a classifying device to build generic categories or blueprints helps to understand business phenomena (Baden-Fuller and Morgan, 2010; Wüstenhagen and Boehnke, 2008). As a management tool, the business model concept helps managers to design, implement, operate, change, and control their business (Johnson, 2010; Wirtz et al., 2010). Business models can also function as blueprints that are ready for being copied or variation and innovation (Baden-Fuller and Morgan, 2010).

2.3. Business model innovation

Business model innovation as a term remains largely unspecified in the current academic literature. Chesbrough (2010) notes that business model innovation is less a matter of superior foresight but of trial and error as well as ex-post adaptation. McGrath (2010: 254) even talks about "business model experimentation". Sosna et al. (2010) understand business model innovation as a strategic renewal mechanism for organizations facing changes in their external environment. In the present study it is understood as the *development of new organizational forms for the creation, delivery, and capture of value*.

First attempts have been made to provide a theoretical grounding for business model innovation. While Sosna et al. (2010) suggest to draw on organizational learning literature Chesbrough (2010) relates to innovation research to identify opportunities and barriers of business model innovation. The latter approach was found very helpful for the purpose of this study, because innovation research has been concerned with the consequences of radical technological changes for incumbent firms in different industries. Especially the research on disruptive innovation (Bower and Christensen, 1995; Christensen, 2006) and the theory of organizational ambidexterity (Duncan, 1976; Tushman and O'Reilly, 1996; Raisch et al., 2009) promise to contribute to the understanding of changes in the energy industry.

Disruptive innovations describe changes that disturb the established trajectory of performance improvement. For example, a new technology follows a different performance logic than the established technology in the market. A major characteristic of disruptive technologies is that they are rarely directly employed in established markets, but change the architecture of the market in the medium and long term (Christensen and Bower, 1996). So, disruptive innovations often destroy the value of existing competencies (Tushman and Andersen, 1986). The problem of disruptive technologies for established companies lies not in the technology itself, but rather in the inability of incumbents to commercialize these new technologies through a business model (Chesbrough, 2007). Consequently, disruptive technological innovation often go along with the need for business model innovation (Hansen et al., 2009).

In contrast to disruptive innovations, sustaining innovations maintain the existing performance logic. They are basically improvements of an existing technology or system. The majority of innovations are sustaining innovations. Therefore, sustaining innovation is less often related to business model innovation. The theory of disruptive and sustaining technological change will help to understand the role of different renewable energy technologies.

The theory of organizational ambidexterity suggests that organizations are successful in the long term, when they are able to exploit their existing capabilities while developing new competencies at the same time (Tushman and O'Reilly, 1996; Raisch et al., 2009). Organizational scholars argue that companies survive by changing and reconfiguring their assets and knowledge according to changes in their external environment (Eisenhardt and Martin, 2000; O'Reilly and Tushman, 2008; Teece et al., 1997). In the case of the energy industry this means that utilities will benefit from the energy transition if they are able to successfully continue to operate their conventional power stations as long as possible, but at the same time build up assets and knowledge in the field of renewable generation and other emerging markets within the energy industry. Scholars found that technological innovation sometimes requires industry incumbents to adopt a completely new core technology (Taylor and Helfat, 2009). This definitely applies to electricity generation sources, changing from fossil fuels and nuclear energy to wind power, biomass, and solar energy. O'Reilly and Tushman (2004) describe ambidexterity as a mental balancing act for managers between maintaining the current core business and developing radically new products and services for the future of the firm. Senior management needs to be open to new markets and technologies and able to reconfigure the assets for future success, while the established business is still going well (O'Reilly et al., 2009). The theory of organizational ambidexterity will help to understand the challenges for utilities in adapting to renewable energies.

2.4. Utilities' business models for renewable energy

The issue of utilities' business models for renewable energy has been addressed by a number of recent studies (e.g. Duncan, 2010; Frantzis et al., 2008; Klose et al., 2010; Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2011). Two generic business models — each with an own underlying business logic — are identified in the literature: Customer-side renewable energy business models and utility-side renewable energy business models.

Utility-side renewable energy business model: comprise large-scale projects with a capacity between one and some hundred megawatts. The main technologies for this application are on- and offshore wind energy, large-scale photovoltaic systems, biomass and biogas plants, as well as large-scale solar thermal energy like concentrated solar power. The value proposition in this business model is bulk generation of electricity (Nimmons and Taylor, 2008). The electricity is fed into the grid and delivered to the customer via the conventional electricity value chain. Therein, the customer interface consists of power purchase agreements on a business to business level, rather than a relationship with the end-customer. Although the projects usually have less generation capacity than conventional coal or nuclear power plants, they have a rather centralized character. From their position in the electricity value chain (see Fig. 1), the production and delivery of electricity from these sources follows a similar logic as from centralized conventional power plants. As far as the overall business model is concerned, these projects are much more similar to traditional centralized power plants than small-scale reneable energy

Fig. 1. Two generic utility business models and their location in the value chain.

Table 2
Utility-side vs. customer-side business model.

	Utility-side business model	Customer-side business model
Value proposition	Bulk generation of electricity fed into the grid	Customized solutions Energy related services
Customer interface	Electricity as commodity	Customer is involved in energy generation by hosting the generation system and sharing benefits with the utility
	Customer pays per unit	Long term customer relationship
Infrastructure	Small number of large-scale assets	Large number of small-scale assets
	Centralized generation	Generation close to point of consumption
Revenue model	Revenues through feed-in of electricity	Revenue from direct use, feed-in and/or from services.
	Economies of scale from large projects and project portfolios	High transaction costs

Table 3
List of interviewed German utilities.

Category (Revenues in m€)	Interviewed utilities	Revenues (in m€)
1. Multinational Utilities (> €10,000 m)	E.ON AG	79,974
	RWE AG	47,741
	Vattenfall AB	20,036
	EnBW Energie Baden–Württemberg AG	15,564
2. Regional utilities (€10,000 m–€1000 m)	EWE AG	5798
	Stadtwerke München GmbH	4900
	Stadtwerke Düsseldorf AG	1918
	Mainova AG	1611
3. Large local utilities (€999 m–100 m)	Stadtwerke Karlsruhe GmbH	997
	HEAG Südhessische Energie AG	603
	Stadtwerke Aachen AG	419
	Elektrizitätswerke Mittelbaden GmbH	202
	Stadtwerke Tübingen GmbH	155
4. Small local utilities (< €100 m)	Stadtwerke Uelzen GmbH	100
	GWS Stadtwerke Hameln GmbH	82
	Technische Werke Schussental GmbH	70
	Stadtwerke Munster–Bispingen GmbH	26
	Hamburg Energie GmbH	n.a.

projects on the customer-side (Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2011).

Customer-side renewable energy business model: This business model comprises energy generation in small-scale systems close to the point of consumption, also referred to as distributed generation. The main technologies for this application are solar photovoltaic (PV) systems, micro-wind turbines, and micro-combined heat and power systems (micro-CHP) (Onovwiona and Ugursal, 2006; Boehnke and Wüstenhagen, 2007). This distributed form of renewable electricity generation is often seen as a potential pillar of the future energy landscape and associated with substantial environmental benefits (Alanne and Saari, 2006; Omer, 2008). In the ultimate case a building can be completely self-supplied with electricity (Leckner and Zmeureanu, 2010). In the corporate context such a business model is also known as “contracting”. This study however refers to small-scale systems, mainly for private customers and small and medium sized business. When distributed electricity generation takes place in private homes it is also described as residential generation. The distributed energy systems are in the range of between a few kilowatts and about 1 MW. These small-scale systems have a different position in the electricity value chain (see Fig. 1). Consequently, they follow a very different logic than utility-side projects as far as production, delivery and consumption of electricity is concerned (Table 2).

The two generic business models are “ideal types” (Baden-Fuller and Morgan, 2010) and represent the two sides of a spectrum. Of course variations are possible. In Section 4 both business models will be analyzed in the context of the German utility sector.

3. Methodology

An explorative qualitative research strategy is applied in this study, because research on business models in the energy sector is still at an early stage (Silverman, 2009). Germany is chosen for the focus of the study, because the country is considered one of the world's leading markets for renewable energies and has established ambitious political targets for the transformation of its energy sector. The data is derived from a series of 20 semi-structured interviews with representatives of 18 German utilities.

About 800 utilities are active on the German market. The sample selection was done by theoretical sampling (Eisenhardt and Graebner, 2007). Four categories were identified based on size and scope of the utilities (see Table 3). The size of the utility relates to annual revenues and the scope of activity refers to the utilities' activities in the field of renewable energy. The four categories are in line with the view of most practitioners in the industry. The adopted qualitative research approach does not allow to derive statistically relevant information. Therefore, the selection of companies in the four categories was conducted following the approach of Yin (2003) to cover the widest possible spectrum of utility business models for renewable energy. The utilities were identified through internet research and consultation of industry experts from utilities, industry associations, and consulting.

The interview participants comprise directors, department heads, and senior managers, mainly from the renewable energies department or business development. All participants were provided with a semi-structured questionnaire which guided the conversation. The interviews were partly conducted face to face and partly via telephone. The length of the conversations ranged from 45 to 90 min. The interviews were recorded and subsequently transferred into written protocols. Because the participants asked for anonymity the quotes in the results section are provided without reference to the company name.

Data analysis from the protocols was conducted in a three step process: first, the answers were coded following the four business model components: value proposition, customer interface, infrastructure, and revenue model. This was done to organize the data and get an overview on the variety of results. Second, the coded results were clustered into the four categories of utilities as described in the table above. This was done to identify potential differences in the answers which are related to the size or market power of the utility. Finally, the results were grouped to identify the relevant issues and enable a thorough analysis and discussion of the interview results.

4. Results

This section displays the results from the interviews with German utility managers about the two generic business models. The findings for both business models are presented following the four elements of the business model: value proposition, customer interface, infrastructure, and revenue model.

4.1. Utility-side renewable energy business model

4.1.1. Value proposition

The value proposition describes the product or service that is offered to the customer. The interviews reveal that the vast majority of utility managers does not see the traditional utility value proposition under pressure to change by increasing shares of large-scale renewable energy projects. “*Maybe we'll use other technologies, but we will still deliver electricity. The product stays the same*” is a statement that summarizes the view of the majority of interviewees. Although many managers expect that service will play a larger role in the future, these managers do not see a major threat to the current way of delivering value to their customers. Several managers even see an additional value that can be offered to the customer in the form of green electricity. A growing demand for green energy products is observed which can be served by offering green electricity tariffs. In this argumentation the use of renewable energy sources is an additional value for customers. In the view of most interviewees, the generation technology changes, but the basic utility value proposition remains the same. This view prevails in all four utility categories.

The practitioners view on the value proposition differs strongly from the assessment in the literature. Authors on utilities' business models argue that the transformation to renewable energy will require fundamentally new utility business models and value propositions (Frantzis et al., 2008; Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2011). It is expected that utilities will need to change from commodity providers to comprehensive energy service providers (Duncan, 2010; Klose et al., 2010). The different perception of practitioners and researchers may result from a different view on renewable energy technologies. In their research on the impact of fundamental technological changes for incumbent companies, Christensen and Bower (1996) distinguish between sustaining and disruptive technological innovation. The former comprise improvements of an existing technology. In contrast, the latter disrupt the established path of technology development and redefine what performance means. Most authors understand renewable energy as a disruptive technology that will significantly change the structure of the industry and the utilities. In contrast, the interviewed utility managers think of renewable energies as large-scale projects and perceive them as sustaining technological innovations that will not significantly impact the traditional utility value proposition. Accordingly, the managers perceive no need for new utility business models.

4.1.2. *Customer interface*

The customer interface describes the interaction between a company and its customers. According to the Renewable Energy Sources Act, electricity from utility-side project is not sold to the end-customer, but to the grid operator. The law requires the grid operator to purchase the electricity from the owner of the project for a fixed price per kilowatt hour. Therefore, the business to business customer interface does not require much attention by the operator of the project. All interviewed utility managers consequently refer to the role of the end-customer. The managers observe that end-customers become increasingly aware of environmental issues and are increasingly willing to switch their supplier for these reasons. Therefore, all interviewees consider the use of renewable energy technologies to have positive effects on their relationship to the end-customer. “*For us it is especially important that the customers know that we engage in renewable energies.*” A green image is increasingly seen as important: “*I think, no utility can afford not to be active in the field of renewables in some way.*” On the other hand it is mentioned, “*Yes, customers want more green electricity, but we cannot speak of real pressure from that side.*” Overall, the statements reveal that customer demand is not the main driver of current expansions in the field of utility-side renewable energy.

Several interviewees also mention a critical issue related to renewable energy: public acceptance. The issue comprises especially two problems: costs and the “not in my backyard” (“NIMBY”) phenomenon. First, the public debate in Germany becomes increasingly critical towards costs. Since the electricity wholesale prices have been raised due to higher costs of renewable energy, especially the costs of electricity from PV are discussed critically. Second, the transformation requires installation of further renewable energy projects and new grid infrastructure. This causes the classical NIMBY phenomenon. A fiercely discussed issue is the strong opposition towards high voltage lines that are needed to connect offshore wind farms in the North Sea with the large centers of consumption in the middle and south of the country. One manager of a small local utility sees public acceptance as a critical issue for his firm. “*What if people oppose our investments in wind farms or biomass plants in the region? Such discussions can increase resistance against projects and ultimately result in a danger for our business.*”

4.1.3. *Infrastructure*

The infrastructure describes the company's organization of value creation. This section concentrates on the organizational structure, and partnerships, because these two issues are acknowledged as major factors in the innovation literature (Boscherini et al., 2011).

Concerning the organizational structure, it is found that practically all multinational and regional utilities established separate ventures for their activities in the field of renewable energy. While this seems to be also true for several large local utilities, the picture is not clear for small locals. While some forerunners have separate units, it is not clear how many of the small locals actually started to become active in the field of renewable energy generation. As the 700 small local utilities only have a minor market share in electricity generation, it is reasonable to conclude that many of them have not become active (VKU, 2011). Due to the large number of utilities and the thin coverage in the literature it is beyond the possibilities of this study to provide a clear and representative picture of the activities of the small local utilities in Germany. However, the interviews revealed that the different utility categories apply different strategies concerning their activity in the renewable energy project value chain.

- The *multinational utilities* clearly try to cover the whole value chain from project development to operations. “*It is a clear trend that the big utilities expand their presence in the value chain. Project development as well as operations and maintenance offer leverage for the overall return of the project.*” All four multinational utilities state to follow this approach, although not slavishly for all projects. In general the utilities are convinced that they can perform all tasks more efficient than external providers, because “*this is the core business of a utility.*”
- The *regional utilities* try to expand their presence in the value chain as well. While project development is seen as an attractive field by many regional utilities, operations and maintenance are seen as difficult. “*Even with our size it probably makes no economic sense to have own service teams.*” They will rely more on external service providers. Many have not yet finally decided on this issue and currently decide from case to case.
- *Local utilities (large and small)* are partly trying to enter the field of project development. But in general they rely much more on external service providers. Project development might be an interesting option for some of them, but maintenance service is too costly in most cases, because no economies of scale can be realized. Consequently, large and small local utilities will earn lower overall project returns than the multinational and regional utilities. This shows that economies of scale are a main driver for profitability in the utility-side business model.

The second important issue comprises external partnerships. It can be observed that the role of external partnerships in the German energy sector has increased in recent years. This study found three main forms of external partnership which are currently important in the German market: cooperation with suppliers, cooperation with project developers, and cooperation with other utilities.

- *Cooperation with suppliers:* The leading multinational utilities E.ON and RWE entered into framework agreements with wind turbine manufacturers Siemens and REpower. This form of cooperation is mainly limited to large utilities.
- *Cooperation with project development companies:* For example, JUWI, one of the major German project developers in the field of renewable energies systematically offers to cooperate with utilities to develop wind, PV, and biomass projects. The utility and the project developer establish a joint venture in which both are 50% shareholders.
  "Both sides bring in their expertise and benefit from a growing pipeline of projects. This way, we can quickly ramp up our renewable energies capacities and learn from an experienced project developer."
- *Cooperation with other utilities:* Groups of utilities bundle resources to be able to invest in larger power projects, which they otherwise could not realize due to a lack of size and financial resources. For example, several small and medium sized utilities currently cooperate to jointly invest to offshore wind energy (Richter, 2011). Cooperation with other utilities is used by utilities of all sizes. It is attractive to small and medium sized utilities, but some of the largest utilities also follow this idea, for example to reduce risks of offshore wind energy investments.

Reflecting the findings about the infrastructure against the existing literature, it turns out that the participating utilities largely apply the existing knowledge about organizational structure and external partnerships. Innovation scholars argue that a separate venture or business unit is vital for a firm's ability to exploit the current business model while simultaneously exploring and commercializing new technologies (Raisch et al., 2009; O'Reilly and Tushman, 2004). A separate venture is independent from the traditional ways of doing business in the parent company and thus more flexible to develop new structures necessary to exploit the new opportunity (Gibson and Birkinshaw, 2004). Even though the different categories of utilities follow different strategies, most of the interviewed utilities established a separate venture for their renewable energy activities. Concerning external partnerships, scholars have underlined the importance to share information and knowledge to improve innovation capabilities to face radical changes in the firm's environment (Boscherini et al., 2011). Collaboration can comprise external stakeholders, like universities, suppliers, research centers, or NGOs and range from research projects to equity joint ventures. Although not yet on a massive scale, it was found that the interviewed German utilities perceive and use external cooperation as a valuable tool to increase their know-how and reduce their risk addressing the new field of business.

4.1.4. Revenue model

The revenue model is the key to the decision whether a renewable energy project is realized or not. Investment decisions for utility-side renewable energy projects are usually based on well defined return expectations. Some utilities define one expectation for all investment projects throughout the company; others differentiate between technologies and markets. One manager explains:

> "We internally call it 'hurdle rate'. We have a certain base-hurdle rate to which we add a risk premium depending on the technology and the geographical region of the project. All projects have to meet our hurdle rate to be realized."

The interviews revealed that in general the multinational and regional utilities put more emphasis on the return expectations than local utilities. This difference is mainly due to the shareholder structure, because local utilities are usually owned by local communities, at least to a large extent. Managers of locals utilities tend to underline the importance of further aspects than return on investment.

> "Of course the project has to be profitable and a certain rate of return has to reached, but we also look if the project fits the needs of the region. Maximizing the rate of return is not our only goal"

All interviewed managers agree that utility-side renewable energy projects are generally profitable. The answers to the question if utility-side renewable projects or conventional power projects are more profitable show a differentiated picture. While some argue "*Renewables are o.k., but the money still comes from conventional power plants*" other state "*We do not see coal and gas as profitable in Germany anymore. We will exclusively invest in renewable sources.*" Generally, the profitability of renewable projects seems to be perceived as slightly lower than the profitability of conventional power projects, but it is also seen that renewable energy projects comprise no price risks for fuels and no price risk on the sales side. One manager explains how this makes wind energy projects attractive:

> "It might be that the rate of return of a coal or gas power plant is a bit higher than of a wind farm. But power projects are long term investments. Looking into the next 20 to 30 years there is a risk of rising coal and gas prices and we don't know how much electricity we can sell at which price. With renewable projects you have the feed-in tariff guaranteed for 20 years on the sell side and you have no price risk on your input side."

So, under a balanced risk-return assessment utility-side renewable energy projects thus can be competitive or even beneficial compared to conventional power plants.

Following the theory of Christensen and Bower (1996) incumbent companies fail to bring disruptive technologies to the market, because they are usually not directly applicable to the established market and do not provide sufficient returns. As pointed out in this section, this is clearly not the case with utility-side renewable energy projects. Overall, the revenue model for utility-side renewable energy projects is seen as clear, stable and sufficiently profitable. Hence, the interviewed managers see a clear and profitable business model for utility-side renewable energy projects and consequently started to invest large sums into the build-up of assets. In this case, utilities developed the competency to maintain the current business, while at the same building up new assets and knowledge in new business fields. It can be concluded that utility-side projects do not have a disruptive character for utilities (anymore), but comprise the characteristics of sustaining innovation. This is also underlined by the fact that utilities start to innovate the utility-side renewable energy business model through vertical integration or systematic outsourcing of certain activities to maximize their overall returns. Thus, utilities reached organizational ambidexterity in this regard.

4.2. Customer-side renewable energy generation

4.2.1. Value proposition

The results on the value proposition start with a paradoxical finding. Although most utility managers do not see customer-side renewable energy as an attractive future market for their company, some of them offer products for distributed and residential renewable electricity generation. In the case of residential use of solar PV some utilities assist their customer with consulting services, others support their customers to install PV systems with direct investment grants and one utility even offered a full "rent-a-roof-package" in which the utility installs and operates a PV system on the customer's roof and pays a rent for the roof. Moreover, several utilities also offer related services such as consulting for energy efficiency and installation of renewable energy systems. The paradox is that for example consulting services for existing customers are counterproductive for the utility, because it helps the customers to consume less energy. This leads to lower revenues for the utility, which can usually not be compensated with the onetime revenue from the consulting service. Offering consulting services to customers of a competitor however might provide a positive effect.

Asked to explain the paradox, several interviewees admit these products and services exist, but are not actively promoted in practice. They are invented mainly for the creation of political goodwill and customer relationship management. In most managers' eyes residential generation makes no economic sense. "*Electricity production costs from small-scale devices like PV are too high compared to conventional power sources.*" In their view "*the investment volumes per installed energy systems are too small to allow a sufficient profit*" for the utility. Many do not see how utilities can contribute at this front.

> "These projects are outside of our core competency. There are others who are well established in this field. For example: Installation services are performed by local handicraft enterprises. Favorable financing conditions are offered by public business development banks. Operation is usually not very comprehensive and is performed by the manufacturer of the energy system."

They see no need for utilities to become active in this field, because they do not know what to offer to their customers.

But there are also two managers, one from a multinational utility and one from a large local utility, to who's assessment distributed and residential generation is already a billion Euro market and will continue to increase significantly. One of them explains:

> "It is a severe threat to our business model. Today you can already see it in the field of heat and gas supply. Due to better insulation new houses use significantly less energy for heating. In new neighborhoods we provide significantly less energy. A similar effect could occur in the electricity sector through distributed generation."

The other one argues "*Distributed electricity generation will become more important. Either we enter this market, or others will do.*" But he admits that he also struggles to find an economically sustainable value proposition to address the market.

> "The main problem is to develop a product or service that offers sufficient value to the customer to be attractive, but also generates sufficient value to the utility to be profitable. I have been working on this for two years now and so far I haven't found a satisfying solution."

To sum up, the utilities — even the ones that see distributed generation as a potential market — severely struggle to develop value propositions for this field.

Existing literature shows that established organization often struggle to radically innovate its value proposition and at the same time maintain the business which is currently still contributing revenues and profits (Sosna et al., 2010). This challenge for incumbent companies to cope with new technologies in the market has been studied in other industries undergoing fundamental changes (Chesbrough, 2010; Christensen and Bower, 1996, O'Reilly and Tushman, 2004). Two main explanations for failure are provided.

First, Chesbrough and Rosenbloom (2002) find a cognitive barrier to business model innovation which strongly influences the information that is used for corporate decisions. O'Reilly and Tushman (2004) add to this by stating that the ability of executives and senior staff to understand the needs of very different businesses is most crucial for companies to be successful at two frontiers at the same time. The arguments against customer-side generation like high production costs per kilowatt hour and insufficient project size indicate that the managers are applying traditional utility performance measures to a disruptive technology. From their perspective, renewable energy technology is not (yet) cost competitive to conventional sources or utility-side renewable energy projects (Christensen et al., 2011). The managers apply their traditional economies of scale perspective to distributed renewable generation. However, such a view neglects potentially different performance measures of centralized generation and distributed technologies. The strategic value of customer-side generation for utilities lies not in being a new technology with cheaper production costs per kilowatt hour, but in the possibility to make a first step into a new distributed energy market. Entering this market could secure an important gate keeper position for future developments which might go beyond pure generation from distributed renewable sources. To achieve this, utilities managers would need to switch their perspective from achieving low production through economies of scale to new value propositions that fit the characteristics of customer-side generation. One example of a new value proposition could be price stability. For example, the Dutch green energy provider Greenchoice developed a program to offer customers a fixed electricity price for the next twenty years through the installation of a PV system. The customer has no investment costs and pays a fixed tariff per kilowatt hour of 23 cents (which is about the level of the current end-customer price for gray electricity), guaranteed for 20 years. The customer directly uses the electricity produced on his roof and pays 23 cents to the provider. Excess electricity is fed into the grid according to the feed-in law. At times when the own production cannot cover the customer's demand, additional electricity is taken from the grid. This model allows house owners to install a solar system without own investment and offers a price hedge against rising electricity costs. The utility benefits from a 20 year long stable customer relationship and earns the return on the PV asset (www.greenchoice.nl).

Second, Christensen and Bower (1996) conclude that the primary reason why incumbent firms fail to maintain their leading positions in radically changing environments is their inability to allocate sufficient resources to new technologies or the development of new business model for these technologies. Evidently, the utility managers do not actively develop customer-side business models or try to find new value propositions, because they see no economically attractive business case. The findings support the view that small-scale renewable energy technologies have to be considered a disruptive technology for utilities as they disrupt the established trajectory of performance or redefine what performance means (Boscherini et al., 2011; Christensen and

Bower, 1996). O'Reilly et al. (2009) argue that many large companies actually have all the resources necessary to adapt to a changing environment. They illustrate the case of IBM. In 1999 IBM found out that it had developed important new technologies such as commercial routers or speech recognition, but failed to take them to the market successfully. Other companies became successful with products IBM had developed first. The company realized that it was good in its traditional core business, but had difficulties to develop or enter new markets. It did not devote sufficient resources to developing business models and strategies to bring new products to the market. These findings resulted in the development of the IBM Emerging Business Organization (EBO). The EBO tracks new market and technology development and brings ideas for business opportunities to the attention of senior management in a structured process (Harreld et al., 2007; O'Reilly et al., 2009). Such an approach could also help utilities to overcome barriers to innovation and systematically develop new value propositions and business models.

4.2.2. Customer interface

As pointed out in the previous section some utilities offer products and services for customer-side generation, although they lack an economically sustainable business model for it. Explanations for this paradox comprised issues such as public expectation, the creation of political goodwill, or customer relationship management. While answers on public expectation remain rather unclear, political goodwill and customer relationship management seem to play a practical role. Political goodwill is especially important for regional and local utilities as most of them have, at least partly, public shareholders. In many cases local politicians hold seats in the supervisory board and thus are very important stakeholders for the utilities. Several local initiatives for solar PV projects, often with investment opportunities for customers, seem to be motivated by a mixture of political goodwill and public expectation. For the multinational utilities this plays no major role. They are more concerned about political goodwill at the federal government level.

Although most managers agree that customer demand is not the main driver for investments in renewable energies, customer relationship management seems to play an increasing role as competition in the energy sector increases. This seems to be equally important for utilities of all sizes. The value of customer-side projects for the customer relationship is acknowledged by several interviewees. One manager, whose utility installs and operates solar PV systems on roofs of small and medium sized corporate customers, explains:

> "I do not force him by contract to buy my electricity, but usually he does for the time we have the PV system on his roof. Even if we are a bit more expensive than others, he is also interested in good relationships to us."

A long term contract usually prevents customers to easily switch their supplier. Another manager of the utility that offers a full rent-a-roof-package to private customers stated: "*This is surely no field we want to expand. We see it as a form of expensive customer-relationship management.*" So, on the one hand, customer-side business models are already used (on a very small scale) as customer relationship management tools. On the other hand, utilities see no demand for new residential energy solutions and thus do not want to expand the business. According to their perception customers are not interested in utility activity in renewable residential generation.

> "Customers don't want to enter into long term contracts with their energy supplier. Most people that are able to finance a building prefer to finance the investment and earn the return themselves."

One key finding of research on disruptive technological innovation is that incumbent firms often fail to bring new technologies to the market, because they listen to their customers too much (O'Reilly et al., 2009). Bower and Christensen (1995) argue that the customer surveys or rational market analysis of most well managed companies fail to show the opportunities for commercializing radically new products or services. This happens because, on average, customers show little interest in disruptive technologies that do not directly address their current main needs. Instead they demand improvements in existing value propositions. Focusing on customer demand therefore can make companies blind for important new developments and technologies. Bower and Christensen (1995) found evidence for this paradox in different industries and the interview results indicate that the utilities will be no exception in this regard.

4.2.3. Infrastructure

The interviews indicate that the utilities' activities in the field of customer-side renewable energy are on a very small scale. The investments into distributed renewable generation infrastructure are practically limited to research and development and pilot projects. For most interviewed managers investments in assets for distributed and especially residential generation are not an issue, because the field as such is not seen as promising. "*As long as there is no economically sustainable revenue model it makes no sense to invest.*" The same seems to be true for investments to build up know-how in this field. A manager of a large local utility explains why he does not think about small-scale projects: "*I have to invest some hundred million Euros into renewable energy in the next years. So, I need large projects otherwise I can't do it.*" Most of the interviewed utility managers do not allocate resources to this issue, because they do not expect customer-side generation to become an attractive market for utilities and other investment alternatives seem to be more attractive.

Concerning organizational structure and external partnerships it is found that utilities do not apply existing knowledge to the field of customer-side generation. Most of the interviewed utilities have established a separate unit for utility-side renewable energy. However, none of the interviewed companies has followed this approach and established a separate venture purely for customer-side renewable energy generation. Concerning external partnerships to improve innovation capabilities the situation is not much better. Only sporadic research projects with universities and research institutions can be found. Given the complex nature of the challenge to develop new value propositions and business models it can be concluded that the partnership activities are at a very early stage.

Following Christensen and Bower (1996) companies fail to allocate sufficient resources to technologies that initially cannot find application in mainstream markets, but later play an important role. As pointed out, the literature suggests organizational structure and external partnerships as two main paths to accumulate new know-how and create openness to innovation (Boscherini et al., 2011). Concerning the organizational structure, innovation scholars argue that companies should establish a specialized venture unit to overcome the internal barriers in the parent company and create a more flexible and open environment for new ideas (Bessant et al., 2004). This is especially important since scholars underline the importance of trial and error for successful business model innovation (Sosna et al., 2010; McGrath, 2010). Concerning external partnerships it is argued that this is a good way to face complexity of the challenge and reduce risks for the individual company (Boscherini et al., 2011). Both issues have not been addressed by the interviewed utilities yet. It seems that the need to scale up renewable energies in the utility portfolios

("*I have some hundred million Euros to invest*…") hinders the thinking about how business model innovation for a customer-side renewable energy business model could look like.

4.2.4. Revenue model

The majority of interviewed managers does not expect sufficient returns from customer-side renewable energy business models. The ones that actively try to develop such a business model admit to struggle to make it profitable. Thus, it can be concluded that there is no economic sustainable revenue model in the market yet. Both sides of the revenue model, the cost side and the revenue side, still comprise major problems.

The *costs* of electricity production in small renewable energy systems are significantly higher than production costs of conventional power sources or large-scale renewable energy projects.

> "The problem is that we cannot realize economies of scale. When size cannot create cost reductions, they have to be realized through increased efficiency of the technology. […] It is possible that major advances in the technology open a new market, but we do not expect this at the moment."

It is debated which price level has to be reached. While solar proponents argue that production prices of electricity on the customer-side need to reach a level below the electricity wholesale price to make customer-side generation economically attractive, others argue this would neglect the true costs, which need to include costs for grids, storage, and taxes as well. The interviewed managers argue that the *revenues* of customer-side projects are too small and too fragmented to be able to contribute significantly to the earnings of the company. "*You just can't earn money with that.*" It is argued that, even if the rate of return on an individual customer-side energy project is sufficient the small investment volume creates a problem, because the return in absolute term is too low to cover the efforts.

> "In this case we compete against the owner of the building. Private individuals usually accept lower rates of return, because return is not their only decision criteria. And they usually do not calculate their time as costs into the project, which increases their rate of return. We as a utility cannot do it like this."

The lack of profitability is a main reason why utilities are not pursuing the path of customer-side business models for renewable energy. The (theoretical) danger arising from small-scale renewable energy systems is recognized ("*[…] this would totally change the game for utilities.*"), but the current lack of profitability is seen as a protection against this danger. One manager of a multinational utility observes:

> "If small-scale systems became economically competitive to centralized production this would totally change the game for utilities. This would require a radically different utility business model. But in the case of PV we would see this in other countries like Spain or Italy with higher solar radiation before the level is reached in Germany."

The lack of profitability is the main reason why this field is not seen as an attractive market by most interviewed utility managers.

At first sight, it appears reasonable for utilities to allocate financial resources to projects with a profitable revenue model. In a direct comparison customer-side generation is not competitive to conventional energy sources or large-scale renewable energy projects. Here lies a generic barrier for the deployment of new technologies. When a new technology is in direct competition with a long established technology, the new technology is only adopted on a large scale if it is more cost- and performance effective (Christensen et al., 2011). Electricity generation from small-scale systems faces a tremendous challenge when its generation costs are directly compared to the generation costs of conventional power plants or large-scale projects. This barrier can only be overcome when value propositions for customer-side addresses new customer needs, such as price stability, energy independence or green lifestyle. Somehow the value proposition must deliver an advantage to the customer compared to the conventional way of just buying electricity for a fixed price per kilowatt hour. A potential solution for utilities lies in not treating distributed renewable generation as another source of electricity generation in competition with traditional sources, but as a strategic gateway into the emerging distributed generation and energy service markets (Richter, 2013). Customer-side renewable generation could provide the basis for further new value propositions with regard to direct use of electricity, energy efficiency and distributed energy storage.

5. Discussion

Germany decided to realize the energy transition and produce 80% of the country's electricity from renewable sources by 2050 (BMWI and BMU, 2010). This transition will fundamentally affect the structures of the electric power industry and change the way how electricity is produced, transmitted, and sold (Frei, 2008; Small and Frantzis, 2010; Schleicher-Tappeser, 2012). Recent studies have claimed that the increasing share of renewable energies constitutes a threat to the utilities' business models in their present form (Frantzis et al., 2008; Klose et al., 2010; Nimmons and Taylor, 2008; Richter, 2012; Schoettl and Lehmann-Ortega, 2011). Based on a series of interviews with utility representatives, the present study investigates how German utilities position themselves to the challenges of the energy transition. The surprising result of this research is that most utility managers do not see renewable energy as a threat to their current business model, although German utilities already lost significant market share to renewable energy investors from outside the energy industry.

Most managers see large-scale renewable energy projects as an important new field of business. The analysis revealed that utility-side projects offer a series of advantages for utilities: they do not make new value propositions necessary, the customer interface is positively affected, and the revenue potential can clearly calculated. The business model is robust and closer to the utilities' traditional business model of operating large-scale power stations and delivering electricity to the customers.

At the same time, the managers show little interest in the field of customer-side renewable energy. They expect no market potential for utilities in this field. The analysis shows that small-scale renewable energy technologies show disruptive characteristics for utilities. The technology, e.g. PV, is available and economically successfully applied in the market. However, utilities lack the business model to commercialize the technology on the market. Many questions about the value proposition, the customer interface, the infrastructure, and the revenue model are unanswered.

Existing literature can help to understand and explain the results. In the case of utility-side renewable generation the interviewed utilities have established the competency to exploit their conventional energy sources and at the same time start to enter the large-scale renewable generation market. This means they fulfill the criteria for organizational ambidexterity: They manage to exploit their current core business, while at the same time building up new business for future success. From a technology perspective large-scale renewable energy technologies have lost their disruptive character for utilities. However, it has to be emphasized that it took German utilities more than ten years to reach this point. Most utilities have defeated renewable generation intensively, although the technology was already successfully commercialized in the market by investors from outside the energy industry. The same seems to happen in the field of customer-side renewable generation today.

Chesbrough (2007) finds that the problem lies not in the technology itself, but in the commercialization of technologies which require a radically different value proposition and revenue model compared to the current way of doing business. Experiences from transition processes in other industries indicate that utility managers are bound by cognitive barriers that hinder them to think of radically new business models, while the old one is still contributing revenues (Sosna et al., 2010). Cognitive barriers restrict new ideas that do not fit with the firm's current business model (Chesbrough and Rosenbloom, 2002; O'Reilly and Tushman, 2004). The results from the interviews suggest that most utility managers are focused too much on technology and the reduction of production costs through economies of scale. Therefore, they claim that the production costs of electricity from small-scale renewable energies are too high and the technologies lacks options for economies of scale. From their perspective, small-scale renewable energy technology is not (yet) cost competitive to conventional sources or utility-side renewable energy projects (Christensen et al., 2011). The managers apply their traditional economies of scale perspective to distributed renewable generation. This deflects from potential new opportunities for value propositions other than cheap price per kilowatt hour. It can be concluded that customer-side generation has a disruptive character for utilities. Utilities have not yet managed to explore the market for customer-side generation, while maintaining their existing business.

The main conclusion from the results of this study is that utilities lack the business model innovation capabilities to successfully master the fundamental changes of the energy transition. The example of renewable electricity generation shows how the energy transition affects the existing utility business models. The analysis reveals that utilities have lost significant market share to investors from outside the energy industry, due to their inability to quickly pick up new business opportunities in renewable generation. The energy transition will hold further challenges for utilities beyond renewable generation. Several other topics in the industry will require massive changes in the coming years and decades. For example, the adaptation of the grid infrastructure to the new generation technologies, the development of technologies and business models for large- and small-scale electricity storage, ways to introduce demand side management, and the development of business models for energy efficiency will be further challenges for utilities. Therefore, utilities need to improve their business model innovation capabilities to be able to pro-actively respond to these new business opportunities. They need to develop the ability to adapt and reconfigure their assets and knowledge more quickly according to changes in their external environment.

Two approaches could be applied to improve the utilities' business model innovation capabilities: organizational structure and external partnerships.

Literature suggests that utilities would benefit from establishing separate ventures or at least an independent business unit for renewable energy. A separate and specialized unit helps to overcome the internal barriers in the parent company and creates a more flexible and open environment for new ideas (Bessant et al., 2004). A separate unit for large-scale renewable energies has been installed by all major German utilities. However, it is found that none of the interviewed companies has established a separate unit purely for distributed renewable generation. This study showed that small-scale customer-side renewable generation has very different characteristics than large-scale renewable energy generation. Therefore, utilities would benefit from explicitly differentiating between small- and large-scale renewable energy in their organizational structure. IBM's Emerging Business Organization is a good example how establishing suitable organizational structures can help new ideas and business opportunities to find their way into the company.

The second approach to improve business model innovation capabilities is external cooperation. External partnerships provide a good way to foster the accumulation of know-how and innovation capabilities to face radical changes in the firm's environment (Boscherini et al., 2011). Collaboration can comprise external stakeholders like universities, suppliers, research centers or NGOs, and range from research projects to equity joint ventures. In the case of renewable generation, utilities could for example benefit from existing know-how of independent project developers. First examples of such an approach can be observed in the market with regard to large-scale renewable energy projects. The independent project developers bring in their experience and contacts, the utilities provide the funds to realize the projects. Utilities could benefit from applying a similar strategy to the field of customer-side generation.

The research methodology of conducting qualitative semi-structured interviews has proven well suited to gain a first insight into the issue, but the findings are subject to some limitations. While the study provides a full coverage of the multinational utilities, the results for the regional and local utilities may not easily be generalized. It has to be emphasized that the sample selection is focused on the forerunners in each category. Thus, this study does not provide a general status of the industry, but intends to highlight the latest developments. Also, business models are highly dependent on the regulatory framework. The German energy market is highly influenced by the political decision to realize the energy transition, so the results might not easily be transferred to other markets. Nevertheless, similar developments might occur in other countries as well. Overall, the methodology allowed some valuable insights into the issue and provides suggestions how to address future challenges.

Given the dimensions of the energy transition there is a huge demand for further scientific analysis and advice on the questions addressed in this paper. During the course of research two issues appeared to be of special value for further research: First, the relationship between the business model concept and existing innovation literature should be explored further. This study indicates that innovation literature can provide great value to the business model discourse. Second, further research on utilities' business model innovation capabilities could help utilities to respond to the challenges of the energy transition in a more effective way. For example, research on business models for customer-side renewable energy generation might add to the development of suitable value propositions and thus help to overcome the current obstacles. This could open a large new market for utilities and also provide benefits of decentralized generation for the customers and society as a whole.

6. Conclusion

The present study applies the business model concept to investigate how German utilities position themselves to the challenges of the energy transition. Two generic business models are derived from a literature review and are subsequently analyzed on the basis of in-depth interviews with utility representatives. A surprising result is that most utility managers do not see renewable energy as a threat to their current business model, although utilities have already lost significant market share to investors from outside the industry. Furthermore, the study reveals that utilities have started to invest in utility-side renewable energy projects and clearly favor these large-scale projects over small-scale renewable energy projects at the customer-side. Many utilities have developed adequate organizational structures for utility-side projects, but lack business models for small-scale renewable electricity generation.

A clear result of this research is that utilities need to strengthen their business model innovation capabilities to be prepared to adapt their way of doing business to the changing environment. If utilities are not able to adapt their business models accordingly, the loss of market share in electricity generation will continue. Considering the looming changes in the energy industry, business model innovation as a strategic development of new organizational forms for the generation and delivery of electricity from renewable sources becomes inevitable for utilities to survive: New business models beyond the delivery of electricity as a commodity are needed. This requires adequate organizational structures like separate business units for utility-side and customer-side generation as well as an increased focus on external partnerships. These structural adaptations and employees with a mindset open to business model innovation could help utilities to overcome the current barriers to business model innovation.

The results also have implications for policy makers. German policy makers' perception of utilities is often influenced by ideological backgrounds: The proponents of the energy transition mainly see the need to reduce utilities' market share and influence, whereas more conservative representatives often try to ‘protect’ utilities’ current business. Both views neglect the idea to leverage the utilities’ experience and infrastructure in favor of the energy transition. As business model innovation is highly dependent on the regulatory framework, politics can create strong impact on business model development. New regulation should encourage utilities to pro-actively strive for sustainable new business models. For example, if utilities developed business models for distributed renewable generation and direct or local use of electricity, it could provide an impetus to small-scale generation and reduce the needs for new high voltage lines and large-scale storage capacities. Providing utilities with new business perspectives through the energy transition could help to achieve the ambitious German energy targets.

Acknowledgments

The author wishes to thank Franziska Boneberg, Richard Lawrence, Sonja-Katrin Fuisz-Kehrbach, Erik Hansen, and Stefan Schaltegger for helpful comments and support. Moreover, this paper greatly benefited from the feedback received from participants at the 2011 World Renewable Energy Congress in Linköping, Sweden. The author is especially grateful to the utility managers who took the time to participate in this study.

References

Alanne, K., Saari, A., 2006. Distributed energy generation and sustainable development. Renewable and Sustainable Energy Reviews 10, 539–558.
Ari, I., Koksal, M.A., 2011. Carbon dioxide emission from the Turkish electricity sector and its mitigation options. Energy Policy 39 (10), 6120–6135.
Baden-Fuller, C., Morgan, M.S., 2010. Business models as models. Long Range Planning 43 (2-3), 156–171.
Bessant, J., Birkinshaw, J., Delbridge, R., 2004. Innovation as unusual. Business Strategy Review, Autumn 2004, 32–35.
BMWI (Federal Ministry of Economics and Technology), BMU (Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety), 2010. Energiekonzept. Berlin.
BMU (Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety), 2012. Entwicklung der Erneuerbaren Energien in Deutschland im Jahr 2011, Berlin.
BMU (Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety), 2013. Erneuerbare Energien in Zahlen. Berlin, accessed June 2013.
Boehnke, J., Wüstenhagen, R., 2007. Business models for distributed energy technologies. evidence from German cleantech firms. Presented at the Academy of Management Annual Meeting, Philadelphia PA, August 2007.
Boscherini, L., Chiaroni, D., Frattini, F., 2011. Escaping the incumbent's curse: the adoption of renewable energies in Italy. In: Proceedings of the XXII ISPIM Conference, Hamburg, Germany, 12–15 June 2011.
Bower, J.L., Christensen, C.M., 1995. Disruptive technologies: catching the wave. Harvard Business Review, January/February 1995, 43–53.
BSW (Bundesverband Solarwirtschaft), 2012. Statistische Zahlen der deutschen Solarstrombranche. Berlin, accessed February 2012.
Chesbrough, H., Rosenbloom, R.S., 2002. The role of the business model in capturing value from innovation: evidence from Xerox corporations's technology spin-off companies. Industrial and Corporate Change 11 (3), 529–555.
Chesbrough, H., 2007. Business model innovation: it's not just about technology anymore. Strategy and Leadership 35 (6), 12–17.
Chesbrough, H., 2010. Business model innovation: opportunities and barriers. Long Range Planning 43, 354–363.
Christensen, C.M., Bower, J.L., 1996. Customer power, strategic investment, and the failure of leading firms. Strategic Management Journal 17 (3), 197–218.
Christensen, C.M., 2006. The ongoing process of building a theory of disruption. Journal of Product Innovation Management 23, 39–55.
Christensen, C.M., Shuman, T., Alton, R., Horn, M.B., 2011. Picking Green tech's winners and losers. Stanford Social Innovation Review (Spring 2011), 30–35.
Duncan, R., 2010. Renewable energy and the utility: the next 20 years. Renewable Energy World 2 (3).
Duncan, R.B., 1976. The ambidextrous organization: design dual structures for innovation. In: Kilmann, R.H., Pondy, L.R., Slevin, D.P. (Eds.), The Management of Organization Design 1. Strategies and Implementation. North-Holland, New-York, pp. 167–188.
Eisenhardt, K.M., Graebner, M.E., 2007. Theory building from cases: opportunities and challenges. Academy of Management Journal 50 (1), 25–32.
Eisenhardt, K.M., Martin, J.A., 2000. Dynamic capabilities: what are they? Strategic Management Journal 21, 1105–1121.
Frantzis, L., Graham, S., Katofsky, R., Sawyer, H., 2008. Photovoltaic business models. National Renewable Energy Laboratory, Golden, CO.
Frei, C.W., 2008. What if…? Utility vision 2020. Energy Policy 36, 3640–3645.
Gibson, C.B., Birkinshaw, J., 2004. The antecedents, consequences, and mediating role of organizational ambidexterity. Academy of Management Journal 47, 209–226.
Hansen, E.G., Große-Dunker, F., Reichwald, R., 2009. Sustainability Innovation Cube—A framework to evaluate sustainability-oriented innovations. International Journal of Innovation Management 13 (4), 683–713.
Harreld, J.O., O'Reilly, C.A., Tushman, M.L., 2007. Dynamic capabilities at IBM: driving strategy into action. California Management Review 49, 21–43.
He, X., Delarue, E., D'haeseleer, W., Glachant, J.M., 2011. A novel business model for aggregating the values of electricity storage. Energy Policy 39 (3), 1575–1585.
IPCC, (Intergovernmental Panel on Climate Change), 2007. IPPC Fourth Assessment Synthesis Report. Cambridge University Press, Cambridge.
Johnson, M.W., 2010. Seizing the white space, Business Model Innovation for Transformative Growth and Renewal. Harvard Business School Publishing, Boston, MA.
Kley, F., Lerch, C., Dallinger, D., 2011. New business models for electric cars—A holistic approach. Energy Policy 39 (6), 3392–3403.
Klose, F., Kofluk, M., Lehrke, S., Rubner, H., 2010. Toward a distributed-power world. renewables and smart grids will reshape the energy sector, The Boston Consulting Group Report.
Klose, F., Rubel, H., Hering, G., 2012. Towards a zero carbon world—Can renewables deliver for Germany?, The Boston Consulting Group Report.
Krägenow, T., 2012. Weiß-blaues Labor für die Energiewende. Energie and Management, 9. (March 2012).
Leckner, M., Zmeureanu, R., 2010. Life cycle cost and energy analysis of a net zero energy house with solar combi system. Applied Energy 88 (1), 232–241.
Loock, M., 2012. Going beyond best technology and lowest price: on renewable energy investors' preference for service-driven business models. Energy Policy 40, 21–27.
McGrath, R.G., 2010. Business models: a discovery driven approach. Long Range Planning 43 (2-3), 247–261.
Nimmons, J., Taylor, M., 2008. Utility solar business models. emerging utility strategies & innovation. Solar Electric Power Association (SEPA) Publication, Washington DC.
Okkonen, L., Suhonen, N., 2010. Business models of heat entrepreneurship in Finland. Energy Policy 38 (7), 3443–3452.
Omer, A.M., 2008. Green energies and the environment. Renewable and Sustainable Energy Reviews 12 (7), 1789–1821.
Onovwiona, H.I., Ugursal, V.I., 2006. Residential cogeneration systems: review of the current technology. Renewable and Sustainable Energy Reviews 10 (5), 389–431.
O'Reilly, C.A., Tushman, M., 2004. The Ambidextrous Organization. Harvard Business Review 2004, 74–81.
O'Reilly, C.A., Tushman, M., 2008. Ambidexterity as a dynamic capability: resolving the innovator's dilemma. Research in Organizational Behavior 28, 185–206.
O'Reilly, C.A., Harreld, J.B., Tushman, M.L., 2009. Orgainzational Ambidexterity: IBM and emerging business opportunities. California Management Review 51, 75–99.
Osterwalder, A., 2004. The Business Model Ontology. A Proposition in a Design Science Approach. University of Lausanne, Lausanne: Dissertation.
Osterwalder, A., Pigneur, Y., 2009. Business model generation. A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ.

Raisch, S., Birkinshaw, J., Probst, G., Tushman, M.L., 2009. Organizational ambidexterity: balancing exploitation and exploration for sustained performance. Organization Science 20 (4), 685–695.
Richter, M., 2011. German municipal utilities' business models for offshore wind energy. In: Proceedings of the XXII ISPIM Conference 2011, Hamburg, Germany, 12–15 June 2011.
Richter, M., 2012. Utilities' business models for renewable energy: a review. Renewable and Sustainable Energy Reviews 16, 2483–2493.
Richter, M., 2013. German utilities and distributed PV: how to overcome barriers to business model innovation. Renewable Energy 55 (7), 456–466.
Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G., 2012. Business cases for sustainability: the role of business model innovation for corporate sustainability. International Journal of Innovation and Sustainable Development 6, 95–119.
Schleicher-Tappeser, R., 2012. How renewables will change electricity markets in the next five years. Energy Policy 48, 64–75.
Schoettl, J., Lehmann-Ortega, L., 2011. Photovoltaic business models: threat or opportunity for utilities?. In: Wüstenhagen, R., Wuebker, R. (Eds.), Handbook of Research on Energy Entrepreneurship, 2011. Edward Elgar Publishing Ltd., pp. 145–171.
Shrimali, G., Slaski, X., Thurber, M.C., Zerriffi, H., 2011. Improved stoves in India: a study of sustainable business models. Energy Policy 39 (12), 7543–7556.
Silverman, D., 2009. Doing Qualitative Research: A Practical Handbook, 3rd ed. Sage, London.
Small, F., Frantzis, L., 2010. The 21st century electric utility, Positioning for a Low-Carbon Future. Ceres report, Boston, MA.
Sosna, M., Trevinyo-Rodriguez, R.N., Velamuri, S.R., 2010. Business model innovation through trail-and-error learning. Long Range Planning 43 (2-3), 383–407.
Taylor, A., Helfat, C.E., 2009. Organizational linkages for surviving technological change: complementary assets, middle management, and ambidexterity. Organization Science 20 (4), 718–739.
Teece, D.J., 2010. Business models, business strategy and innovation. Long Range Planning 43 (2–3), 172–194.
Teece, D.J., Pisano, G., Shuen, A., 1997. Dynamic capabilities and strategic management. Strategic Management Journal 18, 509–533.
Trendresearch, Genossenschaftliche Unterstützungsstrukturen für eine sozialräumliche Energiewirtschaft, 2011, accessed February 2012.
Trendresearch, 2013. Anteile einzelner Marktakteure an Erneuerbare Energien-Anlagen in Deutschland (2. Auflage), Bremen.
Tushman, M.L., Andersen, P., 1986. Technological discontinuities and organizational environments. Administrative Science Quarterly 31 (3), 439–465.
Tushman, M.L., O'Reilly, C.A., 1996. Ambidextrous organizations: Managing evolutionary and revolutionary change. California Management Review 38 (4), 8–30.
VKU (Verband kommunaler Unternehmen), 2011. Aktuelle Ergebnisse zur kommunalen Energieerzeugung 2011, accessed June 2012.
Wirtz, B.W., Schilke, O., Ullrich, S., 2010. Strategic development of business models: implications of the Web 2.0 for creating value on the internet. Long Range Planning 43 (2–3), 272–290.
Wüstenhagen, R., Boehnke, J., 2008. Business models for sustainable energy. In: Tukker, A., Charter, M., Vezzoli, C., Sto, E., Andersen, M.M. (Eds.), System Innovation for Sustainability 1. Perspectives on Radical Changes to Sustainable Consumption and Production. Greenleaf Publishing Ltd., Sheffield, pp. 85–94.
Yin, R.K., 2003. Case Study Research: Design and Methods. Sage Publications, Thousand Oaks, California.
Zott, C., Amit, R., 2008. The fit between product market strategy and business model: Implications for firm performance. Strategic Management Journal 29 (1), 1–26.