Business model transformation in the energy sector: A literature review about barriers in the transformation process

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Abstract.: *In a time of upheaval and digitalization, new business models for companies play an important role. Decentralized power generation and energy efficiency indicators to achieve climate goals and to reduce global warming are currently forcing energy companies to develop new business models. In recent years, many methods of business model development have been introduced to create new business ideas. But what are the obstacles in implementing these business models in the energy sector to develop new business opportunities? And what challenges do companies face in this respect? To answer this question, a systematic literature review was conducted in this paper. As a result, eight categories were identified which summarise the main barriers for the implementation of new business models in the energy domain.*

Keywords. Business model, business model transformation, barriers, energy sector

1 Introduction

A key measure to fight climate change and resource depletion is the transformation of the energy sector towards a more sustainable form of energy production (Metz *et al.*, 2007). The increasing decentralization of energy supply and the socially desired priority of renewable energies are endangering old and stable business models that have generated electricity with uranium, coal, oil or gas (Doleski, 2016). This is a threat to the traditional business model, because it leads to decreasing electricity demand and, consequently erosion of revenues (Richter, 2011). In a time of radical change, in which traditional solutions and concepts become more and more obsolete, the future-oriented development of new business models is of outstanding importance. For the development of new business models, differentiated business model concepts are available that have been established in economics to date. These are e.g. the Business Model Canvas (Osterwalder *et al.*, 2010), the Business Model by (Wirtz, 2013) or the Integrated Business Model based on the St. Gallen Management Concept (Rüegg-Stürm, Johannes and Grand, 2014). After a business model development, which is developed without considering cost and controlling experts, the question arises whether the creatively developed business model can be successfully implemented and what barriers might hinder such a transformation. The present work highlights important barriers to the implementation of new business models and the associated transformation of the energy sector. Therefore, this review deals with the research question: What are the barriers to business model transformation in the energy sector? While different studies focus on barriers in the renewable energy domain (Richter, 2013, Engelken *et al.*, 2016, Herbes *et al.*, 2017) and other scholars investigate general barriers in the implementation of business models (Chesbrough, 2010), this paper addresses barriers for business models with the full range of energy products and services.

The paper is structured as follows: In Section 2 the terms business model and business model transformation are explained and compared. Section 3 describes the methodology of the literature review according to the guidelines of Webster and Watson (2002). Section is the synthesis of this paper, discussing the main barriers and showing the referring concept matrix. In Section 5 the basic findings are discussed and compared. Finally, this paper concludes with Section 6.

2 Business Model Definition

For a business model there exist different definitions. Schallmo (2018) and Chesbrough (2010) have listed various definitions and compared them, e.g. business model describes how benefits for customers can be generated and actually create value. Furthermore, they describe the competitive strategy of a company. Therefore, a linear value chain between the producer and the customers is assumed. This type of value chain is also called a "pipeline" in which seller and buyer are the main actors (Matti, 2016). Now, innovations like Industry 4.0 or the Internet of Things puts companies under great pressure and forces them to develop new business models to remain competitive on global markets. Zeng et al. mentions that this business model transformation phenomena have become the focus of organizational research while enterprises are experiencing more complex organization transformation phenomenon than before (Zeng, Chen and Huang, 2008). This is a new challenge for enterprises. According to Keen and Qureshi (2006) a transformation target can be an opportunity. They mention tactically transformed operations costs can strategically improve overall company efficiency or redefine identity, roles and value (Keen and Qureshi, 2006). This choice of transformation response has profound implications for the structure of organizations. In this context, Moreton (1995) stated that transformation is an effective response to an uncertain and changing business environment, which takes the form of a multi-dimensional, large, all-encompassing change that results in a fundamental reshaping of the organization's behaviour. The organization transformation concept defined by Moreton (1995) is not the daily staff turnover or improvements of conventional production control systems and equipment, but fundamental changes brought about by the transformation of the core organizational activities. In this work we use the presented definitions of business model. Regarding the transformation, we consider the redefine of structure of an organization.

3 Methodology

This chapter examines the conducted literature review on barriers to the transformation process in the energy sector. The results regarding the identified barriers have been collected in a tabular format. The summary of the main barriers determines the synthesis of the present work. For the identification of relevant literature as well as for the analysis and synthesis of the literature, this work is built on the approach of Webster and Watson (2002). To identify relevant literature, a structured search process was carried out, using the five leading online databases for business informatics, ACM Digital Library, SpringerLink, Science Direct, AISeL and IEEE Xplore Digital Library of the period 2011-2019. The first search string 'business model energy sector' **(#1)** was created to find relevant literature for the research question. This formed the basis for the first queries in the databases. However, after running the first analysis it turned out that the first search string did not yield enough relevant literature. Thus, as a counter action, the second search string 'energy digital business model transformation barriers' **(#2)** resulted. In addition, as each online database has its specifics requirements to perform a search query, a new search string was developed for each database. Each specified search string reflects the original research area and concretizes the results of relevant articles: **ACM** (#1: Title: business model; abstract: energy, #2: All field: business model energy transformation challenges); **SpringerLink** (#1: Title: "business model" and "energy", #2: Query ="business% 20model" +"transformation" +"barriers" +"digital "&dc.title= energy); **Science Direct** (#1: Business model energy" AND "development, #2: Title, abstract, keywords: energy digital business model); **AISeL** (#1: Abstract: (business model) AND abstract: (energy sector) OR abstract: (energy area) OR abstract: (energy industry), #2: Abstract: (abstract: energy AND abstract: business model AND abstract: barriers OR abstract: challenge*); **IEEE** (#1: Abstract: business model, energy sector, #2: Abstract: energy AND business model AND transformation AND challenges).

With more than **639 000** articles found, a multi-stage shortening process was used to limit the literature in a meaningful way. The multi-stage shortening process is shown in figure 1. By shortening the search terms, the number of articles could be decreased to **440**. A further restriction was availability, because not all articles were publicly available. As a result, the literature was reduced to **282** articles. From this point on, articles that did not fit to the topic were rejected in a stepwise process: First on basis of paper title, then on keywords and finally on the abstract. This process resulted in **34** articles. Finally, a full text review was carried out to determine whether the articles matched the relevant research question. Consequently, **13** articles were identified which were considered as relevant literature. In all databases the amount of identified papers in the field of the two search strings increased continuously, except for IEEE. To further identify relevant literature, this paper follows the concept of the backward search (Webster and Watson, 2002). Backward search describes the procedure in which mentioned references within the relevant literate are being evaluated. This led to the identification of four additional articles and summed up to **17** relevant articles found.

4 Results

This chapter summarizes the central findings of the literature analysis. The viewpoints of the concepts are

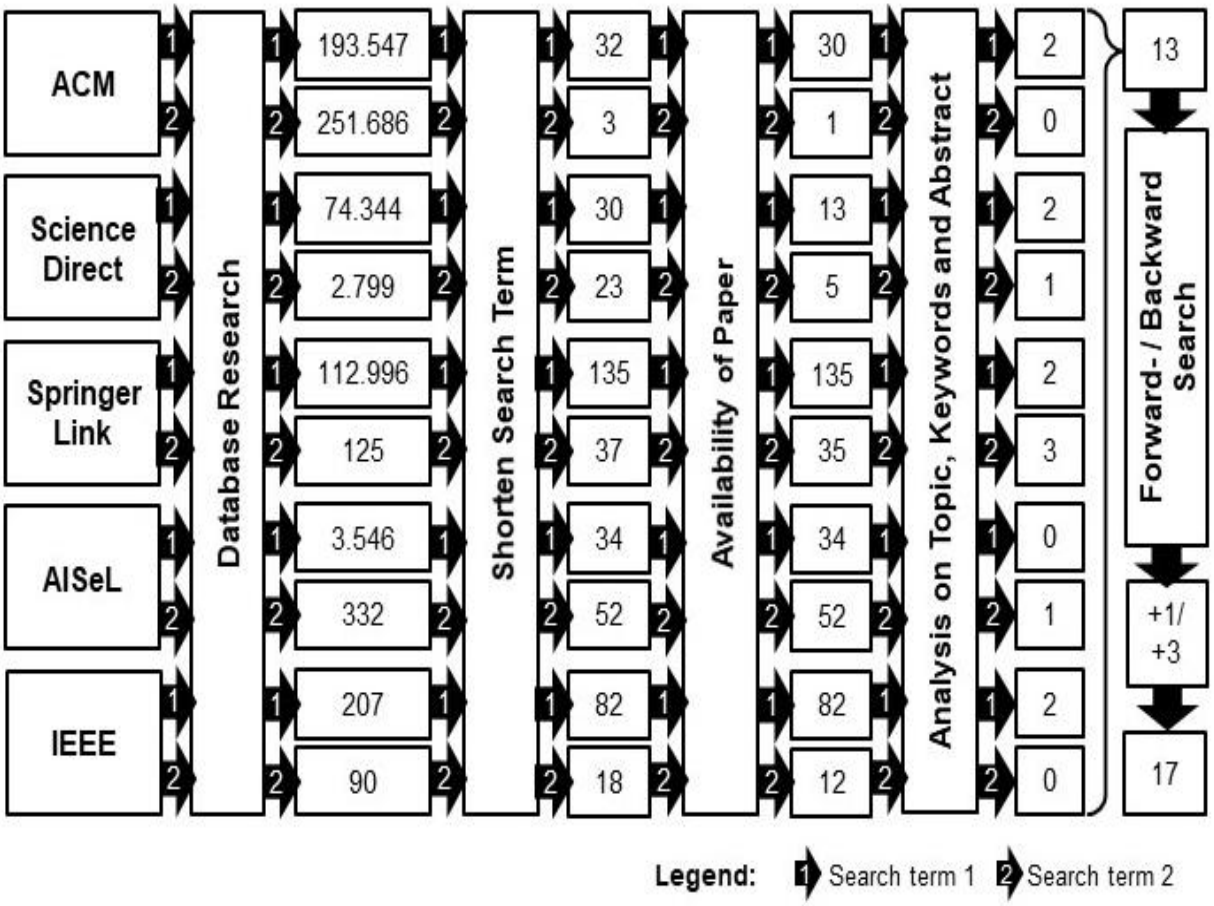

Figure 1. Multi-stage shortening process

described and compared. The resulting barriers are grouped as follows: Financial, Change Management, Internal Competencies, Technological, Market and Regulations. A categorisation of the literature in concept matrix is shown in Table 1.

4.1 Financial

High upfront investment is one of major reasons for the **lack of financial resources**. According to (Engelken *et al.*, 2016) that on one side the technological progress promises decreasing costs and innovative business models and on the other side high investment costs are required. In this context by Ruggiero et al. (2015) and Zhang *et al.* (2017) it is written, that there are high investment costs for example of generation equipment and installation and for long payback time than traditional sources of energy such as fossil fuels. In addition to that, there is a low profitability of small domestic projects. So, the low buy-back rates are responsible for the non-profitable to households. Another lack of financial resources is described by Li et al. (2019) and Engelken et al. (2016), with the cost trigger of high initial investments as well as operating and maintenance costs for batteries in the context of electromobility and as storage for renewable energies. Horváth and Szabó (2018) also describe high investment costs in Photovoltaic (PV) projects and Kotilainen and Sommarberg (2016) mention high investment costs for power generation plants. In addition Ojala (2001) identified that bio energy providers have higher acquisition costs in infrastructure. According to Cowan (2017) this reason hinders smaller companies to enter the energy industry. Very similar Hall and Roelich (2016) describe high entry costs to become a licensed supplier by enter the market. Another financial barrier is the **lack of governmental financial support** (Ojala, 2001). Governmental incentives, for example to promote renewable energies, often do not operate at the local level and are not geared to complex logistical energy networks. In this context of misguided financial incentives and a lack of long-term planning security (Engelken *et al.*, 2016). As a result, Engelken et al. (2016) describe budget problems and a limitation of growth for renewable energies.

4.2 Change Management

According to Hall and Roelich (2016) there are considerable uncertainties and risks in connection with change management, in particular with regard to

Table 1. Concept matrix barriers

Concept matrix	**Financial**		**Change Management**	**Internal Competencies**	**Technological**		**Market**	**Regulations**
	Resources	Governmental support	Business Models	Lack of resources	Technological Capability	Network capacity	Shift of power	Regulations
Ojala, P.: Business Plan Model for Bio-energy Companies	x	x						
Kotilainen and Sommarberg: Prosumer centric digital energy ecosystem framework. (2016)	x						x	x
Richter, M.: How to overcome barriers to business model innovation. (2013)			x	x				
X. Li et al.: Bringing innovation to market: business models for battery storage. (2019)	x			x	x	x		x
Horváth and Szabó: Overcoming the main barriers of distributed energy deployment (2018)	x			x		x		x
C. Zhang et al.: The Digital Transition of Urban Energy System. (2017)	x			x	x	x		
Engelken et al: Comparing drivers, barriers, and opportunities of business models for renewable energies. (2016)	x	x		x			x	x
Cowan: The Case of Electric Vehicle Charging and the Smart Grid. (2017)	x						x	x
Hall and Roelich.: Business model innovation…in the United Kingdom. (2016)	x		x					
Chesbrough, H.: Business model innovation: Opportunities and barriers. (2010)			x	x				
Sen and Ganguly: Opportunities, barriers and issues with renewable energy development. (2017)				x			x	x
Reddy and Painuly: Diffusion of renewable energy technologies, barriers and stakeholders' perspectives. (2004)							x	x
Ruggiero, Varho and Rikkonen: Transition to distributed energy generation in Finland Prospects and barriers. (2015)	x				x		x	
Eleftheriadis and Anagnostopoulou: Identifying barriers in the diffusion of renewable energy sources. (2015)					x	x		x
Karakaya, Nuur and Hidalgo: Business model challenge - Lessons from a local solar company. (2016)								x
Dewald, J.: Storm Clouds and Silver Linings: Responding to Resilience. (2018)				x				
Schubert, D.: When Does the EEG Allocation Start to Decline? (2018)								x

new business models and their value creation mechanisms. Furthermore, that it is difficult to identify the right performance promise together with an energy supplier. In addition, contractual agreements with new suppliers on sources of income are difficult, as monetisation is the main focus of an energy supplier (Hall and Roelich, 2016). Chesbrough (2010) also describes that there are conflicts between an existing business model and a new innovative business model. According to Kotilainen and Sommarberg (2016) and Richter (2013) the challenge of change management in such a way that business innovations are not part of the "corporate DNA" of a traditional energy supplier. In sum, there is a transformation from traditional business model of utilities with focussing on electricity generation in large-scale power plants and distribution and retail to a new business model with products or services like consulting services for PV installation or providing investment grants.

4.3 Internal Competencies

A further obstacle are the **lack of internal resources** in order to transform in the energy sector. Richter (2013) explains that distributed PV projects are outside the core competence of energy suppliers. According to Engelken et al. (2016) and Sen and Ganguly (2017) an internal utility-specific barrier when they mention the shortage of skilled workers to operate and maintain renewable energy hardware. Other authors speak of a lack of awareness Li et al. (2019), Horváth and Szabó (2018) and Zhang et al. (2017). In their papers on battery storage, PV and digital energy system projects, about a weak professional competence and motivation among energy suppliers, whether administrative or work-related. Finally Dewald (2018) describes that new business model adoption is confronted with multiple barriers, but none more significant than managers' cognitive barriers to change. Chesbrough (2010) supports this thesis by describing that managers often stick to their traditional structures, because of their scarceness of the fact that it might threaten their ongoing value to the company.

4.4 Technological

In terms of **technological capabilities** Eleftheriadis and Anagnostopoulou (2015) describes that the suitability and reliability of specific technologies for renewable energies involve a risk. According to Li et al. (2019) which focuses on battery storage business models, mentions that some batteries cannot be used for frequent deep discharges, as these deep discharges can shorten their life. Further technological barriers are the lack of standard procedures for the connection to the power grid and problems with the measurement of input and output quantities of decentralized energies during the integration into the power grid (Ruggiero, Varho and Rikkonen, 2015). The term **missing network capacities** are stated by Li et al. (2019) and Zhang et al. (2017). Both describe the difficulties of integrating large amounts of data for smart city applications while maintaining a stable and secure power supply. In addition to information technology integration, Horváth and Szabó (2018) and Zhang et al. (2017) mention the integration of renewable energies into energy systems as an obstacle. The security of supply and the risk of poor system performance is one of the greatest technological challenges in the development of business models for PV. Very similar, Eleftheriadis and Anagnostopoulou (2015) mention the insufficient development of electricity grids as one of the biggest obstacles to the development of regenerative energy sources. Especially in the field of wind power, areas with high wind potential are neither connected to the mainland grid nor can the generated energy be distributed efficiently because of a lack of technical infrastructure.

4.5 Market

Traditionally, the energy market is known as a monopole market for a reason (Reddy and Painuly, 2004). The **shift of power** (Hegemony) in this market creates barriers to new business models. These monopolies still exist to a certain extent, since expensive energy technologies combined with high capital costs can only be provided by major actors because energy network services are less expensive when they are provided by a single operator (Sen and Ganguly, 2017). These structures reduce the opportunity of market entry for new participants (Cowan, 2017) (Engelken *et al.*, 2016). A lot of energy companies still have an interest in maintaining a monopoly-like status instead of preparing for change (Cowan, 2017). This argumentation is also supported by Ruggiero, Varho and Rikkonen (2015), who conducted expert interviews in Finland. They declare that energy companies are interest in not facilitating the market entry of small-distributed energy producers. That explains why suppliers according to Cowan (2017) and Kotilainen and Sommarberg (2016) are even slowing down the transition to more decentralised energy systems, because they fear that market power could shift to more players and innovative business models which are not predictable nor controllable. However, others claimed that it would be better if their companies would be part of this change rather than staying on the opposite side (Ruggiero, Varho and Rikkonen, 2015).

4.6. Regulations

According to Kotilainen and Sommarberg (2016), Engelken et al. (2016), Horváth and Szabó (2018) and Eleftheriadis and Anagnostopoulou (2015) that the overarching regulations in the energy sector are creating additional complexity and bureaucracy. Similarly, Cowan (2017) emphasizes that the integration of newcomers for renewable energies is hindered by political structures. According to Engelken et al. (2016) and Horváth and Szabó (2018) are shortcomings for the PV industry within the legal framework for tax measures and there the lack of support from energy and environmental policy. Horváth and Szabó (2018) as well as Li et al. (2019) depict that the continued reduction of the feed-in tariff and the high tax rates lead to a lack of reliability in the long-term planning for the expansion of renewable energies. Another regulation barrier is, that there are many countries that still have policies and regulations, that are aimed at monopoly or near-monopoly providers (Sen and Ganguly, 2017). These policies protect the dominant centralized energy production, transmission and distribution. It makes the way of renewable energy very difficult. Furthermore, the barrier through regulations especially in India (Reddy and Painuly, 2004). India has no sufficient government regulations or incentives to support the adoption of renewable energy technologies by companies and industries. Furthermore, regulations,

which provide for a minimum remuneration for electricity from renewable energies over a fixed period are generally good for the entry of renewable energies (Schubert *et al.*, 2018). However, if this law expires in 2020, operators of such systems will not be able to obtain additional remuneration for electricity from regenerative energy sources (Karakaya, Nuur and Hidalgo, 2016). So, in future companies cannot rely on this support anymore.

5 Discussion

The results show, which barriers are existing in a transformation process in the energy sector and how they can be categorised. On the one hand the technological progress in the energy sector promises decreasing costs and innovative business models and on the other hand high investment costs are required to accomplish a successful business model transformation. These include the high upfront investments as well as the lack of governmental financial support. Governmental incentives for example to promote renewable energies, often do not operate at the local level, are misguided or do not fit to complex energy networks. Regarding the Change Management, there are internal barriers at the management level by holding on to traditional structures and business models. At the technical level, there is a lack of staff who owns the right skills and motivation. In the area of technological shortcomings, the suitability and reliability of new energy capacities is mentioned as another obstacle. Batteries are therefore a risk because of their lack of reliability as an instrument of flexibility. The lack of network capacity for information and energy exchange and the fluctuating energy production as a risk to grid stability was also mentioned. Furthermore, the major actors in the energy industry are trying to keep the market as a monopole as they concern about their profitability. Most of new players in the market cannot face that power, that makes them work under the control of the big companies in the market just to keep their business alive. In this context, the government can play an important role to insure a successful business model transformation, due to financial support and policies. On the other side, this can make processes more complex and difficult to enter the energy sector for companies. But how can these barriers be overcome? On one side leasing and contracting can offer new markets for energy companies and on the other can be a new income opportunities for households for example by offering roof PV systems and receiving part of the revenue (Engelken *et al.*, 2016). Furthermore, joint-venture models can enable small and medium sized enterprises to share risk and investment to minimize costs. Community-shared and third-party-owned business models are represented in as possible solution because they reduce the upfront costs of the projects (Li *et al.*, 2019). So, there are solution approaches for the financial barriers. But what about the other five barriers Change Management, internal competencies, technology barriers, market and the regulations? Here a lack was found, which is still to be explored.

6 Conclusion

In this study, we conducted a systematic literature review to identify key barriers to implementing new business models in the energy sector. Our study provides two main contributions. The first contribution is a summary of the literature referring to transformation barriers across the energy sector. Second, the refereeing concept matrix which shows the result of six main barriers which should be taking into account by transforming traditional business model in the energy sector. The six barrier identifies are the lack of financial resources, lack of change management, lack of internal competencies, lack of technology as well as market and regulation barriers. These barriers are not necessarily comprehensive but represents the most important barriers mentioned in the literature. In future studies, additional barriers may be identified and investigated. Future research can investigate the barriers for a particular energy application. For example, obstacles to intelligent energy applications at the neighbourhood or city level or obstacles to the development of local and self-sufficient energy networks can be investigated.

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