

## **Business Model Innovation for Sustainable Energy**

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# Business model innovation for sustainable energy:

German utilities and renewable  
energy



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**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 and invest huge sums in this field. 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 theory a new perspective on the energy transition is suggested and applied. Furthermore, practical recommendations for utility managers are provided how to create and capture more value in the energy transition.

**Keywords:** Renewable Energy, Business Model Innovation, Utility.

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## 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 Koksai, 2011; IPCC, 2007). Accordingly, the German federal government strives to produce 80% of the country's electricity from renewable energy sources until 2050 (BMW 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; Small and Frantzis, 2010). Consequently, utilities as the industry's largest group of actors need new business models to commercialize renewable energy technologies on a large scale (Duncan, 2010).

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). It is argued that the overemphasis of the technology perspective often hinders new solutions (Chesbrough, 2007; Hansen et al., 2009). By contrast, the business model is found to be as important for large scale adoption of new technologies as the technology itself (Teece, 2010). In this regard a fundamental business model challenge currently arises for electric utilities in the energy sector (Boscherini et al., 2011; Richter, 2011). As finding new approaches for sustainable electricity generation is crucial for utilities and the society, the research question of this work is: *How do German utilities shape their business models for renewable energies?*

The present study uses 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. It is found that most utility managers do not see renewable energy as a threat to their current business model. Furthermore, utilities clearly favor investments into large scale projects and do not expect small scale renewable energy projects to be of great importance. Overall, utilities' capabilities for systematic business model innovation appear to be limited. Drawing on experiences from fundamental transitions in other industries could help utilities to master the challenges in the energy sector.

The contribution of this paper is twofold: first, it adds to the discussion about business model innovation by bringing together the business model concept and established innovation and organization literature. Moreover, it adds to the discussion about utilities' business models for renewable energies by pointing out how innovative business models help utilities to tackle the challenges of the energy transition. Second, the paper provides insights into current developments in the German electricity sector which is relevant for the economic and political debate about the transition towards a more sustainable energy landscape.

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The study is organized as follows. Section 2 introduces the 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. THEORETICAL AND ANALYTICAL FRAMEWORK

### 2.1 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. Osterwalder and Pigneur (2009: 14) define a business model as "*the rationale of how an organization creates, delivers, and captures value*".

The business model provides a valuable new tool for analysis and management in research and practice (Zott and Amit, 2008). The growing importance of this new tool in the field of energy research is underlined by the growing number of articles applying it in journals such as Energy Policy (e.g. He et al., 2011; Kley et al., 2011; Loock, 2010; Okkonen and Suhonen, 2010; Schrimali et al., 2011). In terms of analysis, the concept enables the examination and comparison of 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). As a management tool, the business model concept helps managers to design, implement, operate, change, and control their business (Wirtz et al., 2010). In this context, business models can function as recipes or blueprints that are ready for copying or variation and innovation (Baden-Fuller and Morgan, 2010).

Although there is no generally accepted business model definition in the literature, a review of the literature shows that many definitions are comprised of four basic elements: the value proposition, the customer interface, the infrastructure, and the revenue model (Johson, 2010; Osterwalder, 2004; Osterwalder and Pigneur, 2009; Stähler, 2001; Wirtz et al., 2010; Wüstenhagen and Boehnke, 2008). For the purpose of this study it is referred to the terminology of Osterwalder and Pigneur (2004; 2009), because their concept has been successfully applied to the field of renewable energies (e.g. Okkonen and Suhonen, 2010).

Table 1: The Business Model Conceptualization.

<b>Business Model Pillar</b>	<b>Description</b>
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 the customers.

Source: Osterwalder 2004; Osterwalder and Pigneur 2009.

## 2.2 Business Model Innovation

Business model innovation as a term remains largely unspecified in the current academic literature. As Chesbrough (2010) notes business model innovation is less a matter of superior foresight but of trial and error as well as ex-post adaption. Referring to the organizational learning literature Sosna et al. (2010) understand business model innovation as 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 technological innovations, as opposed to sustaining technological innovations, describe changes that disturb the established trajectory of performance improvement. The new technology follows a different logic and redefines what performance means. Thus, disruptive innovations often destroy the value of existing competencies (Tushman and Anderson, 1986). 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). In contrast, sustaining innovations maintain the existing performance logic. They are basically improvements of an existing technology or system. The majority of technological innovations are sustaining innovations. 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; Raish et al., 2009). For example, technological innovation sometimes requires industry incumbents to a completely new core technology (Taylor and Helfat, 2009). 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. Thus, the theory of organizational ambidexterity will help to understand the challenges for utilities in adapting renewable energies.

### 2.3 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; Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2010). 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.



Figure 1: Two Generic Utility Business Models and their Location in the Value Chain.

*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 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 to the end-customer. As far as the infrastructure is concerned, these projects are much more similar to traditional centralized power plants than the customer-side business model (Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2010).

*Customer-side renewable energy business model:* This business model comprises energy generation in small scale systems close to the point of consumption. The main technologies for this application are solar photovoltaic (PV) systems, solar thermal collectors, geothermal heat pumps, wood pellet stoves, 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 energy generation (also often referred to as residential 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, heat, and cooling energy (Leckner and Zmeureanu, 2010). The value proposition offered by the utility can range from simple consulting services to a full-services package including financing, ownership and operation of the asset on the client's property (Frantzis et al., 2008; Klose et al., 2010; Pecan Street, 2010). While such a business model in the corporate context is also known as "contracting", in this study it is referred to small scale systems, mainly for private customers in the range a few kilowatts and about 1 megawatt in this study.

Table 2: Utility-side vs. Customer-side Business Model.

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

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

The intention of this work is to relate real world experiences from the German electricity market to the findings from previous work on utilities' business models for renewable energy and established innovation and organization literature. Germany is chosen, 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, including the nuclear phase-out. An explorative qualitative research strategy is applied, because research in this field is still at an early stage (Silverman, 2009). The data is derived from a series of 20 semi-structured interviews with representatives of 18 German utilities.

Table 3: List of interviewed German Utilities.

<b>Category</b> (Revenues in m€)	<b>Interviewed utilities</b>	<b>Revenues</b> (2009 / in m€)
Multinational Utilities ( > €10,000m)	E.ON AG	79,974
	RWE AG	47,741
	Vattenfall AB	20,036
	EnBW Energie Baden-Württemberg AG	15,564
Regional Utilities (€10,000m - €1,000m)	EWE AG	5,798
	Stadtwerke München GmbH	4,900
	Stadtwerke Düsseldorf AG	1,918
	Mainova AG	1,611
Large Local Utilities (€999m - €100m)	Stadtwerke Karlsruhe GmbH	997
	HEAG Südheessische Energie AG Stadtwerke	603
	Aachen AG	419
	Elektrizitätswerke Mittelbaden GmbH	202
	Stadtwerke Tübingen GmbH	155
Small Local Utilities ( < €100m)	Stadtwerke Uelzen GmbH	100
	GWS Stadtwerke Hameln GmbH	82
	Technische Werke Schussental GmbH	70
	Stadtwerke Munster-Bispingen GmbH	26
	Hamburg Energie GmbH	n.a.

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. 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 and reflect the different roles and options of utilities in the market. As the adopted qualitative research approach does not allow to derive statistically relevant information on the subject the selection of companies in the four categories focused on the most active and interesting ones in terms of renewable energy engagement. This was done to cover as many different utility business models as possible (Yin, 2003). The utilities were identified through internet

research and consultation of industry experts from utilities, industry associations, and consulting.

The *multinational utilities* are a group of four utilities with a very strong position in the German market. They own and operate the majority of coal and nuclear power plants in the country. The *regional utilities* are a group of about ten large utilities who set ambitious goals and invest heavily into large scale renewable energy projects. It can be observed that these utilities mainly take the energy transformation as a chance to actively position themselves against the multinational utilities. *Large local utilities* comprise about 80 utilities. While the large locals sometimes operate generation capacity this is rather seldom in the group of the *small local utilities* which constitute the vast majority of some 700 German utilities. Among the small locals some companies already provide their customers with electricity exclusively from renewable sources while others have not reacted at all. One characteristic that most of these utilities have in common is a (at least partly) public shareholder.

Data collection comprises 20 in-depth interviews with representatives of 18 German utilities. The participants comprise directors, department heads, and senior managers, mainly from business development departments or from the renewable energies department. All participants were provided with a semi-structured questionnaire in advance 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 minutes. 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 20 in-depth 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. Overall, the interviews reveal that utility managers do 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."* Although it is widely expected that service will play a larger role in the future they 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 ecological 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, 2010). 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.

#### 4.1.2 Customer Interface

The customer interface describes the interaction between a company and its customers. All interviewed utility managers, regardless of the size or scope of their utility, observe that

customers become increasingly critical towards 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 the customer interface. The communication of activities in the field of renewable energy is seen as very important instrument to maintain customer loyalty and differentiate from competitors. *"For us it is especially important that the customers know that we engage in renewable energies."* A green image becomes increasingly 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 "NIMBY" (not in my backyard) 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 und ultimately result in a danger for our business."

#### 4.1.3 Infrastructure

The infrastructure describes the company's organization of value creation. It comprises everything that is necessary to produce the value proposition. 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 majority of the 700 small local utilities has not operated own generation capacities so far, it is reasonable to conclude that most of them have not become active. 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 design 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 for renewable energy.

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, 2011a). 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 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 extend. Manager 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 be 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 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 project comprise no price risks for fuels and no price risk on the sell 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 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. Thus, it can be concluded that utility-side projects do not have a disruptive character for utilities (anymore), but comprise the characteristics of sustaining innovation. It may be assumed that this is due to establishing organizational ambidexterity for these technologies (see section 4.1.3 Infrastructure). 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.

## **4.2 Customer-Side Renewable Energy Generation**

### *4.2.1 Value Proposition*

The results on the value proposition start with a paradox finding. Although most utility managers do not see customer-side renewable energy as an attractive future market for their company, several of them offer products or services such as consulting for energy efficiency and installation of renewable energy systems. The paradox is that for example consulting services 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. 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.

Asked to explain the paradox, several interviewees admit these products and services exist, but are not actively promoted in practice. They are invented for mainly fuzzy reasons, such as public expectation, customer relationship management, or the creation of political goodwill. They are not actively promoted in practice, because 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 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 isolation 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 *"Decentralized 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 residential 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 residential 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 this perspective, renewable energy technology is not competitive to conventional sources or utility-side renewable energy projects (Christensen et al., 2011). Such a view neglects potentially different performance measures of centralized generation and residential technologies and thus has to be considered a cognitive barrier. 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. 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 value proposition. 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).

#### 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 as public expectation, the creation of political goodwill, or customer relationship management. While answers on public expectation remain rather fuzzy, 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 rather 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 play a role for utilities of all sizes. The value of customer-side projects for the customer relationship is acknowledged by several interviewees. One manager, who's 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. 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 of existing value propositions. Focusing on customer demand therefore can make companies blind for important new developments and technologies. Bower & 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 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 existing knowledge is not applied by utilities. None of the interviewed companies has established a separate venture purely for customer-side renewable energy generation though most of the interviewed German utilities have followed this advice and established separate units for utility-side renewable energy. 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) the inability to allocate sufficient funds to new technologies lies at the root of decline of many incumbent companies. 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). 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. 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 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. 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 (Chesbrough 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 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.



## 5. DISCUSSION

The political targets for the energy transition in Germany are set. In contrast to the argumentation in many studies (Frantzis et al., 2008; Nimmons and Taylor, 2008; Schoettl and Lehmann-Ortega, 2010) the interviewed Germany utility managers mainly do not see renewable energies as a threat to their current business model. Instead, the utilities start to apply the utility-side business model on a large scale. The analysis reveals 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 revenue potential is clearer than is seen with customer-side projects. 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. Moreover, it was found that utilities established adequate organizational structures and external partnerships for large scale renewable energy projects. Thus, it can be concluded that large scale renewable energy technology (meanwhile) has a sustaining rather than a disruptive character for utilities. Furthermore, it can be argued that 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 build up large scale renewable generation assets. This means they have reached organizational ambidexterity.

The analysis on utilities' activities in the field of customer-side renewable energy reveals that small scale renewable energy technologies show characteristics of a disruptive technology for utilities. The technology for customer-side electricity generation based on renewable energies is available and economically successfully applied in the market. However, utilities lack the business model to bring the technology to the market. Many questions about the value proposition, the customer interface, the infrastructure, and the revenue model are unanswered. In terms of infrastructure the utilities lack adequate organizational structures for business model innovation and are in early stages to increase know-how through external partnerships. The unclear value proposition is the largest obstacle to develop an economically sustainable revenue model. Thus, utilities are far from reaching organizational ambidexterity in the field of customer-side renewable energy.

Existing literature can help to understand and explain the results. In this study it is found that utilities have started to commercialize large scale projects, but obviously have problems to create, deliver, and capture value from small scale renewable energy technologies. It was argued that large scale project have a sustaining character, while customer-side generation has a disruptive character for utilities. This is supported by earlier research on disruptive innovation in other industries (Christensen and Bower, 1996). Chesbrough (2007) finds that the problem lies not in the technology itself, but in the commercialization of these technologies which require a radically different value proposition and revenue model to what the traditional utility business model looks like. Research on the failure of leading firms in other industries identifies two major obstacles for incumbent companies to develop adequate business models for disruptive technologies: cognitive barriers and lack of resources for innovation. First, managers seem to have difficulties to develop radically new business models, while the old one is still contributing revenues, because 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; Sosna et al., 2010). Second, Christensen and Bower (1996) find that the allocation of sufficient resources to technologies that initially cannot find application in mainstream markets, but later invade them, lies at the root of the failure of many once-successful firms. A main conclusion of their work is that when a proposed innovation does not meet the needs of the mass market incumbent firms find it difficult to succeed in this field, even if the technology is straightforward (Christensen and Bower, 1996). Hence, it can be concluded that mental barriers hinder the interviewed managers to develop innovative business models. Moreover, literature supports the view that the lack of utilities' innovation activities in the field of customer-side renewable energy results in a severe danger for utilities to lose a significant portion of the electricity generation market.

The method 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 highlights current developments. Furthermore, the high level approach to analyze two generic business models, which cannot cover all details of real world utility business models, creates the danger of over-simplification. Also, business models are highly dependent on the regulatory framework, so the results might not easily be transferred to other markets. However, 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 business model innovation 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 results of this paper contribute to business model innovation literature and allow to provide practical recommendations for utility managers. The present study adds to the literature by suggesting and applying a new perspective on industry change processes through the combination of the business model concept and innovation theory. Existing knowledge from disruptive changes in other industries is used to analyze and understand the current developments in the energy sector. Combining this knowledge with the business model perspective allows to go beyond a "technological innovation" perspective and arriving at a more general "business model innovation" perspective. This perspective is important, because as 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 [...]". Chesbrough (2010) finds that technology by itself has no economic value until it is commercialized via a business model. Therefore, Teece (2010: 186) notes that the creation of new business models is of equal - if not greater - importance to the company and society, particularly for sustainability oriented innovations (Hansen et al., 2009; Schaltegger and Wagner, 2011). This research supports the view that benefitting from technological change is less a question of technology, but rather of strategic change (Christensen and Bower, 1996) and business model innovation (Chesbrough, 2010). The application of the suggested perspective to the energy transition has underlined its potential and offered a first step to develop a better understanding of business model innovation as a strategic renewal process for utilities.

A clear result of this research is that business model innovation capabilities will be crucial to master the challenges of the energy transition. Therefore, utilities need to intensify their thinking about business models and foster constant business model innovation to create and capture most value from the transformation. Currently, this competence is especially needed to develop adequate customer-side renewable energy business models. But it will also be of importance for other emerging issues such as, smart metering, demand side management, smart home systems, centralized and decentralized storage, and e-mobility. Utilities need to be prepared to develop new business models beyond the delivery of electricity as a commodity. This requires adequate organizational structures and employees with a mindset open to business model innovation.

## 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.
- 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. The 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*, Jan/ Feb 1995, 43-53.
- 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 & 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, 167-188.
- Eisenhardt, K. M., Graebner, M. E., 2007. Theory Building from Cases: Opportunities and Challenges, *Academy of Management Journal* 50 (1), 25-32.
- Frantzis, L., Graham, S., Katofsky, R., Sawyer, H., 2008. *Photovoltaic Business Models*. Golden, CO: National Renewable Energy Laboratory.
- 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.
- 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. IPCC fourth Assessment Synthesis Report. Cambridge: Cambridge University Press.
- Johnson, M.W., 2010. Seizing the white space. Business model innovation for transformative growth and renewal. Boston, MA: Harvard Business School Publishing.
- 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.
- Leckner, M., Zmeureanu, R., 2010. Life cycle cost and energy analysis of a Net Zero Energy House with solar combisystem. *Applied Energy* 88 (1), 232-241.
- Loock, M., 2010. Going beyond best technology and lowest price: on renewable energy investors' preference for service-driven business models. *Energy Policy*, Available online 22 July 2010.
- Nimmons, J., Taylor, M., 2008. Utility Solar Business Models. Emerging Utility Strategies & Innovation. Solar Electric Power Association (SEPA) Publication.
- 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*, April 2004, 74-81.
- 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. Hoboken, NJ: Wiley.
- Pecan Street, 2010. The Pecan Street Project. Austin, TX: Working Group Report.
- 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. Mastering the Energy Transition: a Review on Utilities' Business Models for Renewable Energy. Working Paper at the Centre for Sustainability Management, Lüneburg, Germany.
- Richter, M., 2011a. German Municipal Utilities' Business Models for Offshore Wind Energy. The Proceedings of the XXII ISPIM Conference 2011, Hamburg, Germany, 12-15 June 2011.

- Schaltegger, S., Wagner, M., 2011. Sustainable Entrepreneurship and Sustainability Innovation: Categories and Interactions. *Business Strategy and the Environment* 20, 185-232.
- Schoettl, J., Lehmann-Ortega, L., 2010. Photovoltaic Business Models: Threat or Opportunity for Utilities?, in: Wüstenhagen, R. & Wuebker, R. (Eds.), *Handbook of Research on Energy Entrepreneurship*. Edward Elgar Publishing Ltd., 2010, 145-171.
- Shrimali, G., Slaski, X., Thurber, M.C., Zerriffi, H., 2011. Improved stoves in India: A study of sustainable business models. *Energy Policy*, Available online 17 August 2011.
- Silverman, D., 2009. *Doing Qualitative Research: A Practical Handbook*, 3rd ed. London, Sage.
- Small, F., Frantzis, L., 2010. *The 21st Century Electric Utility. Positioning for a Low-Carbon Future*. Boston, MA: Ceres Report.
- 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.
- Stähler, P., 2001. *Geschäftsmodelle in der digitalen Ökonomie*. Josef Eul Verlag.
- 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.
- 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.
- 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*. Sheffield, Greenleaf Publishing Ltd., 85-94.
- Yin, R.K., 2003. *Case Study Research: Design and Methods*. Thousand Oaks, California, Sage Publications.
- 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.