MASTER THESIS

EXPLORING BUSINESS MODEL INNOVATION FOR DUTCH ENERGY SUPPLIERS: AN OVERVIEW OF DRIVERS, BARRIERS AND CONDITIONS

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Date: 14 January 2021

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Abstract

The energy sector has long stood out for its stability regarding players and business models. However, the environment of actors in the energy sector is currently subject to change. Consequently, incumbent Dutch energy suppliers face the challenge to find new ways of creating, delivering and capturing value. This study investigates the developments in the environment of Dutch energy suppliers and describes what business model innovations Dutch energy suppliers could use to respond to their changing environment. Therefore, the research question of this study is: *'What business model innovations could Dutch energy suppliers use to respond to their changing environment?'*

To answer this question, the business model innovation framework of Wirtz and Daiser (2017) is used to structure the explorative literature reviews and the interview guides. This framework is chosen because it connects the key elements and dimensions of business model innovation. To enhance the understanding of this framework, we have elaborated on this model by providing the perspectives of this framework with a definition. Consequently, a qualitative case study has been conducted at a Dutch energy supplier. Semi-structured interviews are held to validate the findings of the exploratory literature reviews and to gain additional insights into the developments in the environment of Dutch energy suppliers.

Our research revealed three key trends in the environment of Dutch energy suppliers: decarbonisation, decentralisation and digitalisation. We find that these trends drive energy suppliers to innovate their business models. On the other hand, we find that financial barriers, managerial issues and a lack of regulatory support are the main barriers for energy suppliers to innovate their business model. Based on these findings, we provide three considerations for future energy supplier business models: (1) gaining a position in the market for renewable energy, (2) responding to the increased need for flexibility of the grid due to the unpredictability of the renewable energy sources and (3) selling energy services to facilitate the energy transition and profit from the advances in technology. These considerations challenge energy suppliers to go beyond the delivery of energy as a commodity, and collaboration between all actors in the value chain is needed. Energy suppliers need to carefully manage the intensity of the business model process, adopt new organisational forms to innovate the business model and find a way to engage their customers in this new model. Partnerships with companies outside the energy sector, such as IT-companies, can accelerate the speed of the innovation towards new, more sustainable energy supplier business models. Moreover, policy makers can support this transition through more favourable regulatory frameworks for new energy services. Together, the actors in the energy sector could set the mark for a truly sustainable energy future.

***Keywords**: business model innovation, energy suppliers, energy transition, energy services, decarbonisation, decentralisation, digitalisation, flexibility.*

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Glossary

Acronym	Full term	Definition
ACM	(Dutch) Authority Consumers and Market	Contributes to realizing a healthy economy by ensuring that markets work well for people and businesses (ACM, n.d.).
ACI	Advanced metering infrastructure	A system that measures, collects and analyses data about energy usage and power quality from smart meters (Zhou et al., 2016).
BRP	Balance Responsible Party	Responsible for maintaining supply and demand on the energy market within their own portfolio (TenneT, n.d.).
BOO	Build, own, operate	Business model for the installation of renewable energy systems or DERs
BM	Business Model	Business models are 'the rationale of how an organization creates, delivers and captures value' (Osterwalder and Pigneur, 2010, p.14)
BMG	Business Model Generation	Framework of Osterwalder and Pigneur (2010) that forms an approach that can be used to assess existing business models and to develop new ones.
BMI	Business Model Innovation	Business model innovation is 'a novel way of how to create and capture value, which is achieved through a change of one or multiple components in the business model' (Frankenberger et al., 2013, p.3)
DSM	Demand side management	A portfolio of actions from energy suppliers to manage the consumption of energy by the customer (Bahrami et al., 2012)
DER	Distributed Energy Resources	Small-scale (often renewable energy based) power production unit that operates locally and is connected to the energy distribution grid.
DSO	Distribution System Operator	Operating managers of energy distribution networks operating at low and medium voltage levels in a certain area.
ESCO	Energy Service Company	See *ESP (Energy Service Provider)*
ESP	Energy Service Provider	Energy companies that provide all kinds of energy-efficient services.
ESS	Energy storage system	Systems that 'move energy over time' (Rastler, 2010).
	Energy supplier	An energy supplier is an organizational unit that deals with the supply of energy (electricity, gas, or heat) to communities,

		businesses, and other organizations and recovers its costs through charging rates.
EPC	Engineering, procurement and construction	Business model for the installation of renewable energy systems or DERs
GTS	Gasunie Transport Services	GTS is the Dutch TSO for (natural) gas.
IEA	International Energy Agency	Works with countries around the world to shape energy policies for a secure and sustainable future (IEA, n.d.).
IRENA	International Renewable Energy Agency	An intergovernmental organisation supporting countries in their transition to a sustainable energy future (IRENA, n.d.).
MRP	Metering Responsible Party	(Third) Party that installs and maintains meters and measures how much energy customers take.
NEDU	Nederlandse Vereniging voor Energie Data Uitwisseling (Dutch Energy Data Exchange Association)	Connects market parties in the Dutch energy sector. Within NEDU, the market parties make clear and constructive agreements about free market facilitation together (NEDU, n.d.).
PV	Photovoltaics	Photovoltaic solar energy, a renewable energy source, seen as an alternative to dealing with the challenges of shortage of energy produced from traditional source (Sampaio and Gozález, 2016).
PPA	Power Purchase Agreement	An agreement between two parties (mostly the energy supplier/utility and an owner of renewable energy production facility to sell the power generated by this facility).
	TenneT	The (only) Dutch TSO for electricity.
	Utility	A utility is a producer and supplier of energy (electricity, gas, and heat) (Stephens et al., 2017).
VEMW	Vereniging voor Energie, Milieu en Water (Association for Energy, Environment, and Water)	Knowledge center and advocate for business energy and water users in the Netherlands (VEMW, n.d.).
VPP	Virtual Power Plants	Virtual Power Plants are ‘systems that rely on software and other technology to remotely and automatically dispatch and optimize distributed energy resources’ (Verhaegen and Dierckxsens, 2016, p. 32).

1 Introduction

This chapter introduces our research and presents the main research problem. Moreover, the research questions and the methodology used to answer these research questions are described, as well as the relevance of the research and its contributions. This chapter ends with an overview of the research structure.

1.1 Background

Rapid changes in the environment of the firm such as advances in technology, changing customer wishes and increased competition can be threatening to the competitive advantage of a firm (Chesbrough, 2007). To address these changes and sustain their advantage, businesses need to make changes in their business model (Amit and Zott, 2010; Chesbrough, 2007). The innovation management literature acknowledges this need for innovation and defines the concept of business model innovation (BMI) in this regard (e.g. Breuer, 2013; Chesbrough, 2010; Teece, 2010).

The business model concept was initially developed in the 1990s, allowing entrepreneurs to communicate complex business ideas to potential investors within a short time frame (Zott, Amit and Massa, 2011). In the years thereafter, the concept developed into a tool for analyzing and reconfiguring one or more organizational units and relevant parts of the environment (zu Knypenhausen-Aufsess and Meinhardt, 2002; Doleski, 2015). Moreover, as indicated above, academics such as Chesbrough (2007) and Afuah (2004) state that business models can be seen as strategic assets for competitive advantage and firm performance. On the other hand, business model innovations involve 'the search for the new business logic of the firm and new ways to create and capture value for its stakeholders to deal with changes and opportunities in the environment of the firm' (Casadesus-Masanell and Zhu, 2013).

This study focuses on business model innovation for (Dutch) energy suppliers. The energy sector is under pressure due to many changes in their environment. For instance, the energy transition makes that a shift towards more sustainable ways to produce energy is needed (Johansson et al., 2012). In addition, the liberalization of the energy market and developments in (communication) technology make that the amount of competitors in this sector has increased (Shomali and Pinkse, 2016). Moreover, technological advances have empowered customers with the possibility to self-generate their energy needs with the help of small-scale renewable energy sources, such as photovoltaics (Frantzis et al., 2008). This increased competition and new options for customers to provide in their energy needs drive energy suppliers to obtain a more customer-focused and sustainable mindset, as the customer no longer a 'given', which was the case before the liberalization of the Dutch energy market in 2004 (Kieft et al., 2013). In other words, business model innovation is needed.

The current Dutch energy market is mainly comprised of energy generation, transmission, distribution and retail and consumption (Richter, 2013). Due to the importance of the transmission and distribution parts of the value chain, these markets are regulated by the law. However, the generation and retail parts of the value chain is liberalized and therefore based on the principles of 'free market economy' (Kieft et al., 2013).

In blue, Figure 1 shows the complete value chain of the Dutch energy sector and the corresponding actors for each part of this chain. In order to include all actors and make clear what their main responsibility is, we have added some steps between the generation, transmission, distribution and retail and consumption. The figure shows that energy producers are responsible for the generation of energy and traders and Balance Responsible Parties (BRPs) are obliged with trading the electricity. BRPs are also responsible for maintaining the balance between the supply and demand of energy within their portfolio (TenneT, n.d.). Moreover, the Transmission System Operator (TSO) is accountable for the national transmission of energy on the high-voltage grid, whereas the Distribution System Operators (DSO) manage the regional distribution using the medium and low voltage electricity grid (Kieft et al., 2013). As stated, both the transmission and the distribution are regulated by the government.

Next, energy suppliers are responsible for the retail of units of energy and therefore the contact with consumers. Lastly, large-scale consumers can choose a separate Metering Responsible Party (MRP) who is responsible for installing and maintaining the energy meter of these consumers and measuring the amount of energy they take from the grid. Other customer segments communicate their amount of consumption with their energy supplier. Chapter 3 describes this value chain and the actors in more detail.

1.2 Problem statement and research questions

Their changing environment forces energy suppliers to shift away from their traditional, centralized business model based on fossil fuels, towards a business model that can fulfil the need for energy in a more environmentally sustainable way (Wüstenhagen and Boehnke, 2008; Bocken et al., 2014; Hall and Roelich, 2016). Authors such as Tayal and Rauland (2017) and Thomas (2018) argue that when energy suppliers fail to innovate their business model, the challenges they encounter will worsen. To clarify, Thomas (2018) and Richter (2013) argue that if incumbents do not innovate their business model, their profitability and maybe even their sheer existence is massively under threat, because they will lose market share to investors from outside the energy industry.

However, because each technological improvement or institutional enhancement traditionally follows the same pathway stemming from previous decisions, energy suppliers have to deal with path-dependence and technological and institutional lock-in hindering business model innovation in this sector (Foxon et al., 2002, 2011; Lee et al., 2015). For example, incumbent energy suppliers are often part of large energy companies owning a large amount of tangible (carbon-based) energy production assets. Due to the large fixed costs of these assets ('sunk costs'), energy suppliers are '*reluctant to invest in more sustainable alternatives*' (Foxon et al., 2002, p. 2). In addition, institutional lock-in arises, due to social conventions such as fear of change (Foxon et al., 2002). Therefore, Hannon et al. (2013) describe that energy suppliers need to break from this path dependence to stay relevant in the future. For this reason, this study aims to make clear what business model innovations Dutch energy suppliers could use to respond to their changing environment. Business model innovation is namely about finding novel ways to create and capture value (Frankenberger et al., 2013). In order to fulfil this aim, we investigate what the developments in the environment of energy suppliers are and how these developments impact the traditional energy supplier business model. More specifically, the drivers and barriers of business model innovation for Dutch energy suppliers is studied to find out what business model innovations Dutch energy suppliers could use to respond to their changing environment.

This study focusses on the Dutch energy market. This market provides an interesting context for this research since there is an ongoing debate about environmental sustainability in the Netherlands (IMD, 2014; Verhees et al., 2013). This debate also affects the energy sector in this country (Huijben and Verbong, 2013; Meijer et al., 2019). Markad, Raven, and Truffer (2012) state that, despite the effort of companies in the Dutch energy sector, the transition towards sustainability remains rather slow. However, since sustainability is one of the key environmental changes that needs to be considered when dealing with business model innovation (Bocken et al., 2014), applying the concept of business model innovation to the case of Dutch energy suppliers is an interesting topic for this research. Therefore, the main research question of this paper is:

'What business model innovations could Dutch energy suppliers use to respond to their changing environment?'

To answer this research question, the following sub-questions are formulated:

a. What is business model innovation?
b. What are the barriers to business model innovation?
c. How is the value chain of the Dutch energy sector structured?
d. What are the developments in the environment of Dutch energy suppliers?
e. What are the drivers and barriers of these developments for Dutch energy suppliers?

1.3 Research methodology

To answer the research question and sub-questions stated above, three data collection methods are used: literature reviews, desk research, and semi-structured interviews. This study is performed at a case company, a Dutch energy supplier. Chapter 4 introduces this case company. Figure 2 presents an overview of the methodology and structure of this paper. The remainder of this section elaborates on the data collection methods per sub-question.

The first and second sub-questions are related to the current literature on business model innovation and its barriers. To answer these sub-questions, a literature review of scientific literature is conducted. This literature review gives a theoretical background on the concepts of business models, business model innovation, and the barriers to business model innovation. These concepts are the key theoretical concepts of this paper. Furthermore, in this literature review, the chosen theoretical framework is described.

We use the business model innovation framework of Wirtz and Daiser (2017) to structure this paper. This framework integrates most of the theories described in the literature review. Moreover, this framework takes into account the forces in the macro-environment of the firm, which can be used to identify the developments in the environment. Doing this, identifying the developments for Dutch energy suppliers, is the goal of the fourth research question. So, the framework helps to structure the fourth research question.

Before this fourth research question can be answered, a description of the Dutch energy sector is given. This description consists of an overview of the Dutch value chain, an explanation of the regulations for energy suppliers in the Netherlands, and a generalized version of the business model that is currently used by Dutch energy suppliers (the 'traditional' business model). In this way, a starting point for the business model innovation process is drawn. This description of the Dutch energy sector is based on desk research, focusing on reports from

Dutch authorities, such as the Dutch government, the Authority for Consumers and Markets (ACM), and various industry organizations. With this description, the third sub-question is answered.

The fourth sub-question and fifth sub-question are respectively about the developments in the Dutch energy sector and their drivers and barriers for Dutch energy supplier business model innovation. These questions are answered using a literature review and semi-structured interviews with academic experts, employees of the case company and other experts in the field. These interviews validate, supplement and give a deeper understanding of the subjects found in the literature review. Together, the answers on the five sub-questions answer the main research question.

1.4 Research scope

The scope of this research involves Dutch energy suppliers. According to the Dutch Electricity Act 1998, an (electricity) supplier is 'an organizational unit dealing with the supply of electricity'. Bryant et al. (2018) define an energy supplier as 'a supplier of energy (electricity, gas, and heat) to households, communities, businesses and other organizations that recovers its costs through the charging of rates' (p.1033). In this paper, a combination of these definitions of an energy supplier is used:

> *'An energy supplier is an organizational unit that deals with the supply of energy (electricity, gas, or heat) to communities, businesses, and other organizations and recovers its costs through charging rates.'*

Households are explicitly not included in this definition. This is due to the focus of the case company, which does not supply energy to households and organizations with a 'small-scale consumer connection'. Chapter 4 describes the case company. Moreover, existing research in this field already addressed the impactions of the changing environment for energy suppliers who provide their services to households (e.g. Hall and Roelich, 2016; Mengelkamp, Schlund, and Weinhardt, 2019; Hellström et al., 2015; Burger and Luke, 2017).

Second, this definition explicitly excludes the production of energy. According to the Dutch Electricity Act 1998, electricity producers are, 'organizational units that deal with the generation of electricity' (Rijksoverheid, 1998). Taken this definition broader, energy producers are 'organizational units that deal with the generation of energy (electricity, gas, or heat)'.

The exclusion of the production of energy is due to the same reasoning as for the exclusion of households and with a small-scale consumer connection. First, the case company is not concerned with the production of energy. Moreover, extensive research is already done to show ways in which energy producers can deal with their changing environment. For instance, by making the shift to all kinds of renewable energy sources, such as <u>solar photovoltaics</u> (e.g. Wainstein and Bumpus, 2016; Newcomb et al., 2013; Lüdeke-Freund and Loock, 2011), <u>biofuels</u> (e.g. Dowaki and Mori, 2005; Heffels et al., 2012) or <u>renewable energy in general</u> (e.g. Christensen et al., 2012; Behrangrad, 2015; Yildiz et al., 2015).

Furthermore, many scholars investigated the impact of this shift towards renewable energy on the business models of energy producers and utilities (e.g. Richter, 2012; Richter, 2013; Rodriguez-Molina et al., 2014). A utility is, according to Stephens et al. (2017) '*a producer and* *supplier of energy (electricity, gas, and heat)'*. Thus, utilities fulfil the role of energy producer as well as energy supplier (see also Chapter 3).

In short, the key actors in this paper are energy suppliers. Energy suppliers are only concerned with the retail part of the value chain. More specifically, this paper is about energy suppliers that sell and supply (distribute) energy to a customer who is not a household or an organisation with a 'small-scale consumer connection'. Only organizations that have a 'large-scale consumer connection' are the target group of the case company, and therefore this research. A connection is considered as a 'large-scale consumer connection' when the capacity of the connection is more than 3x80 Amps (electricity) or at least 40 m^3 per hour (gas) (ACM ConsuWijzer, n.d.). A gas connection can also be considered as a 'large-scale connection' if the connection is larger than a G25 connection (ACM ConsuWijzer, n.d.). If one of the two connections (electricity or gas) is considered as a 'large-scale consumer connection', the company is considered as a large-scale consumer (Essent, 2019).

To summarize, this research focuses on business model innovations for energy suppliers that supply large-scale consumers but do not produce energy themselves. A visual representation of the research scope is shown in Figure 1 In blue, the Dutch value chain is shown. Chapter 3 elaborates on this value chain. In grey, the capacity limits per target group are shown. The 'large-scale consumers' and 'small-scale consumers' are (often) organisations, whereas the households are private persons. The Figure shows that this research focuses on the retail part of the value chain and the target group 'large-scale consumers'.

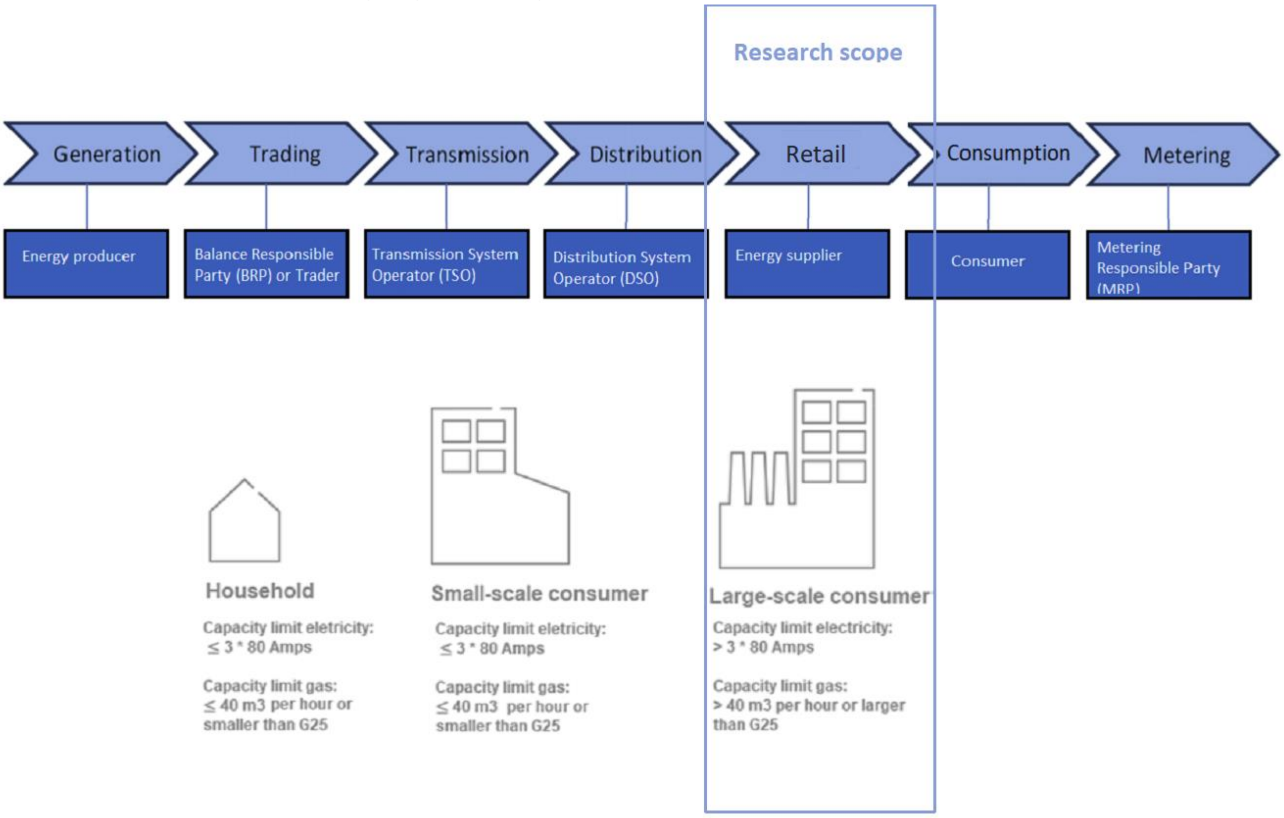

Figure 1 Research scope (based on Transrisever et al., 2013 and NLE, n.d.)[1]

[1] A larger version of this image can be found in Appendix B (Figure A4).

1.5 Research relevance and contributions

This research complements existing research in academic literature, by applying the framework Wirtz and Daiser (2017) to the energy sector. Since the model of Wirtz and Daiser (2017) deals with all elements of business model innovation, this paper contributes to the current literature about business model innovation in the energy sector. To be more precise, current studies on this topic focus only on the impact of challenges or opportunities for selected elements of the business model (e.g. Rai and Sigrin, 2013; Huijben and Verbong, 2013; Drury et al., 2012) or on the impact of one change or opportunity in the market, for instance, smart grids (Catalin et al., 2014), photovoltaics (Frantzis et al., 2008) or rural electrification (Lemaire, 2011). However, the framework of Wirtz and Daiser integrates all business model elements. Applying this framework to the energy sector would, therefore, give a new, integrative perspective on business model innovation in the energy sector. Moreover, by adding definitions to the factors of this framework, we add to the understanding of this framework. Secondly, several researchers (e.g. Wüstenhagen et al., 2007; Inigo, Albareda and Ritala, 2017; Boons et al. 2013; Chaurey et al. 2012; Geissdoerfer et al., 2018) and political institutions (United Nations, 2015; European Commission, 2011) state that the energy sector must become more sustainable and encourage companies in the energy sector to adopt renewable energy sources and other measures for sustainability. For that reason, it is useful to understand the operational possibilities for such a shift.

Third, this study adds to the sustainable business model literature. Although this literature on this topic is extensive these studies do not focus on the energy industry, but primarily on other industries such as the automotive industry (Wells, 2013), manufacturing industry (Stock and Seliger, 2016), chemical industry (Iles and Martin, 2013) and food industry (Jolink and Niesten, 2015). Studying business model innovation in the energy sector is, therefore, extending the current literature. Lastly, this research answers the call of Boons and Lüdeke-Freund (2013) for more empirical research on sustainable business models.

Practically, this research allows Dutch energy suppliers to innovate their business model to act upon the challenging circumstances they are facing. This research identifies the developments in the Dutch energy market. In this way, Dutch energy suppliers have insight into the drivers and barriers for business model innovation. Dutch energy suppliers can use these insights, together with company-specific information and desires, to make strategic decisions about business model innovation in their firm and integrate and implement innovations that are suitable for their specific situation.

1.6 Thesis structure

This thesis is divided into seven chapters. The current chapter, Chapter 1, introduces the topic, research questions and objectives of this study. The second chapter reviews literature on business model (innovation) to present a theoretical basis. The third chapter provides more information about the Dutch energy market and its developments, to provide a practical (case) background for this study. Afterwards, Chapter 4 describes the methodology used in this study. Chapter 5 presents the results of the macro-environment analysis, whereas Chapter 6 is about the Central Business Model Innovation (BMI) Dimensions, the BMI Intensity and the BMI Output/Impact. Lastly, Chapter 7 is about the conclusion and discussion and summarizes the contributions, limitations and directions for future research.

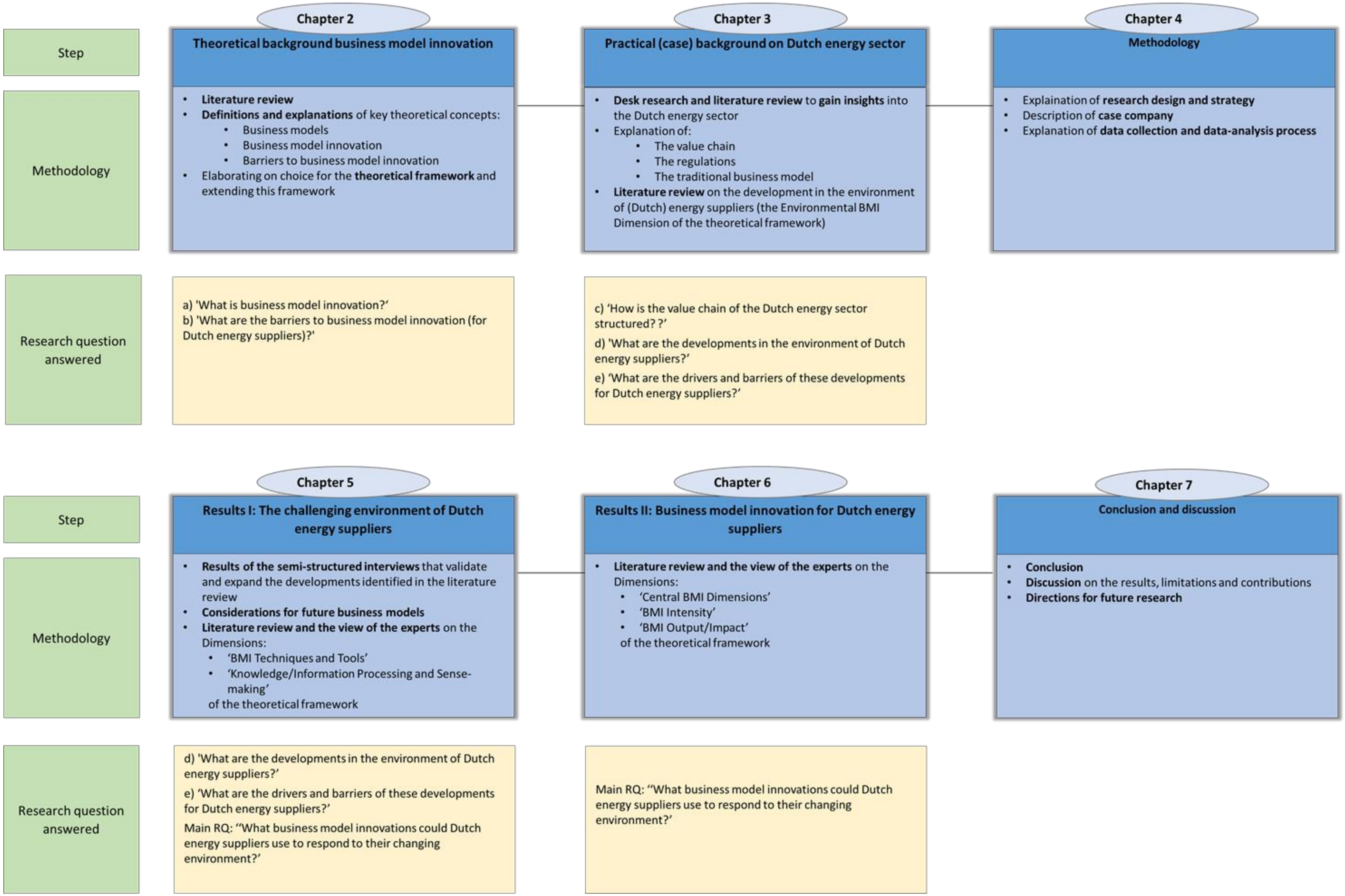

Figure 2 Overview of research structure and methodology

2 Theoretical background: business model (innovation)

This chapter describes the theoretical foundation of the research. Business models and business model innovation are the key theoretical concepts of this thesis. This chapter explains these two theories as well as the theoretical framework that is used to structure this thesis. Therefore, this chapter answers the first and second sub-questions of this research: *'What is business model innovation?'* and *'What are the barriers to business model innovation?'*.

First, the literature review method is described. Second, relevant literature about business models and business model innovation is provided. Afterwards, the barriers to business model innovation are shown and a framework for business model innovation is presented.

2.1 Literature review method

In this chapter, a literature review is conducted to gain insights into the key concepts of this study and to come up with a theoretical framework that could structure the empirical part of this study (Levy and Ellis, 2006; Hart, 2018). Moreover, by reviewing the current literature, ideas could be gained about the methodology that could be used for this empirical part.

The review uses the procedure for a systematic literature review described by Webster and Watson (2002) and vom Brocke et al. (2009). This methodology is commonly used in management literature and research in the energy sector (e.g. Zott et al., 2011; Kossahl et al., 2012; Cucchiella and D'Adamo, 2013). Accordingly, the first step of this literature review was determining the research scope. Secondly, the topics are conceptualized. Afterwards, the literature could be searched and analysed and a theoretical framework is chosen.

<u>Review scope</u>

The review scope of this chapter is, as stated above, to gain insights into the key concepts of this paper and to present a theoretical framework to structure this paper. This chapter focusses on the concepts 'business models' and 'business model innovation'. In addition, we found that many scholars discuss the barriers of business model innovation, which therefore became an additional section in this chapter. In the section 'barriers to business model innovation', general barriers to business model innovation as well as specific barriers to business model innovation for the Dutch energy sector are described.

Chapter 3 draws the traditional, currently most used, business model by Dutch energy suppliers. This approach is chosen because background information about the Dutch energy market is needed to fully understand the business model of Dutch energy suppliers.

<u>Conceptualization</u>

The conceptualization of the concepts 'business models' and 'business model innovation' is based on a literature search. The author found that there is a wide range of definitions of the concepts 'business models' and 'business model innovation'. Therefore, a comparison of a couple of influential definitions of the concepts is made, and eventually, a definition for this review is drawn.

<u>Literature search</u>

For the conceptualization and further literature review, a literature search was performed. The starting point of this literature review was several key publications on 'business models' and 'business model innovation' (e.g. Chesbrough, 2010; Zott et al., 211; Johnson et al., 2008). These key publications were found after entering the basic keywords 'business models' and ‘business model innovation’ in the research databases Scopus and Google Scholar. Especially Scopus was found useful, since this database contains all the major journals for this study, both about business model (innovation) and the energy sector. The results of these search terms were subsequently sorted on the number of citations, starting with the article with the highest number of citations.

Also, the literature reviewed in this paper were found using the snowball technique (Verhoeven, 2014). In this technique, relevant references used by the often-cited papers as well as papers that cited these often-cited papers and got often cited themselves served as the input of the literature review as well. This allowed for fast insight into relevant literature on this topic. However, a danger of this method is that not the whole research area around the topic is covered since only references that are used in the often-cited papers are taken into account. Therefore, combining this method with additional search entries, gave a more complete overview of the current literature on business model (innovation). These search entries consisted of the search terms ‘business model’ or ‘business model innovation’.

The results of this search entry were filtered on the type of document. Only articles and conference papers were selected. Moreover, since the literature on business model (innovation) develops quickly, special attention was given to the date of publication. In short, the focus of the literature search was on highly cited papers in the past, as well as recent publications about the topic. Eventually, this literature review led to the business model innovation framework of Wirtz and Daiser (2017) which is both recent and combines elements of the theoretical concepts described in the literature review.

The next section elaborates on the following key concepts: business models and business model innovation. Subsequently, the barriers for business model innovation are discussed and the theoretical framework is described. This theoretical framework serves as the basis for the case study.

2.2 Business models

Over the last decades, the circumstances of doing business successfully have changed. This is due to factors such as faster innovation cycles, increasing globalization, and increased competition (Wirtz, 2011). As a consequence, markets are more competitive, dynamic, and complex (Aslani, Helo, and Naaranoja, 2012). In order to survive, business owners and managers need to come up with new business ideas and strategies, examine if current business processes still fit in these new plans, and change them if needed (Wirtz, 2011). A business model can help managers and business owners structure their ideas, making clear how these ideas relate and lead to value for both the customer as the company (Johnson, 2010).

The concept of ‘business models’ is widely accepted among scholars. A lot of research is done into the concept of business models. Zott et al. (2011) compared 103 business model publications and found out that authors do not agree about the definition of a business model. They state that, in general, business models are referred to as a description, architecture, conceptual tool, model, structural template, pattern, set, framework, statement, or representation (Zott et al., 2011). One of the most cited definitions of a business model is the definition of Chesbrough and Roosenboom (2002). These authors argue that a business model describes the organizational and financial architecture of a firm (Chesbrough and

Roosenboom, 2002). In addition, Teece (2010) argues that a business model defines how 'the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit' (p.172). Moreover, business models can function as a blueprint that is ready for innovation (Baden-Füller and Morgan, 2010).

For this research, the definition of Osterwalder and Pigneur (2010) is used, because this definition is extensively used by both academia and practitioners (e.g. Suhonen and Okkonen, 2009), and combines aspects of many common definitions:

Business models are 'the rationale of how an organization creates, delivers and captures value' (Osterwalder and Pigneur, 2010, p.14)

Osterwalder and Pigneur (2010) define nine building blocks of a business model, together named the 'business model canvas' (Osterwalder and Pigneur, 2010). These nine building blocks of the business model canvas are: key partners, key activities, key resources, customer value proposition, customer relationships, channels, customer segments, cost structure and revenue stream (Osterwalder and Pigneur, 2010). The nine building blocks are organized into four pillars: value proposition, customer interface, infrastructure management, and revenue model.

Value proposition
The value proposition pillar has a central position on the business model canvas and consists of only one building block, the value proposition. Osterwalder and Pigneur (2010) state that the value proposition represents how the products and services of the firm create value to the customers.

Customer Interface
The Customer Interface pillar is closely connected to the Value Proposition pillar and consists of the building blocks 'customer relationships', 'customer segments' and 'channels. This Customer Interface pillar focusses on the interaction with the customer, the identification of the target customer and the way in which the product or service is delivered (Osterwalder and Pigneur, 2010; Osterwalder, 2004).

Infrastructure Management
A pillar that is also closely related to the Value Proposition pillar is the Infrastructure Management pillar, which consists of the building blocks 'key partners', 'key activities' and 'key resources' building blocks. This pillar is linked to the Value Proposition pillar, because it contains the human and physical resources, including networks and partnerships, that need to work together to deliver the value proposition of the firm (Wallin, 2004; Teece, 2007; Eisenhardt and Martin, 2000).

Revenue Model
The last pillar is the Revenue Model pillar and consists of the building blocks 'cost structure' and 'revenue streams' and is positioned so that it matches with all other pillars. This pillar is about the relationship between the costs that the firm makes to and the revenue that the firm gains to deliver the value proposition. Table 1 provides an overview of the pillars and their description. A visual representation of the business model canvas is shown in Figure A1 in Appendix A.

Table 1 Business Model Canvas (Osterwalder and Pigneur, 2010)

Element	Building blocks	Description
Value proposition	Value proposition	Contains the bundle of products and services that creates value for the customer.
Customer interface	Customer relationships Customer Segments Channels	Describes how the interaction with the customers takes place; how the company maintains its relationship with the customers, which customers are targeted by the company and how the company communicates with their (potential) customers.
Infrastructure management	Key partners Key activities Key resources	Defines the network and logistical approach that a firm needs to deliver the created value, including partnerships, knowhow and (tangible and intangible) assets.
Revenue model	Cost structure Revenue Streams	Addresses the relationship between the costs and the revenues, that is, the costs made by the company and the money generated by the company.

The business model canvas approach is used in this research because of its shown usefulness as an analytic tool (He et al., 2011; Okkonen and Suhonen, 2010; Shrimali et al., 2011). Moreover, the concept allows the examination and comparison of market solutions in a structured way (Richter, 2013; Wüstenhagen and Boehnke, 2008). In addition, the business model concept helps to design, change and control the operations of the firm based on the perceived challenges in the future (Johnson, 2010).

2.3 Business model innovation

Challenges in the environment of the company are usually dealt with on a strategic level. Overall, strategy and business models are closely related. The business model reflects the strategy of a firm (Casadesus-Masanell and Ricart, 2010) and describes the logic behind how the firm creates and captures value (Teece, 2010). Firms need to be aware of their business model as mere product or process innovations are insufficient in the current fast-changing environment (Chesbrough, 2007). Business model innovation (BMI) is needed to obtain sustainable competitive advantage (Christensen, 2001) and is as important for economic growth as the technology or R&D innovation itself (Teece, 2010).

Business model innovation can be understood in multiple ways. For instance, Markides (2006) defines the concept as 'the discovery of a fundamentally different business model in an existing business' (p. 20). Casadesus-Masanell and Zhu (2013) refer to business model innovation as 'the search for a new business logic of the firm and new ways to create and capture value for its stakeholders' (p. 464). Sosna et al. (2010) argue that business model innovation is 'a strategic renewable mechanism for organizations facing their external environment' (p. 387). Schallmo (2013) and Foss and Saebi (2017) both have made an extensive literature review on this topic. Analysing these literature reviews, as well as recently published works (e.g. Velu, 2019) makes clear that business model innovation can serve as (1) a tool for activating strategic changes in innovation processes and (2) a source of competitive advantage, in which the business model itself is innovative. The different definitions of business model innovation often refer to changes in the value proposition or how the firm creates, delivers or captures value (e.g. Tongur and Engwall, 2014; Markides, 2006; Chesbrough, 2010; Amit and Zott, 2001), indicating the usefulness of the concept for creating competitive advantage and sustainable business success. Therefore, in this paper, business model innovation is defined following the definition of Frankenberger et al. (2013, p.3) as:

Business model innovation is 'a novel way of how to create and capture value, which is achieved through a change of one or multiple components in the business model' (Frankenberger et al., 2013, p.3)

Accordingly, in this paper, business model innovation is focussed around the elements of the business model canvas by Osterwalder and Pigneur (2010). Richardson (2008) redefined these elements into three pillars: value proposition, value creation, and delivery, and value capture. The relationship between the building blocks of the business model canvas and the pillars of Richardson can be seen in Figure 3. The value proposition is the product or service that the company offers to generate profit from, which can be economic profit, or in the case of a non-profit organization, measurable social or ecological profit (oftentimes in combination with some economic profit) (Boons and Lüdeke-Freund, 2013). Value creation and delivery need to be the core of the organization, it namely describes the key activities of the organization. Organizations mainly create new value by seizing new business opportunities, markets or revenue streams (Teece, 2010). Lastly, value capture is about how the product, service or information is offered to customers and generates revenue for the organization (Teece, 2010).

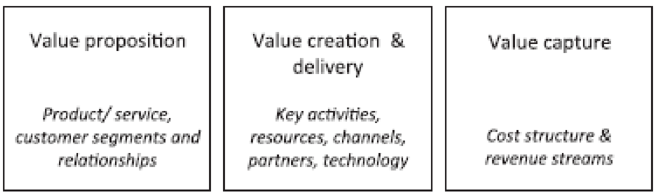

Figure 3 Relationship between the business model canvas (Osterwalder and Pigneur, 2010) and the conceptual business model framework of Richardson (2008)

In short, most business model innovation authors refer to aspects concerning value, when talking about business model innovation. Therefore, it can be stated that companies need to be clear about their value proposition and how they create, deliver and captures value. In the energy sector, the value aspects are even more important, because the business models of energy suppliers can deliver value beyond the customer. For instance, innovations in the business models of energy suppliers can contribute to the society by reducing (the chance of) earthquakes due to gas extraction, but also by improving the world-wide accessibility of energy, reducing the fuel poverty in some parts of the world and as a result, improving the health benefits of people living in these regions (IEA, 2014). Moreover, business model innovation in the energy sector can deliver value to the energy sector itself too. As an example, business model innovations can account for demand-side management, reducing traditional, expensive, energy reinforcement (Hall and Foxon, 2014).

2.4 Barriers to business model innovation

Now is clear what business models and business model innovation is, the question remains 'Why diffuse business model innovations so slowly?' (Sosna et al., 2010; Sprecht and Madler, 2019). This has all to do with the barriers to business model innovation. Therefore, in this section, the barriers to business model innovation are described. These barriers are obtained by performing a literature review using the same methodology as described in section 2.1.

The main search entry for this section was 'business model innovation barriers'. After indicating the key papers for this search entry (e.g. Chesbrough, 2010; Christensen, 2006), this search entry was extended with one of the keywords 'energy', 'renewable energy', 'electricity', 'energy sector' or 'sustainability' to come up with barriers specific for the energy sector (e.g. Sosna et al., 2010; Aslani and Mogahar, 2013; Engelken et al., 2016). Moreover, the keywords 'Dutch energy sector' was added to get results specified to the Dutch energy sector. This led to the key paper by Meijer et al. (2019). Using the snowball technique, other relevant papers about barriers to business model innovation were found and added to the overview.

This section continues with an overview of the barriers to business models innovation. After reading papers about barriers to business model innovation in the energy sector, it became clear that entrepreneurs and other strategic decision-makers in energy firms mainly have to deal with the 'generic' barriers to business model innovation. That is, the barriers need to be overcome by all entrepreneurs, irrespective of the nature of the company. For this reason, the decision is made to not separate the generic barriers to business model innovation and those that are specific for the energy sector in different chapters (generic barriers in this chapter and energy-specific barriers in chapter 3) but combine them in this section.

During the literature review, three main theories related to barriers to business model innovation are derived. First, the work of Chesbrough (2010) on organizational learning is valuable to get insights on the barriers of business model innovation in general, applicable to different industries. The same counts for the work of Sosna et al. (2010) on trial-and-error learning. Concerning the energy sector, the disruptive innovation literature of Christensen (2006) is useful to get insights on the barriers of business model innovation in the energy sector. Lastly, the work of Bocken et al. (2014) on barriers to business model innovation for sustainability is relevant for this thesis, because sustainability is a key driver for business model innovation in the energy sector (Laslett et al., 2017).

<u>Hesitance due to a fear of losing out on current revenue streams</u>

The first barrier to business model innovation has to do with the emergence of disruptive technologies (Chesbrough, 2010). Disruptive innovation is about changes that interrupt established ways of performance (Christensen, 2006). More precisely, 'they may lack certain features or capabilities of the established goods but they are typically simpler, more convenient and less expensive, so they may appeal to less-demanding or new customers' (Christensen, 2006, p.2). Technologies such as artificial intelligence and 3D-printing are often mentioned as examples of disruptive innovations. Christensen and Bower (1996) argue that disruptive technologies are hardly ever used directly in established markets, but change the design of these markets in the long term. This is due to the inability of established firms to commercialize new, disruptive technologies through their existing business model (Chesbrough, 2010). These established firms are hesitant to commercialize these new, disruptive technologies, because they fear to miss out from exiting revenue streams (Sosna et al., 2010; Amir and Zott, 2001).

Moreover, incumbents are worried about the performance of the new business model (Sosna et al. 2010). When the new business model delivers less profit than expected in the early phase, managers are often discouraged to further engage in the development of this business model (Sosna et al., 2010).

Organizational inertia, cultural problems and cognitive barriers

Another reason why incumbents are hesitant to business model innovation, arise from the fear organizational inertia, cultural problems and cognitive barriers (Chesbrough and Roosebloom, 2002; Bohnsack et al., 2014; von der Eichen et al., 2015). Authors emphasize in particular the cognitive barriers, stating that none of the barriers to business model innovation is more significant than the cognitive barriers of managers to change (Hodgkinson and Wright, 2002; Dewald and Bowen, 2010). In addition, Daim, Madjdi, and Hüsing (2011) state managers often struggle with a lack of creativity for innovating their business model. Organizational inertia is based on a set of beliefs and norms that over the years became the dominant logic of the firm (Prahalad and Bettis, 1986). It shapes the perspective of the manager towards the risks and opportunities in the environment and guides his or her actions (Chesbrough, 2010). Therefore, managers can fail to rethink the current business model and underestimate the level of innovation that it needs (Bertels et al., 2015).

Problems with valuing the benefits of improved (environmental) sustainability

Regarding the energy sector, scholars found that energy suppliers and other companies in the energy sector face barriers around sustainability. These barriers are even more aggregative. According to Bocken et al. (2014), businesses face problems when valuing benefits from enhanced environmental conditions. For example, managers find it hard to see the potential of business cases concerning sustainable technologies, as the profit from such technologies is likely to be limited in the short term (Hahn et al., 2014).

In addition, managers can be confronted with problems regarding communicating the benefits of such sustainable technologies to prospective customers (Pinkse and Dommisse, 2009). Since the success of sustainable business innovation strongly depends on the value delivered to customers (see section 2.2), businesses do not only face internal, but also external barriers to business model innovation. Internal barriers are related to barriers within the business itself, for example, the hesitance of managers to innovate resources and capabilities, while external barriers deal with the willingness of customers to accept the value creation and delivery of the new business model (Chesbrough, 2010).

An overview of all the internal and external barriers for adopting business model innovation in the energy sector can be found in Table 2, which is structured using the Business Model Canvas of Osterwalder and Pigneur (2010) as represented in Table 1.

Table 2 Internal and external barriers to business model innovation for energy suppliers

Element of the Business Model Canvas	Internal barriers	External barriers
Value proposition	Not able to capture value from environmental conditions (Bocken et al, 2014; Wüstenhagen and Boehnke, 2008)	High market competition (Meijer et al., 2019)
Customer interface	Limited attention to the end-user (Meijer et al., 2019; Helms, 2016) Limited marketing and communication (Helms, 2016)	Missing demand and willingness to pay (as observed by managers) (Helms, 2016)
Infrastructure management	Risk averseness (Meijer et al., 2019; Engelken et al., 2016; Tiwari and Buse, 2007) Cognitive barriers (Bohnsack et al., 2014; Richter, 2013) Short-time planning (Cagno et al., 2012; Tiwari and Buse, 2007), while the development circles are long and uncertain (Engelken, 2016). Lack of competencies and resources of the organization (e.g. personnel, time, knowledge) (Hall and Roelich, 2016; Engelken et al., 2016; Bohnsack et al., 2014; Yildiz, 2014; Richter, 2013; Aslani and Mohagar, 2013) Internal competition between renewable energy and fossil-based energy sources (Helms, 2016; Yildiz, 2014) Inadequate coordination among the various stakeholders (Aslani and Mohagar, 2013) Lack of flexible structures and incentives that are not designed to meet locally varying requirements (Helms, 2016; Engelken et al., 2016).	Underdeveloped or complex technology (Aslani and Mohagar, 2013; Meijer et al., 2019) Some incumbents want to maintain the states-quo (Schleicher-Tappeser, 2012; Engelken et al., 2016)
Revenue model	Lack of profitability and high costs (Aslani and Mohaghar, 2013; Helms, 2016; Richter, 2013; Yildiz, 2014) Limited financial resources (Meijer et al., 2019) Fear to miss out from existing revenue streams (Sosna et al., 2010)	Lack of supportive policies and the reliability of actors on these policies (Aslani and Mohaghar, 2016; Meijer et al., 2019; Hall and Roelich, 2016; Engelken et al., 2016)

2.5 Theoretical framework

Wirtz and Daiser (2017) analysed 179 articles in the field of business models and came up with an integrative business model innovation framework consisting of six main elements. This framework, among others, integrates the business model canvas of Osterwalder and Pigneur (2010) with the business model framework of Richardson (2008). Next to this integration, other elements are added to this model. For instance, Wirtz and Daiser (2017) add elements that deal with barriers around knowledge and information processing and contain the macro-environment. Since changes in the environment, such as the increasing importance of sustainability issues and the rapid development of technology strongly impact the business models of energy suppliers (Evans et al., 2009; Zhou et al., 2016), and knowledge barriers constrain business model innovation (see section 2.3), applying this business model innovation framework of Wirtz and Daiser (2017) is advantageous for this study.

The framework of Wirtz and Daiser (2017) offers an integrative approach between almost all of the main theories discussed earlier in this chapter. In addition, it indicates multiple dimensions that need to be considered in order to make suggestions for feasible business model innovations (BMI). The six dimensions of the framework of Wirtz and Daiser (2017) are: *environmental BMI dimension, central BMI dimension, BMI techniques and tools, knowledge/information management, BMI intensity, and BMI outcome/impact*. These six dimensions are split up in multiple elements that each consist of multiple aspects. A visual representation of the dimensions and their associated perspectives and aspects is shown in Figure 4.

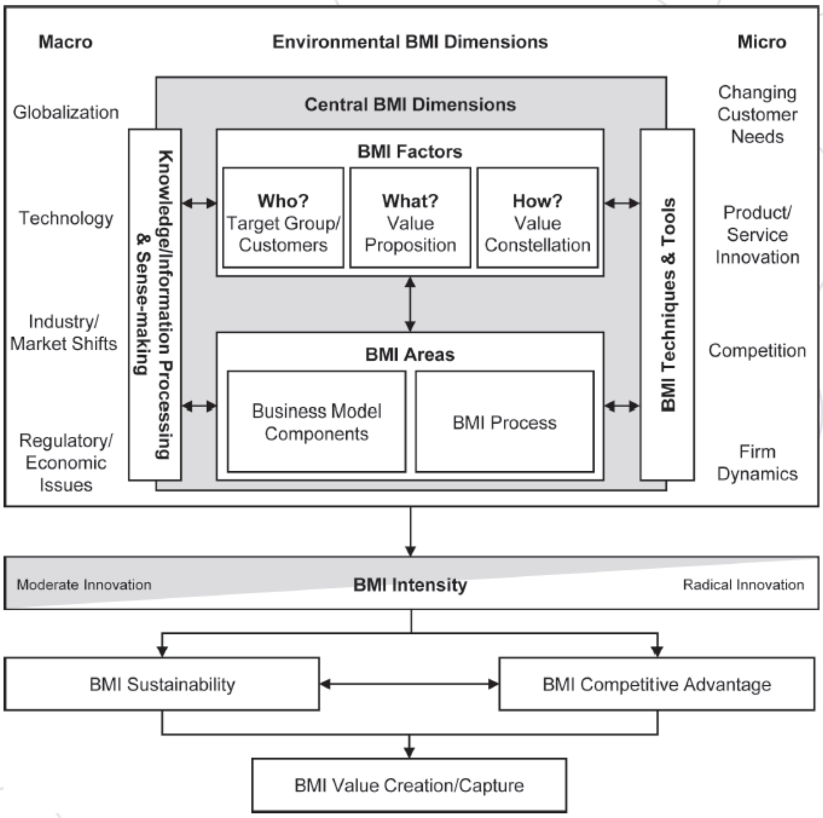

Figure 4 Business model innovation framework of Wirtz and Daiser (2017)

The remainder of this section further explains the business model innovation framework of Wirtz and Daiser (2017). However, because this framework is complex and Wirtz and Daiser

(2017) do not define the perspectives and factors of their framework clearly, a theoretic framework is drawn to further specify them. In other words, we give a definition of the perspectives and factors of the framework of Wirtz and Daiser (2017). In this way, the interpretation of the model and its elements become clearer. This theoretical framework can be found in Table 3. First, the framework as proposed by Wirtz and Daiser (2017) is explained.

Environmental BMI Dimension

The first dimension of the framework of Wirtz and Daiser (2017), the Environmental BMI dimension, is concerned with how firms interact with their environment. Wirtz and Daiser (2017) divided this dimension into two perspectives, namely the macro-level perspective and the micro-level perspective.

The macro-level perspective contains factors such as globalization, technology, environment, and regulatory/economic issues (Wirtz and Daiser, 2017; Brews and Tucci, 2004; Mahadevan, 2004; Voelpel et al., 2004; Habtay, 2012). These factors impact the company strongly and force them to innovate their business model.

Next to issues in the macro-level perspective, micro-level environment issues deal with internal factors that trigger business model innovation. Wirtz and Daiser (2017) derived the following micro-environment elements: changing customer needs, product/service innovation, competition, and firm dynamics.

Central BMI Dimension

The Central BMI Dimension refers to the target customer, value propositions, and value delivery system (Wirtz and Daiser, 2017). This dimension is about innovation trough altering the value creation process, the market or target group, and/or the value constellation (Wirtz and Daiser, 2017). The latter, value constellation is about the network of actors around the firm and the relationships between the firm and its actors (Normann and Ramirez, 1994).

The Central BMI dimension is divided into the elements ‘BMI Factors’ and ‘BMI Areas’. BMI Factors refer to the elements ‘who’ (target group/customers), ‘what’ (value proposition), and ‘how’ (value constellation).

BMI Areas contain the business model components of Osterwalder and Pigneur (see section 2.1) and the element BMI Process, which is about how the business model innovation process is designed. When dealing with BMI, managers should consider the process as well, since BMI is not a static construct and is applied in different ways (Wirtz and Daiser, 2017). Adjustments in the BMI process might, therefore, increase the efficiency and effectiveness of the BMI (Wirtz and Daiser, 2017).

To systematically integrate the Environmental and Central BMI Dimensions, two additional dimensions are drawn: BMI Techniques and Tools and Knowledge/Information Processing and Sense-making (Wirtz and Daiser, 2017). These dimensions help the firm to translate the identified factors in the macro- and micro-environment into actions for the Central BMI Dimension (the BMI Factors and Areas).

BMI Techniques and Tools Dimension

The BMI Techniques and Tools Dimension describes the need for firms to actively search for new knowledge in the internal and external business environment (Wirtz and Daiser, 2017). Moreover, this dimension is about the ability of firms to identify BMI opportunities and drivers for change (Wirtz and Daiser, 2017). Wirtz and Daiser (2017) state that tools and methods can help with these tasks and will systematically structure and assess internal and external information.

The paper of Wirtz and Daiser (2017) does not describe specific tools or techniques that could be used to search for or identify business opportunities. However, in the frame of this research, knowing which (type of) tools and techniques could be used for this purpose, is relevant. The reason for this is that this paper aims to make visible how the concept of business model innovation could be applied in practice, in this case, the energy sector.

Reviewing the sources used by Wirtz and Daiser (2017) as well as additional sources makes clear that authors such as Eppler et al. (2017) and Henderson (1991) argue that the processes of searching for and identifying new business opportunities could be structured with templates such as the business model canvas of Osterwalder and Pigneur and the Five Forces Model of Porter (1997). Moreover, Steiber and Aläange (2013) argue that cooperation with (independent) researchers and universities is recommended for firms to source their environment.

Knowledge/Information Processing and Sense-making dimension

The second dimension that is drawn to integrate the Environmental and Central BMI Dimensions, is the dimension Knowledge/Information Processing and Sense-making. This dimension is about the ability of firms to understand customer- and market signals (Wirtz and Daiser, 2017).

Again, Wirtz and Daiser (2017) only describe that firms need an ability to process relevant knowledge and information from their external environment and make sense of this knowledge and information, in order to successfully translate the developments in the external environment to the internal environment. The authors, again, do not mention which methods firms can use to develop or train this ability, or perform knowledge processing and sense-making activities in general. Reading the sources cited by Wirtz and Daiser (2017) more closely, makes clear that a process of recursive learning is recommended for this purpose. In other words, the knowledge and information processed in this stage need to be renewed and evaluated frequently (Denicolai, 2014). Other authors such as Freeman (1991) and Kodama (2009) and Teece (2010) refer to the importance of networks based on ‘scientific and technical information and advice’ (Freeman, 1991) for this purpose.

BMI Intensity

Subsequently, the dimension BMI Intensity is drawn. This dimension is about the extent to which the current business model needs to be changed. After the developments in the environment are identified in the Environmental BMI Dimension and translated into the desired Central BMI Dimensions by using the BMI Techniques and Tools and Knowledge/Information Processing and Sense-making, the firm now needs to decide the Intensity of the business model innovation.

In other words, it needs to decide how much change is needed to transform the current business model to the desired business model. Wirtz and Daiser (2017) argue that the innovation intensity of the BMI can take two types: moderate or radical. Therefore, the BMI Intensity Dimension consists of these two perspectives (Wirtz and Daiser, 2017).

The perspective 'moderate innovation intensity' is similar to the term 'incremental innovation', which indicates that only slight changes to the business model are required (Hargadon, 2015). On the other hand, the perspective 'radical innovation intensity', is similar to the term 'disruptive innovation' and reflects massive business model change (Markides, 2006).

BMI Outcome/Impact

The last dimension of the framework of Wirtz and Daiser (2017) is BMI outcome/impact, which consists of the following three key elements: BMI Sustainability, BMI Competitive Advantage, and BMI Value Creation/Capture. BMI Sustainability is about the factors that protect and increase the sustainability of the business model (Wirtz and Daiser, 2017). Specifically, this element is about factors such as exceptionality of resources (asset-based), preferential access to resources or customers (relationship-based), and valuable experiences concerning working in a specific manner (tacit knowledge-based) (Mahadevan, 2004).

The second element of this dimension is 'BMI Competitive Advantage'. Wirtz and Daiser (2017) argue that developing competitive advantage is often the goal of business model innovation, but during the BMI process, this goal is not always on top of mind (Wirtz and Daiser, 2017). As a consequence, the BMI process can be subject to change and time-consuming. By adding this element to the framework, the authors want to make sure that the goal of achieving a competitive advantage with the BMI is kept in mind (Wirtz and Daiser, 2017). Lastly, the third element 'BMI Value Creation/Capture' refers to how the firm captures the value that it creates for its customers through its innovated business model (Wirtz and Daiser, 2017; Teece, 2010). This is not only about financial value, but also about returns with another character, for instance value for the society (Bocken et al., 2014).

Theoretical Framework

As discussed above, to make the structure of the framework and the definitions of the perspectives and factors in this model clearer, a theoretical framework is drawn. This theoretical framework can be found in Table 3. The definitions and descriptions are composed using the snowball technique as described in section 2.1. The starting point of these descriptions was the work of Wirtz and Daiser (2017).

However, because the explanation by Wirtz and Daiser (2017) about these perspectives and factors is rather limited, these descriptions are extended with the additional literature search. The sources used for this extension are based on the papers cited by Wirtz and Daiser (2017). By carefully reading these papers, it became clear er what Wirtz and Daiser (2017) meant with the different elements of the framework and how the relationship between these elements is. To make this intention clearer for readers of the current study, the descriptions of the elements, as described by Wirtz and Daiser (2017), are extended with the findings of an additional literature study in the final theoretical framework. This theoretical framework is shown in Table 3, the theoretical framework.

Table 3 Theoretical Framework (based on Wirtz and Daiser (2017)

Dimension	Perspective	Factors	Description/Definition	Source (next to Wirtz and Daiser, 2017)
Environmental BMI Dimension	Macro-level	Globalization	External factors that force companies to innovate their business model	Brews and Tucci, 2004; Mahadevan, 2004; Voelpel et al., 2004; Habtay, 2012
		Technology		
		Industry/market shifts		
		Regulatory/economic issues		
	Micro-level	Changing customer needs	Internal factors that trigger business model innovation	Mahadevan (2004); Voelpel et al. (2004); Giesen et al. (2010); Enkel and Mezger (2013).
		Product/service innovation		
		Competition		
		Firm dynamics		
Central BMI Dimension	BMI Factors	Who (target customers)	The group of customers that the company tries to satisfy (share common needs, behaviours or other attributes)	Yang et al. (2014); Mahadevan (2004)
		What (value propositions)	Represent why the firm creates value to its customers via the products and services that they offer. It is the reason why customers choose for this product (solving a problem or satisfies a need)	Osterwalder and Pigneur (2010); Mahadevan (2004); Teece (2010); Amit and Zott (2012); Johnson et al., (2008)
		How (value constellation / value delivery)	The network of actors around the firm and the relationships between the firm and its actors (the value chain)	Normann and Ramirez, (1994); Margretta (2002); Chesbrough (2013)
	BMI Areas	Business model components	The business model components of Osterwalder and Pigneur (2010), see Table 1 and Figure A1.	Osterwalder and Pigneur (2010)
		BMI Process	Defining, modifying and optimization of the process or approach toward BMI to increase effectiveness or efficiency of the BMI or to adapt the process to unexpected/new events	Linder and Cantrell, (2000); Pateli and Giaglis, (2005); Johnson et al., (2008); Sosna et al., (2010); Teece, (2010)
BMI Techniques and Tools			Developing a capacity to innovate the business model by using innovation	Chesbrough (2010); Denicolai et al. (2014);

			tools and techniques that systematically assess internal and external information	Yang et al. (2014); Eppler et al. (2011)
Knowledge / Information Processing and Sense-Making			Dealing with the organizational need for knowledge creation and renewal, market signal interpretation and customer understanding, using a recursive learning process	Malhotra (2000); Kastalli et al. (2013); Denicolai et al. (2014).
BMI Intensity		Moderate (Incremental) Innovation	Only small modifications of the current business model, low risk, and effort of change.	Burcherer et al., (2012); Mitchell and Bruckner (2004); Hargadon (2015); Wirtz (2011)
		Radical (Disruptive) Innovation	Extensive changes in the current business model, high risk and effort of change.	Markides (2006); Bucherer et al. (2012); Wirtz (201)
BMI Output/Impact		BMI Sustainability	BMI should include factors (asset, relationship or tacit knowledge-based) that protect and increase the sustainability of the business model.	Mahadevan (2004)
		BMI Competitive Advantage	BMI is the output of striving for competitive advantage, and successful BMI produces a BM that is a competitive advantage itself, by being sufficiently differentiated and/or difficult to replicate.	Teece (2010); Margretta (2002); Günzel and Holm (2013).
		BMI Value Creation/Capture	BMI should make it possible for the firm to derive returns (financial or otherwise) in exchange for the value they created for their customers through the innovation.	Eichen et al., (2015); Chesbrough and Rosenbloom, (2002); Amit and Zott (2012).

3 Practical (case) background: the Dutch energy sector

This chapter focusses on the Dutch energy sector and provides background information to gain a solid understanding of this sector. Therefore, this chapter answers the third sub-question *'How is the Dutch energy value chain structured?'.* In addition, this chapter gives a first impression of the answer to the fourth sub-question *'What are the developments in the environment of Dutch energy suppliers?'*, as well as the fifth sub-question *'What are the drivers and barriers of these developments for Dutch energy suppliers?'*, because it gives an overview of the developments in the Dutch energy sector and their drivers and barriers according to the literature. This overview is validated and extended using interviews with experts in the Dutch energy sector in Chapter 5.

First, the current chapter elaborates on the value chain of the Dutch energy sector. Subsequently, the second section is about the rules and regulations in the Dutch energy sector. Third, an overview of the current most common (traditional) business model of energy suppliers is provided. Lastly, a literature review of the developments in the (Dutch) energy sector is drawn.

3.1 The value chain of the Dutch energy sector

To understand how energy suppliers work (i.e. what their business model looks like) it is important to understand what the value chain of the Dutch energy sector is. In this way, the impact of the business model innovation decisions for the value chain becomes visible. Moreover, based on the value chain, insights could be gained for the focus of the business model innovation (Schoetll and Lehmann-Ortega, 2011). Therefore, Schoettl and Lehmann-Ortega (2011) propose that businesses in the energy sector, at the start of their business model innovation process, should identify their role in the value chain. Thereafter, these businesses have to decide if they want to engage in other steps of the value chain (Schoetll and Lehmann-Ortega, 2011). Building upon this notion, this section elaborates on the current Dutch energy (electricity and gas) value chain. Moreover, for each of the phases of the value chain, some foreseen changes are described. The Dutch electricity value chain can be seen in Figure 5. The value chain for gas can be found in Figure 6. A simplified version of these value chains can be found in Figure A3 in Appendix B, as well as an overview of the main tasks of each of the actors in the value chain (Figure A4 in Appendix B).

The description of these value chains is based on desk research. There is little academic research describing the Dutch energy value chain. Therefore, the description of this value chain is mainly based on reports of authorities, such as the Dutch government (Rijksoverheid), the Authority for Consumers and Markets (ACM), Statistics Netherlands (CBS), and various industry organizations. Examples of these organizations are the Dutch Energy Data Exchange Association (NEDU) and the Association for Energy, Environment, and Water (VEMW). Moreover, webpages of the Dutch Transmission System Operators, TenneT, and Gasunie were found to be very helpful. The remainder of this section elaborates on the Dutch electricity and natural gas value chain.

Electricity value chain

Figure 5 shows the electricity value chain, consisting of the parts 'generation', 'transmission', 'distribution and retail', and 'consumption' (Kieft et al., 2013). This figure is based on the descriptions of the ‘Nieuw Marktmodel’. From 2013, companies operating in the Dutch energy market are required to work according to this model (NEDU, 2017).

<u>Generation</u>

In the generation part of the electricity value chain, electricity is made by transforming an energy source into electric power. This is done on large scale power plants (Blyth et al., 2014). Only a small group of energy producers own these power plants. In the Netherlands, the power plants are owned by utilities like Engie, Essent, Vattenfall, Delta, EDF, and, E.ON (Netbeheer Nederland, 2019). The energy producers are required to estimate their energy production. In practice, this is done with the help of a BRP (balance responsible party, see ‘transmission’ below) (Kieft et al., 2013). The most used energy sources for generating electricity are fossil fuels (Hannon et al., 2013). In 2018, 78% of the gross produced electricity in the Netherlands was based on fossil fuels. Renewable energy contributed to around 16% and nuclear power for around 3% (CBS, 2020).

As stated earlier, renewable energy is expected to increasingly substitute the conventional, fossil, power sources as governments are setting targets to stimulate this transition (e.g. Schleicher-Tappeser, 2012; Timilsina et al., 2012). The Dutch government strives for almost completely renewable energy supply by 2050 (Rijksoverheid, n.d.).

<u>Transmission</u>

The transmission phase of the value chain is about the transport of electricity to the distribution system operation (DSOs, see below). Electricity is, at this moment, mainly transported via the transmission grid at high voltages (Kieft et al., 2013). A Transmission System Operator (TSO) is responsible for the transmission of the energy and therefore supplies energy to all distribution system operators (DSOs, see below) and a limited number of end-users and (ACM, 2019). The Dutch TSO is TenneT. Next to the tasks that originate from being a TSO, TenneT has also the role of system administrator. In this role, TenneT needs a) to guarantee the transport of electricity across the grid safely and efficiently, b) to resolve issues with the transport of electricity and c) is responsible for balancing the supply and demand of electricity in the country (TenneT, n.d.). The latter, balancing the supply and demand of electricity, occurs with the help of an imbalance market.

In the Netherlands, all parties connected to the grid (both producers and consumers) have the responsibility to manage their energy balance in so-called energy programs (Kieft et al., 2013. Individuals (households) and small-scale users automatically transfer this responsibility to their energy supplier (Kieft et al., 2013). These energy suppliers, as well as energy producers and large-scale users, have to hire a BRP (balance responsible party) to manage their energy balance. At large energy suppliers (for example Vattenfall, Eneco, and Essent), the energy supplier and the BRP are often part of the same holding, but there are also stand-alone BRPs (NEDU, n.d.).

BRPs are thus required to estimate the electricity production and/or consumption of their customers. TenneT deals with the deviations between these estimations and the actual production and/or consumption. When there is more (less) electricity needed on the grid, TenneT asks electricity producers to produce more (less) energy and pays them a fee for the fact that they have assets ready to respond immediately to a request from TenneT (Kieft et al., 2013). Moreover, this fee is also for the costs that are made for the production of more energy, or on the contrary, the loss of revenue arising from the production of less energy (ACM, 2019). These costs are usually passed on the perpetrators of the imbalance and are based on the imbalance price that was applicable during the period of the imbalance (TenneT, 2019).

Currently, electricity is transmitted from a few centralized power plants to a large number of customers (Hannon et al., 2013). However, in the future, with the increasing importance of renewable energy, new transmission grids are needed (Richter, 2013). The reason for this is two-folded. First, the output of energy based on renewable sources, such as solar photovoltaics and windmills, fluctuates strongly (Hall and Roelich, 2016). This indicates the need for a grid that can handle a flexible amount of power. Second, Richter (2012) states that ‘centralized renewable energy power plants, such as offshore windmill farms, will be more remote than the conventional power plants’ (p. 2486). Therefore, the produced energy will have to bridge a longer distance to the end-customer. As a consequence, conventional transmission grids need to be redesigned.

Distribution and Retail

In the distribution and retail phase, the energy is distributed to the end-customers via the distribution network. This network is only connected with a few connection points to the transmission network (Richter, 2012). A Distribution System Operator (DSO) is responsible for the expansion and maintenance of the distribution network and its capacity (Enexis, n.d.). In addition, the DSO is responsible for the connection of the end-user to this network, as well as for the management and maintenance of this connection of small-scale users (Enexis, n.d.). Examples of Dutch DSO’s are Enexis, Liander, and Stedin (Netbeheer Nederland, 2019). Large scale-users can choose a separate metering responsible party (MRP). MRPs need to be authorized by TenneT (TenneT, n.d.).

The retail part of this phase is about the purchase of power, the measurement of the amount of energy used by the end-customer, billing, and the overall communication with the end-customer (Richter, 2012). These tasks are performed by the energy supplier. End-customers have a contract with an energy supplier of their choice.

A supplier buys the electricity from a trader or BRP (balance responsible party). Only these parties are allowed to trade electricity (TenneT, n.d.). A trade recognition or full recognition of the system administrator, TenneT, is needed to trade on the electricity trade market. A party with a full recognition is allowed to fulfil the role of BRP next to the role of trader (Kieft et al., 2013). TenneT only issues a trade recognition or full recognition if strict requirements are met. The reason for these strict requirements is the major financial risks associated with the trading of energy (Kieft et al., 2013). Consequently, only a few dozen traders and BRPs are currently active within the Dutch energy market (TenneT, n.d.). In other words, traders and BRPs are a link between the trade market and the energy supplier. The energy suppliers enter into a contract with a trader or BRP of their choice. Some suppliers and producers have their trading floors, others outsource the process to external parties (TenneT, n.d.)

Traders and BRPs buy electricity on the bilateral market or a power exchange market (Kieft et al., 2013). On the bilateral market, the suppliers trade the electricity with each other. This can be done directly, or with the help of a broker. The latter is called over-the-counter trading (VEMW, n.d.). The power exchange market consists of the EPEX Spot (formerly called APX) and ENDEX market. Unlike the bilateral market, trading on the power exchange market is anonymous and with standardized products. Moreover, at this market, electricity for both the short and the long term is traded. The electricity that is traded on the EPEX Spot market is traded for the day itself (intra-day) and the upcoming day by hour (day-ahead). At the ENDEX market, contracts with a fixed term for a longer period are traded. Due to the short timeframe, the price of electricity at the EPEX spot market is uncertain. As a result, a large part of the electricity is traded on the bilateral market or the ENDEX (Kieft et al., 2013; VEMW, n.d).

After the electricity is bought, the energy supplier forwards this electricity to the end-customer (Kieft et al., 2013). When the supplier also fulfils the role of producer it can supply the produced electricity directly to the end-customer (Kieft et al., 2013). This is the case for large energy companies, like Vattenfall and ENGIE. For the supply of energy to individuals, a permit of the ACM is necessary (ACM, n.d.). From 2013, the energy supplier is required to work according to the 'Nieuw Marktmodel' (New Market Model) (NEDU, 2017). This means, among other things, that the supplier sends an invoice to the end-user for both the costs of the supply and the costs of the distribution of the energy. The latter is done by the Distribution System Operator (DSO). The distribution costs are regulated by the ACM (Dutch Authority Consumers and Market) (ACM, n.d.). The supplier needs to take care of the financial settlement with the DSOs (Kieft et al., 2013)

The distribution and retail phase are also expected to change. Since customers more and more produce energy themselves (so-called 'prosumership') and an increasing amount of renewable energy projects occur and are connected to the grid (Bocken et al., 2014), the exchange of energy, money, and information will come from two sides, in contrast to the current one-sided flow (Hall and Roelich, 2016). Moreover, as the number of prosumers increases, the revenues of energy suppliers are expected to decrease (Richter, 2012). Therefore, energy suppliers need to develop new value propositions for their customers.

<u>Consumption</u>

Finally, the customer 'consumes' electricity. Richter (2012) expects that the customer segments and communication channels will change, due to the changing energy production and consumption of the customers. Valocchi et al. (2014) underline this statement by stating that the number of consumers that will produce energy themselves will increase. As a consequence, the number of prosumers increases, impacting the current value chain of the energy sector.

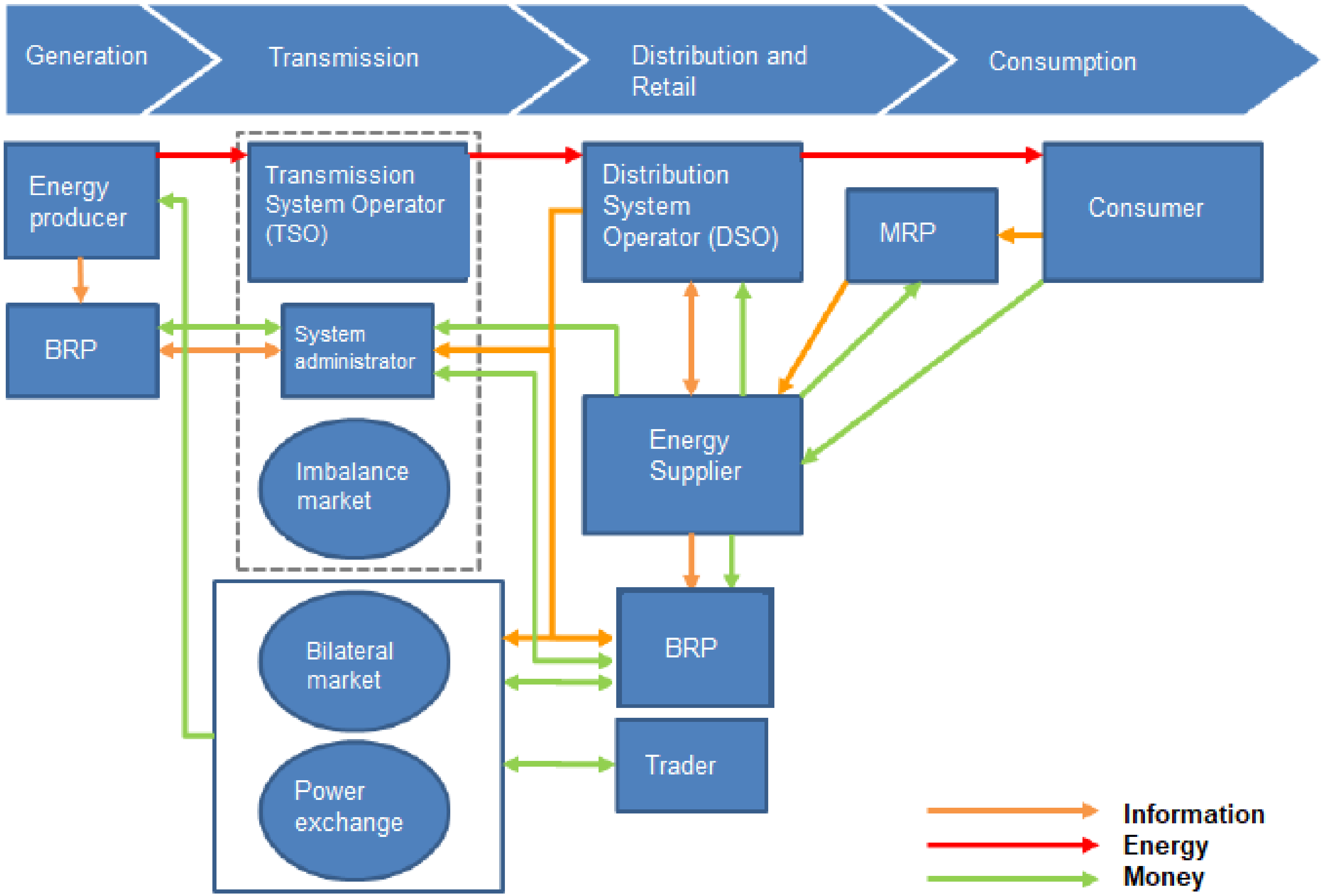

Figure 5 The electricity value chain (based on Kieft et al., 2013)

Gas

The natural gas value chain is comparable to the electricity value chain. The gas value chain is shown in Figure 6 (Pelletier et al., 2005). In the generation phase of the natural gas value chain, gas is produced by exploration and production companies (E&P companies) that explore, drill and extract the gas from the ground (Weijermars, 2010). Afterwards, in the transmission phase, the transmission system operator (TSO) connects the natural gas fields, energy suppliers, and customers with pipelines. Natural gas can also be traded as liquefied natural gas (LNG) (GECF, n.d.). The Dutch TSO is Gasunie Transport Services (GTS). This company is, just like TenneT is for electricity, responsible for the control of the network between the gas supply and production sources (Weijermars, 2010).

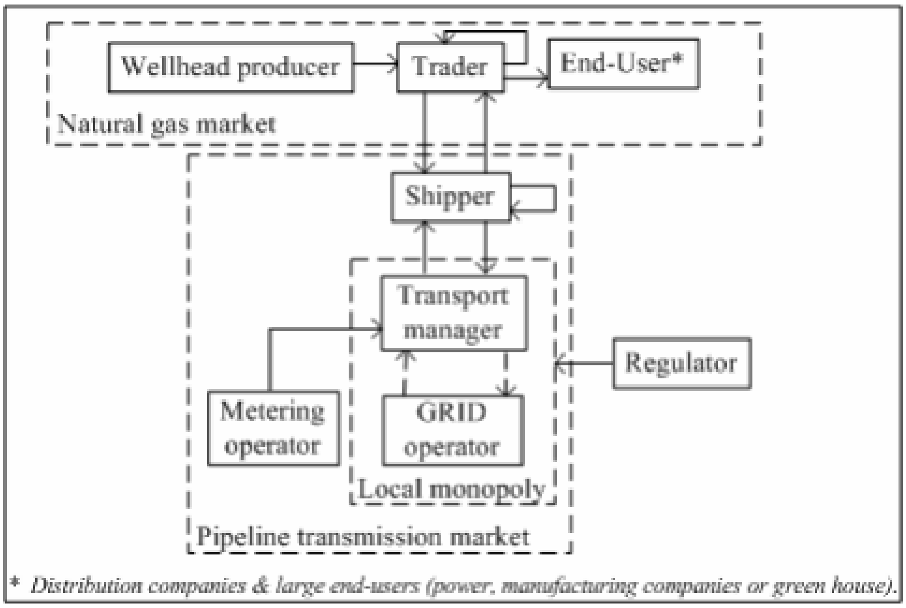

Figure 6 The natural gas value chain (Pelletier et al., 2005).

Similarly, with the tasks of a BRP on the electricity market, shippers on the natural gas market make sure that that there is capacity available on the transportation grid. The shipper has a contract with GTS. This contract consists of different conditions, for example, the available capacity for the shipper and which entry and exits ports this shipper can use. Shippers need a license of GTS (Gasunie Transport Services, n.d.). The TSO, GTS, is responsible for maintaining the network and keeping it safe. Moreover, it is, just like TenneT responsible for the overall balance of the grid and needs to take action if unbalance is detected (Gasunie Transport Services, n.d.). The ACM monitors the tasks of GTS (ACM, n.d.).

Just like the electricity value chain, a local gas distribution company (DSO) is responsible for the distribution of the gas on their local grid to the end-customer. These can be commercial or residential customers. In the Netherlands, DSOs are companies like Cogas, Enexis, and Stedin (Gasunie Transport Services, n.d.). Other activities of a DSO are connecting houses and companies to the grid and the maintenance of the metering system (Enexis, n.d.).

Customers can choose a supplier from which they will buy their gas. This supplier then buys natural gas for this customer from a shipper or a trader. Traders and shippers trade the gas on the TTF market (Gasunie Transport Services, n.d.). Traders and shippers need to be certified by GTS to trade on the TTF. Interestingly to know, the TTF trades more than 14 times the amount of gas used in the Netherlands' (Gasunie Transport Services, n.d.). Next to buying gas, the supplier also makes sure that there is (enough) capacity available on the transportation grid to transport the gas to the end-customer by buying this capacity from a shipper (Gasunie Transport Services, n.d.). Thereafter, the energy is shipped on the grid of the TSO and DSO to the end-customer and the customer can consume the gas. The metering operator is responsible for metering the amount of gas used by the customer. This information can be used to get insights into the flow of the gas and for billing purposes (Pelletier et al., 2005). The metering activities can be done by the energy supplier (often the case by small users) or can be outsourced to another metering operator (Pelletier et al., 2005).

3.2 Regulations in the Dutch energy sector

In this section, background information about the liberalization and the regulations that are in effect in the Dutch energy sector, especially applicable to Dutch energy suppliers, are described.

<u>Liberalization and unbundling</u>

The value chain described in the previous section is the consequence of the restructuring and liberalization of the Dutch energy market. Before the restructuring and liberalization, vertical integrated local monopolies characterized the Dutch energy sector. In other words, an (in the Netherlands geographic-based) energy firm was responsible for all parts of the energy value chain (Shomali and Pinkse, 2016) and customers were not able to choose their energy supplier and the competition was not possible (Van Damme, 2005). However, in the middle of the '90s, the European Union decided to start with a liberalization of the energy markets in all its member states as a part of the 'free movement of capital, goods, services, and people' within the EU (van Damme, 2005). Moreover, the introduction of a liberalized market would provide more efficiency, competition, and would be beneficial for the development of a sustainable energy market (Tanrisever et al., 2015). The European Union introduced three directives for the liberalization of the energy market. In the Netherlands, these directives have been processed into the Electricity Act 1998 and the Gas Act.

The adoption of the Electricity Act of 1998 changed the electricity market radically. Before this Act was introduced, the energy supply and distribution were executed by the energy supplier or utility. However, with the adoption of the Electricity Act 1998, this supply and distribution are separated. This separation is also called 'unbundling' (Tranrisever et al., 2015). After this unbundling, the distribution activities are performed by the network operator (DSO) and the energy supply activities by the energy supplier (Tranrisever et al., 2015). Moreover, energy producers and suppliers were, from that moment on, not allowed to acquire shares in network operators (DSOs) and vice versa (Tranrisever et al., 2015). The liberalization made it possible for customers to choose their energy supplier. This is not the case for network operators (DSOs). A network operator has a monopoly in a region (see Figure A5 and A6 in Appendix C).

The liberalization of the Dutch electricity market started in 2001. Large-scale customers (businesses and organizations) were the first customer group that was able to choose their energy supplier. Later, in July 2001, small-scale customers were able to choose their energy supplier as well. Initially, customers were only able to choose a supplier of green energy. However, from July 1, 2004, customers were free to choose a supplier for all types of energy.

From that moment on, the Dutch energy market was fully liberalized (Verbong and Geels, 2007). The Netherlands was one of the front-runners of this liberalization because the European Union set the final date for the liberalization of the energy market on July 1, 2007 (Verbong and Geels, 2007). Eventually, this liberalization should contribute to the aim of the European Union to establish a single European Energy Market, but at this moment, this is still a goal for the future (Tranrisever et al., 2015).

<u>Regulations</u>
The Dutch energy market is liberalized but still regulated. The Authority for Consumers and Markets (ACM) supervises the energy market in the Netherlands (ACM ConsuWijzer, n.d.). It is an independent party that makes sure that the actors operating in the Dutch energy sector operate fairly and comply with the law (ACM ConsuWijzer, n.d.). Moreover, it protects the interest of customers and companies and ensures a fair competitive environment in the Dutch energy market.

In order to fulfil these responsibilities, the ACM has two main tasks: granting permits to DSOs and energy suppliers and composing and enforcing energy codes (ACM EnergieKamer, n.d.). To make sure that only trustworthy energy suppliers can offer their services on the Dutch energy market, the ACM grants permits for the supply of gas and electricity. Moreover, it establishes the regulations between the users and operators of the grid in the so-called 'energy codes' (ACM EnergieKamer, n.d.).

These energy codes form the regulations between the parties operating in the energy sector, especially DSO's and energy suppliers. They determine (ACM EnergieKamer, n.d.):

- The rates that DSO's are allowed to use for every service that they deliver (rate codes);
- The rules for energy suppliers to get access to the network (technical codes);
- The regulations for sharing energy consumption data between DSOs, energy suppliers, metering companies, and end-users (information codes).

The rate codes and technical codes are different for electricity and gas. The information codes are the same for electricity and gas (ACM, n.d.). The technical codes contain the rules regarding things such as connecting customers to the grid, the measurement of the energy consumption, the transportation of the gas and electricity and the compensation to customers if they are temporarily not able to use electricity or gas (failure of malfunction of the grid) (ACM, n.d.).

Furthermore, actors in the Dutch energy sector have to deal with laws and regulations compiled by the government (ACM, n.d.). In addition to the European directives and regulations, there are three main Dutch laws: the Electricity Act 1998, the Gas Act and the Independent Grid Management Act (ACM, n.d.). As stated before, one key element of the Electricity Act 1988 and the Gas Act, is that these acts allow several suppliers to be active on the market and for customers to choose between these suppliers. Next to this important element, these Acts contain rules about, for instance, the organization of the market (respectively the electricity or gas market), the unbundling of electricity production and grid management (TSO and DSO), the protection of small-scale users and the definitions that apply to these regulations (VEMW, n.d.). The 'Independent Network Act' states that grid operators (the TSO and the DSOs) are not allowed to carry out any (commercial) activities other than managing the electricity and gas grids (VEMW, n.d.). In other words, grid management is separated from the production and supply of electricity to ensure that the grid itself and its management are of good quality (VEMW, n.d.).

The ACM makes sure that all actors operating in the Dutch energy sector comply with these laws and regulations. To limit the power of the ACM, the authorities Netbeheer Nederland (Distribution System Operators the Netherlands) and NEDU (Dutch Energy Data Exchange) can exert influence on the regulations of the ACM by summiting complaints or improvement proposals (ACM EnergieKamer, n.d.).

3.3 Traditional energy supplier business model

Based on the value chain and the regulations described above, the traditional energy supplier business model can be described. This traditional business model is used by the majority of the large energy supply incumbents in the world (Bryant et al., 2018; Richter, 2013). Due to liberalization and unbundling of the market in the 1990s (Richter, 2013) and the introduction of the mandatory 'Nieuw Marktmodel (New Market Model)' (NEDU, n.d.) in 2013, the operations of energy suppliers in the Netherlands are limited to energy trading and retail.

As stated above, in the traditional business model, the energy supplier is a retailer of energy (gas, electricity or heat) (Richter, 2013; Hall and Roelich, 2016; Bryant et al., 2018). As a consequence, turnover is generated by selling energy to the end-customer (Hannon et al., 2013; Blyth et al., 2014). Customers pay for every unit of energy used (Bryant et al., 2018; Hall and Roelich, 2016). The energy is generated by a utility in centralized large-scale power plants, mostly using fossil fuels, resulting in low-cost but reliable and efficient energy supply (Bryant et al., 2018; Hall and Roelich, 2016). The utility uses large-scale energy production projects with a capacity between one and a couple of hundred megawatts (Richter, 2013; Nimmons and Taylor, 2008; Thomas, 2018).

Consequently, the value proposition of this type of business model is providing energy to customers against low-cost via the conventional value chain (Richter, 2013; Bryant et al., 2018). This conventional value chain is described in section 3.1. Moreover, the energy supplier is responsible for the largest part of the communication with the customer. However, this contact is often limited to sending and receiving the energy bill (Richter, 2013). Suppliers try to attract new customers via channels of sales representatives (business-to-business sales) (Specht and Madlener, 2019). 'Communication' with existing customers mainly takes place via the energy bill (Bryant et al., 2018).

An overview of this business model structured using the business model canvas of Osterwalder and Pigneur (2010) can be found in Table 4. However, this traditional energy supplier business model seems to be over its prime. All kinds of trends in the macro-environment of energy suppliers, such as the growing societal and political pressure to decrease (or completely stop) the usage of fossil fuels, urge all actors in the energy sector, to rethink their business model. Therefore, the remainder of this paper is about what business model innovations Dutch energy suppliers could use to respond to their changing environment.

Table 4 Business Model Canvas for the traditional energy supplier business model category (based on Richter, 2013 and Bryant et al., 2018).

Element	**Building blocks**	**Description of the traditional business model**
Value proposition	Value proposition	Low cost, efficient and reliable energy provision, generated in bulk at centralized power plants, distributed via the grid.
Customer interface	Customer relationships	Energy is seen as a commodity, limited attention for long customer relationships.
	Customer Segments	The energy supplier serves all entities that need energy: organizations, industrial firms and governments
	Channels	The energy supplier 'communicates' with the customer using the monthly energy bill, new customers are attracted using sales representatives
Infrastructure management	Key partners	Key partners of the energy supplier in this business model category are the parties mentioned in Figures 5 and 6. Mainly energy producers and grid operators.
	Key activities	The energy supplier is occupied with the retail of energy; trading and selling the energy (gas, heat, and electricity).
	Key resources	A small number of large, centralized assets that are owned by utilities.
Revenue model	Cost structure	Costs for the deployment of the infrastructure as well as staff costs, costs for IT systems, and certificates.
	Revenue Streams	Revenues generated by selling units of energy to customers and other parties such as traders and BRPs. Economies of scale from large energy production projects.

3.4 Developments in the (Dutch) energy sector

In this section, we describe the trends and developments in the (Dutch) energy sector. In the energy sector three main trends, also called 'the 3D's', can be distinguished: Decarbonisation, Decentralisation, and Digitalisation (Di Silvestre et al., 2018; Frei et al., 2018). These three trends are related to the Environmental BMI dimension of the framework of Wirtz and Daiser (2017). For instance, the trend 'decarbonisation' is related to the 'industry/markets shifts' and 'regulatory/economic' macro-elements of the model, but also with the 'changing customer needs' micro-element of this dimension.

The methodology used in this section is similar to the methodology used in the other literature review sections in this paper. In order to gain insights into the trends for energy suppliers, weeks of studying websites, reports and literature on this subject are performed. Consequently, it was found that the trends in the energy sector could be summarized more clearly in the '3Ds' than in the elements of the Environmental BMI Dimension of Wirtz and Daiser (2013).

Therefore, the remainder of this section describes these three trends, their corresponding developments, and their corresponding drivers and barriers for energy supplier business model innovation. First, we elaborate on the decarbonisation trend, subsequently on the decentralisation trend and lastly on the digitation trend. Additionally, Appendix D provides more details about the methodology used in this literature review and provides generalized business models that are designed around these trends.

3.4.1 Decarbonisation

Decarbonisation refers to 'the declining average carbon intensity of primary energy over time thanks to the exploitation of new and clean energy sources' (Di Silvestre et al., 2018, p.484).

As stated above, this trend is related to the 'regulatory/economic' macro-element of the framework of Wirtz and Daiser (2017). Starting in 1990, governments began to address some of the world's most pressing problems in United Nations Conferences on Environment and Development (UNCED) (United Nations, 1992). One of the major topics discussed in these Conferences is climate change, resulting in the United Nations Framework on Climate Change (UNFCCC) and agreements such as the Kyoto Protocol (1997) and the Paris Agreement (2016). Almost every nation in the world is affiliated with the UNFCCC (UNFCCC, n.d.), which commits them to take measures to 'stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system' (UNFCCC, 1992, p. 3). Moreover, the European Union wants to be at the forefront in terms of fulfilling the agreements described in the Paris Agreement and aims to be climate neutrally by 2050 (European Commission, 2018). To reach this goal, the European Commission composed the 'Energy Roadmap 2050', which underlines the necessity to decarbonize the EU energy system by 2050 (European Commision, 2012).

Regarding the decarbonisation trend, I define three developments: renewable energy, energy storage and power plant optimization and flexibility.

Renewable energy

The decarbonisation trend is closely related to renewable energy, as decreasing the usage of energy from carbonized sources, increases the need for energy from other types of sources, such as renewable energy. The International Energy Agency (IEA) (2013) defines renewable energy as 'energy that is derived from natural processes that are replenished constantly' (p.11). Moreover, this agency states that renewable energy is directly or indirectly derived from various forms of solar, wind, biofuels, hydropower, geothermal, and ocean resources (IEA, 2013). Engelken et al. (2016) further specify these renewable energy sources. These authors state that renewable energies are 'comprised of solar photovoltaic, solar thermal, wind, tide, wave, ocean, solid and liquid biofuel, biogas, geothermal, renewable municipal waste and hydroelectricity' (Engelken et al., 2016, p. 796). Climate change and the decreasing availability of fossil fuels such as oil drive the major interest in renewable energy (Jolly et al., 2012). Politicians urge the importance of the shift towards renewables and come up with all kinds of measures to reduce CO_2 and policies that support the diffusion of renewables (Andersen et al., 2009; Davidson and Steinberg, 2013).

Therefore, the need to shift towards renewable energy has become clear for energy producers (utilities). Fei et al. (2018) analysed the annual report of the 25 biggest electric utilities worldwide from 2003 to 2015 and found that all of these utilities expanded the share of renewable energies in their portfolio. In total, the renewable energy production capacity of these 25 utilities tripled. However, some utilities increased their renewable energy capacity only with a small percentage, whereas others engaged more strongly in the production of energy from renewable energy sources. The research by Frei et al. (2018) also showed that these utilities preferred to increase their engagement in the production of energy from geothermal power offshore wind, biomass, concentrated solar power (CSP), onshore wind and solar photovoltaics.

Because this research is not about the production of electricity, but about the retail and supply of energy, there will not be discussed in this paper how energy could be generated from renewable sources in a (technological and financial) viable way. In addition, lots of research on decarbonisation in the energy sector and the impact on the business model of energy producers (utilities) is already done (e.g. Richter (2013); Lüdeke-Freund and Loock (2011); Newcomb et al. (2013); Hämäläinen et al. (2011); Cato et al. (2008); Helström et al. (2015) and Yildiz (2014)). These authors all apply the concept of business models to a specific renewable energy source or renewable energy in general. Nevertheless, since decarbonisation is one of the major trends in the energy sector, affecting this sector dramatically and impacting the other trends as well, describing the trend decarbonisation was found of importance for this research.

Drivers and barriers of this development

For energy suppliers, selling renewable energy is similar to selling energy in the traditional business model. However, as is described by multiple researchers, selling renewable energy is interesting for energy suppliers to a new customer group, namely those that want to be environmentally friendly (Richter, 2013; Bryant et al., 2018). Moreover, Richter (2012) describes that energy based on renewable energy sources can be used to improve the corporate image and to increase the customer's level of trust. Overall, there can be stated that selling renewable energy is almost similar to selling fossil energy. It can offer additional value to enhance the customer relationship because the energy is produced in an environmentally friendly way. As a consequence, Bryant et al. (2018) argue that energy suppliers could add a slight premium in the price paid for the green energy by customers, but it remains to be seen which part of the (potential) business-to-business customer base is willing to pay for this (Richter, 2012).

Energy storage

A second development that can be ascribed to the trend 'decarbonisation' is energy storage. As described earlier, the goal of the European Commission is to fully decarbonize Europe by 2050 (European Commision, 2012). On the other hand, researchers such as Steinke et al., (2013) argue that it is not likely that renewable energy sources can provide sufficient energy to serve the (growing) demand for energy. Moreover, the amount of energy produced from renewable energy sources highly fluctuates due to changing weather conditions (Helms, 2016). Therefore, additional (back-up) energy sources, such as energy storage, can be a solution to deal with the variability of renewable energy sources, to make sure that the energy demand can still be met and the energy grid can be stabilized (Ibrahim et al., 2008).

Drivers

Energy storage could be a solution for the aforementioned challenges because it uncouples the generation and supply of energy (Connolly et al., 2012). As a consequence, the flexibility of the electricity grid is increased and is more resistant to fluctuations in supply or demand (Connolly et al., 2012). Energy storage systems (ESS) are used to store excess energy. According to Rastler (2010), the main function of energy storage systems is 'moving energy over time'. Based on this function, Rastler (2010) underlines the potential of these systems for energy suppliers, because this indicates that energy suppliers, can buy energy against off-peak prices while selling them in peak-periods against peak-prices.

Barriers

However, authors such as Kooshknow et al. (2018) and Aneke (2016) argue that ESSs are still only implemented in small size due to all kinds of institutional, economic and technical challenges. These barriers, as well as, the lack of supportiveness of the regulatory framework of ESS, make that business model for ESS are often not (yet) (financial) viable, but based on financial support of the government (Kooshknow et al., 2018; Gallo et al., 2016; Engelken et al., 2016). Nevertheless, as the technology develops and the reliability and stability of the grid needs to be guaranteed when the amount of energy originating from renewable energy sources increases, several authors expect market growth and the development of new firms in this market (Steinke et al., 2013; Ibrahim et al., 2008; Velu, 2015).

Others argue that combining the different applications of ESS is necessary for financial viability (Kooshknow et al., 2020; Newcomb et al., 2013). These applications are mainly part of the trend 'decentralisation', but in order to group the developments regarding energy storage, these applications are in this section. On their own, these business models are often not financially viable, due to the high purchase value of ESSs in comparison to the often low costs of additional units of fossil energy (Kooshknow et al., 2020). Kooshknow et al. (2020) define four main applications of energy storage systems (Kooshknow et al., 2020). A first possible application of energy storage systems (ESS) is the possibility for prosumers (see below) to store excess energy instead of feeding this back into the grid. Second, ESS can be used by BRPs in order to balance the market on demand for TenneT (the system operator). Moreover, it can be used to 'shave' peaks. In this case, a behind-the-meter ESS is used as a buffer that reduces the demand at the connection points during peaks. The last application of ESS is in combination with mobility. The ESS in electric cars could serve as short-term storage to stabilize the grid (Kooshknow et al., 2020). This is also called ‘vehicle-to-grid’ (Engelken et al., 2016).

<u>Power plant optimization and flexibility</u>
Power plant optimization is the third development related to the decarbonisation trend. This development is about the (temporal) optimization of the currently available power plants based on fossil resources, such as coal and gas (Helms, 2016). There are three main reasons for the development of power plant optimization and increased flexibility activities in the energy sector (Helms, 2016).

First, as stated above, the amount of energy from renewable sources highly fluctuates (Schleicher-Tappeser, 2012). Actors in the energy sector, including energy suppliers, must deal with these fluctuations because the demand and supply of energy must be synchronized at all moments. Power plant optimization helps to decrease these fluctuations, to avoid tremendous power outages (Hoppmann et al., 2014). Second, because energy storage options on their own are only to a limited extend economically viable (IEA, 2014; see also above) and additional extensions of the grid (installing additional centralized power plants) is rather costly as well, there is also an economic driver for optimizing power plants and better synchronizing the energy supply and demand.

Lastly, fluctuations in the demand create price variations. These price variations can partly be predicted, for example, price variations based on the season or the time of the day (peak and off-peak) (Clark et al., 2001). Other the other hand, there are also unpredictable factors, such as deviations from forecasts and unexpected climatic conditions, that influence the variations in the energy prices (Clark et al., 2001). Because these factors are unpredictable, increased flexibility of the power plant and its production programs is useful to timely react to changes in energy prices (Helms, 2016).

Drivers
These three reasons indicate the need for firms to optimize their power plants and conduct activities to increase the flexibility of the energy grid. Dealing with this need might be challenging for actors in the energy sector, especially for those that own production assets (mainly utilities), but drivers might also arise from this need. For example, as stated before, the different applications of energy storage systems might be a driver for the highly fluctuating amount of energy that is produced from renewable energy (Kooshknow, 2020). Moreover, for short-term back-up energy capacity, the vehicle-to-grid concept can be interesting (Engelken et al., 2016).

Providing these sources, more potential business opportunities are found that (could) deal with the need for power plant optimization and increased flexibility of the electricity grid. Authors such as Engelken et al. (2016) and Frei et al. (2018) describe developments as demand side management, virtual power plants and smart grids as promising opportunities for energy suppliers to deal with the flexibility of the grid. However, because these developments are strongly linked to the ‘decentralisation’ and ‘digitalisation’ trends in the energy sector, these developments are described in their corresponding sub-sections in this chapter.

In short, demand side management is mainly focused on stabilizing the grid by changing the demand side of the grid, for example by declining the amount of energy that a customer uses or by shifting the point of time in which the customer consumes the energy to a time in which the energy supply is larger (Frei et al., 2018). On the contrary, energy storage systems store excess energy for usage for consumption at a later point of time, indicating a shift in the supply side of the value chain (Newcomb et al., 2013). Virtual power plants are concerned with decentralised energy assets (see below). By grouping electricity generated on these decentralised energy plants, virtual power plants allow owners of these energy plants to participate in the energy market, which leads to additional flexibility of the grid (Helms, 2016). Lastly, smart grids 'use two-way flows of electricity and information to create an automated and distributed advanced energy delivery network' (Fang et al., 2011, p. 1). Smart grids involve all (digital) activities that can be used to consume electricity in a more efficient way, which can include for example virtual power plants, demand side management and energy storage systems (Rodriguez-Molina et al., 2014).

Barriers
Leisen et al. (2019) describe some challenges for this development. These authors expect that there will be a decrease in the revenues from reserve power because this power will be used less because the balance between the supply and demand is more precise. Second, these authors refer to the higher operational costs due to the need for more experienced and higher educated staff, as well as higher investment costs in communication technology (Leisen et al., 2019). Moreover, Helms (2016) suggest that the advantages of power plant optimization needs to be 'coupled or grounded in a complementary valuable that can be controlled by the new business model' (p. 357) in order to offer a sustainable business model. In other words, the author argues that the optimization of the power plant as a service to provide flexibility needs to be complement with an asset to leverage more value.

3.4.2 Decentralisation

Decentralisation is about 'the need of reducing the complexity of managing infrastructures without overloading the decisional centres in all areas (political, social, economic and technical fields' (Di Silvestre et al., 2018, p. 486). Regarding the energy sector, decentralisation is closely related to distributed generation and prosumership and energy cooperatives.

The decentralisation trend is related to most of the macro- and micro-elements of the 'Environmental BMI Dimension' of Wirtz and Daiser (2017). First, it relates to the 'Technology' and the 'Industry/Market Shift' macro-elements, because technological developments enabled the shift towards distributed generation. In other words, more and more companies in the energy industry shift their production from centralized assets to multiple decentralised assets (Frei et al., 2018). Second, decentralisation is related to the micro-elements 'Changing Customer Needs' and 'Product/Service Innovation', as changing customer needs (e.g. prosumership) urged all actors in the energy sector to think about how this trend could be integrated into the value chain, resulting in product/service innovation.

<u>Distributed generation and prosumership</u>
Distributed generation is about generating electricity close to the point of consumption in small-scale generation units (Pepermans et al., 2015). Most often, distributed energy projects are based on renewable energy sources, in which the main role is played by solar photovoltaics (PV) and wind power (EEG, 2007). The energy sources used in distributed energy projects are

also referred to as ‘distributed energy resources’ (DERs). In other words, distributed generation deals with a large number of small-scale assets close to the point of consumption, whereas conventional centralized generation is about a small number of large-scale assets (Richter, 2013).

Drivers
Distributed generation allows consumers to become ‘prosumers’: consumers who both produce and consume renewable energy (Inderberg et al., 2018). The declining price of PV systems, which are often used by prosumers, and the (financial) governmental support for both households and firms to become prosumers as well as the growing environmental consciousness of customers, make that an increasingly growing group of customers become prosumers (Flaute et al., 2017). Authors as Zhou et al., (2010) and Geels et al. (2017) argue that the self-generation of energy accelerates the sustainable energy transition.

Barriers
On the other hand, Strupeit and Palm (2016) argue that there are barriers for self-generation (prosumership) on a large-scale. They argue that consumers, except early adopters, face ‘*consumer inertia, high up-front costs, long payback periods, efforts associated with the planning and installation steps, various informational gaps and customer concerns about reliability*’ towards the adoption of DERs (Strupeit and Palm, 2016, p.124). In addition, Behr and Grossklos (2017) argue that consumers face more and more difficulties with the development of a DER asset portfolio because of the increasing product ranges and possibilities for combining these options. Moreover, these authors argue that the legislation, regulations and financial frameworks of governments regarding (investments in) DERs are often complex (Behr and Grossklos, 2017).

Drivers
Nevertheless, these barriers can create also be a driver for business model innovation. For instance, Strupeit and Palm (2016) argue that actors in the energy sector could design business models around reducing the up-front costs of DERs for prosumers (i.e. contracting) or based on reducing the complexity in the choices for choosing between (combinations of) the various technologies available (service-based). Chapter 6 elaborates more on these developments.

<u>Energy cooperatives</u>
Another development regarding the trend ‘decentralisation’ is the development of energy cooperatives and communities. As stated before, the development of DERs made it possible for customers to generate energy by themselves, and with that, becoming prosumers. In addition, the liberalization and unbundling of the energy market, allowed the emergence of new organisational models and legal forms to develop (Yildiz, 2014). One of these new legal forms is an energy cooperative. Bauwens et al. (2016) state that cooperative energy projects are ‘formal or informal citizen-led initiatives which propose collaborative solutions on a local basis to facilitate the development of sustainable energy technologies’ (p. 136). In other words, rather than the investor-oriented organisations, the energy cooperative follows other goals than (pure) profit maximization. It strives (also) for social and environmental goals (Yildiz, 2014). This is underlined by the fact that some cooperatives use the net earnings for the development of the local community (Bryant et al., 2018). Another characteristic of energy cooperatives is

that decision making in these cooperatives is often not proportioned to equity but mainly based on the one-member-one-vote principle (Holstenkamp et al., 2016).

There are different types of energy cooperatives which all have their own goals. Most communities have the aim to educate the local community on renewable energy use, help in technology or renewable energy procurement or provide renewable energy that can be used by other local actors (Boon and Dieperinck, 2014). Regarding financial aspects, most cooperatives are run and administered by individuals and no other entities than residents are allowed to become a member of this cooperative (Hamwi and Lizarralde, 2017). On the other hand, most cooperatives are administered by a third party, and energy suppliers or utilities could also take part in or establish an energy cooperative or community (Hamwi and Lizarralde, 2017).

Drivers
As a consequence, (the management of) energy cooperatives could be interesting for energy suppliers and utilities. For example, Hamwi and Lizarralde (2017) found that some utilities establish communities to retain their (environmentally conscious) customers. In these communities, the households of SMEs offer their rooftop for a DER (e.g. PV system) in exchange for a share of the revenue (Engelken et al., 2016). Another option is the joint-venture community business model, in which SMEs can share their investment costs and their corresponding risks with each other (Engelken et al., 2016). Lastly, Hamwi and Lizarralde (2017) distinguish the 'Utility-sponsored solar communities' in which consumers that want to engage in renewable energy projects but are a tenant or have a roof that is not suitable for DERs can participate. In this type of communities, the members lease a part of a decentralised renewable energy plant of the utility. In this way, the utility can maintain its customers, increase their renewable energy rate and profit from investment returns (Hamwi and Lizarralde, 2017).

Barriers
On the other hand, the development of energy communities is concerned with some barriers. Brummer (2018) identified a couple of barriers that energy communities face. First, because the needs of multiple stakeholders have to be taken into account, organizational barriers and barriers regarding balancing the interests and responsibilities of stakeholders. In addition, as is the case for the most renewable energy developments, there is a lack of institutional and political support for energy communities. Although this organisational type is allowed by the government, there are only a few policies that support the development of this type of organisations, that are complex, confusing and often subject to change. Moreover, energy communities have to deal with scepticism of individuals (a 'wait-and-see' mentality) and expected saturation levels in the future (Brummer, 2018).

3.4.3 Digitalisation

Digitalisation is 'the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business' (Gartner, n.d.). Regarding the energy sector, digitalisation is related to smart grids and demand response management, and aggregators.

The digitalisation trend is also connected to most of the macro-elements and micro-elements of the Environmental BMI Dimension of the framework of Wirtz and Daiser (2017). The developments of, for example, smart meters and the need for an integration of a communication network in the energy system (Daoud and Fernando, 2011) are technological drivers for the shift towards digitalisation in the energy sector. Therefore, this trend relates to the macro-element ‘technology’. In addition, the trend is related to the ‘industry/market shifts’ macro-element. For example, the fluctuations in the amount of generated energy from renewable sources require ICT systems that allow utilities and energy suppliers to make efficient use of the available resources (Römer et al., 2012).

Moreover, as an increasing group of customers want more insight in their energy consumption to lower their energy costs or for environment-friendly purposes (Curtius et al., 2012), the digitization trend is also related to the ‘changing customer needs’ micro-element of the framework of Wirtz and Daiser (2017). Secondly, as many other companies – mainly start-ups – took the lead in developing products and services that can fulfil these new customer desires, the energy market becomes more competitive. For example, in Germany, companies like ‘Buzzn’ and ‘Beegy’ started to sell (access to) IT-platforms that allow prosumers to make more use of the flexibility of their decentralised assets, for instance by selling or sharing excess energy with other prosumers (Specht and Madlener, 2018).

The remainder of this section elaborates on the main digitalisation developments in the energy sector: smart grids, demand response management and aggregators. Chapter 5 validates these developments and their expected impact for energy suppliers using semi-structured interviews with experts in the Dutch energy sector. First, Chapter 4 elaborates on the methodology used for these interviews.

<u>Smart grids</u>
As stated before, the trends decarbonisation and decentralisation have a fundamental impact on the (Dutch) energy sector. In order to deal with this impact and to make sure that the energy grid and its surrounding network maintain to function, smart grids can be implemented. Smart grids are ‘grids that integrate information and communication technologies (ICT) into the existing network to allow for a two-way flow of information and electricity between producers and consumers’ (Gerpott and Paukert, 2013, p.483). Different technologies, such as smart meters and advanced metering infrastructures (ACI) have been developed as a part of these smart grids (Fang et al., 2011).

Drivers
In other words, smart grids are communication networks between the consumer and a service provider (Markovic et al., 2013). They enable a shift from the current centralized energy network, towards a more bottom-up decentralized and digitalized grid (Giordano and Fulli, 2010). Moreover, smart grids enable more efficient management and control of the grid, by using all kinds of technological applications. In this way, actors in the energy market could take advantage of energy savings, due to more fast insights about the amount of energy consumed and its corresponding costs (for consumers) as well as declining costs for maintenance of centralized assets and other operational factors (for energy suppliers and utilities) (Gerpott and Paukert, 2013).

In addition, Tuballa and Abundo (2016) describe that smart grids ‘allow renewable energy resources to be safely plugged into the grid’ (p. 711). As a consequence, smart grids make possible that distributed energy resources (DERs), that are mainly based on renewable energy sources, as well as energy storage options, could supplement the current power supply (Tuballa and Abundo, 2016).

Thus, smart grids have great potential for the energy market. Additionally, BRPs and energy suppliers could use them to optimize the supply/demand balance and the timing of energy purchases (Shomali and Pinkse, 2016). Moreover, it could be used to achieve sustainability goals for firms, as it enables energy savings and the integration of distributed energy (Geelen et al, 2013). Lastly, smart grids allow customers to control their energy consumption as well as to become prosumer and to profit from additional value streams (Camarinha-Matos, 2016).

Dileep (2020) underlines the potential of smart grids for utilities. Currently, as described in section 3.1, the energy sector operates with a clear separation between the generation, transmission and distribution and retail parts of the value chain. These parts could be seen as subsystems that developed on their own. Hence, different levels of, for instance, automation and usage of ICT-systems are created (Dileep, 2020). Because energy producers (utilities) do not have access to real-time information about the usage of energy by the consumers, they are over-engineered in order to make sure that peak demands can be supplied, and power outages are prevented. However, because peak demands (in the size that is nowadays accounted for by utilities) do not occur frequently (Dileep, 2020), this method of peak demand based energy production is inefficient. Smart grids could be used to make this more energy production system more efficient.

Challenges / barriers
However, as smart grids provide promising advantages, some authors also indicate some challenges. For example, Cometta et al. (2010) state that the payback time of smart grids is uncertain, while it is concerned with high investments. Secondly, despite the technical and social advantages of smart grids, researchers such as Kabalci (2016) indicate threats concerning data security and privacy issues. These, as well as more technical issues, such as the different options for creating the smart grid and connecting DERs to this grid, are currently getting a lot of attention by researchers (e.g. Lagendijk et al., 2013; Curtius et al., 2012). Moreover, the potential of integrating blockchain in smart grids is studied often as well, but the technique is yet not used at large scale (e.g. Mengelkamp et al., 2018; Andoni et al., 2019).

Demand side management
For energy suppliers, the main advantage of smart grids is that it enables them to bundle value-added tailored services to the energy commodity (Valocchi et al., 2014). For instance, energy suppliers can offer demand side management programs. Demand side management programs involve actions from energy suppliers that manage the consumption of energy by the customer (Bahrami et al., 2012). It is, like energy storage and smart grids, used to increase the flexibility of the energy system (Lund et al., 2015). Three main categories of means can be used for demand side management. That are means that (1) reduce the energy demand (peak shaving), (2) increase the energy demand (valley filling / load growth) or (3) reschedule the energy demand (load shifting or demand response management) (Kirschen, 2003). Lund et al. (2015) argue that shifting the demand from peak to off-peak periods (load shifting) is the most beneficial because it offers flexibility without reducing the quality and continuity of the process.

Drivers
In other words, the main advantage of demand side management is that it can be used to shape the generation, transmission and distribution of the grid more efficiently, as it enables TSOs, DSOs and BRPs to get insights in the demand profile of customers and reduce, increase or reschedule the energy demand (Bahrami et al., 2012). In other words, demand side management can be used to mitigate the challenges caused by fluctuating generation by reducing the need for backup power (Kies et al., 2016). Moreover, it reduces emissions by levelling the consumption profile and shifting the consumption away from peak hours (Holland and Mansur, 2008). In addition, authors such as Mathieu et al. (2013) argue that demand side management (DSM) replaces or suspends infrastructure expansion, shifts the market power from producers to customers and facilitates energy efficiency measures.

Barriers
However, other authors describe the barriers to demand side management. Kim et al. (2011) provide an overview of these barriers. These authors argue that there is a lack of financing of the technology and ICT infrastructure, insufficient communication between key stakeholders and lack of key stakeholder involvement, the lack of spread and availability of the necessary technology in some countries, the poor response from and minor savings for certain customer groups, discussions about the rate structure design and the lack of or changes in the policies and processes regarding DSM (Kim et al., 2011). In addition, other authors describe, similarly to smart grids, the risks regarding privacy and security of demand side management (Lisovich et al., 2010). Because of these risks, there are strict regulations regarding the collection and storage of data from companies and even stricter regulations for private consumers (Lisovich et al., 2010).

For energy suppliers which customer base in the industrial sector, it is worth describing that demand side management (DSM) faces major challenges in this sector. Because these customers often have long-term fixed contracts with suppliers or financially hedged their electricity price risks, these customers will argue that participation in demand side management is not interesting for them (Brockl, 2011). More technically, realising demand side management for industrial firms is challenging because industrial processes need to run continuously (Brockl, 2011).

<u>Aggregators, flexibility and virtual power plants</u>
As stated before, the energy system needs to be in balance at each point in time. The increasing use of variable power plants on the supply side, such as wind and solar power, and the increased demand for energy at the demand side, make that the energy system needs to deal with increased uncertainty and variability (Huber et al., 2014). Therefore, the need for flexibility of the grid increases as well. To unlock new options to increase the flexibility of the grid, mechanisms that foster the growth of the flexibility of the grid need to be developed. In this way, the energy system is able to cope with the increasing amount of renewable energy sources. The aggregator concept is seen as one of these mechanisms (e.g Verhaegen and Dierckxsens, 2016).

The aggregator concept indicates both the activity of aggregation and the entity ‘aggregator’ as a new type of intermediary. Altmann et al. (2010) argue that aggregation is a function executed by a legal entity that aggregates the flexibility of prosumers and offers this to other actors in the energy system as a commercial and technical service. An aggregator is one of the possible legal entity that could adopt this function, as an independent actor within the grid.

Drivers

Together, prosumers (households, firms or other owners of decentralised assets), could offer small-scale flexibility to the market. On their own, most prosumers do not have the means to do this. An aggregator assists prosumers with this process and allows prosumers to participate in the electricity market. The aggregator does this by adding the small-scale flexibility of prosumers together and offers this to the market (Eid et al., 2015). In other words, the aggregator is an intermediary between purchasers and suppliers of flexibility. The purchasers of flexibility are the BRPs, TSO and DSOs (USEF Foundation, 2015). The function of aggregator can be performed by an existing actor in the market that already fulfils other roles in the market (such as producers, BRP or supplier) or by a new market player which does not yet perform a role in the market (ACM, 2019). Verhaegen and Dierckxsens (2016) provide an overview of all possible variations of market players fulfilling the aggregator function (e.g. aggregator-supplier; aggregator-BRP etcetera).

Aggregators receive revenue for offering the flexibility of the prosumers as a demand response service to balancing authorities (BRPs, TSO, DSOs) and they pay prosumers for offering this flexibility (Niesten and Alkemade, 2016). The aggregator can coordinate the flexibility in demand response programs, in which the prosumers participate by adjusting their electricity consumption to offer (additional) flexibility (Niesten and Alkemade, 2016). Aggregators use Virtual Power Plants (VPP) to link the prosumers to the balancing authorities. Virtual Power Plants are 'systems that rely on software and other technology to remotely and automatically dispatch and optimize distributed energy resources' (Verhaegen and Dierckxsens, 2016, p. 32).

Barriers

Lampropoulos et al. (2018) examined the barriers for aggregators in the Dutch energy system and describe which actions could be taken to overcome these barriers. The authors describe all kinds of barriers such as market barriers (based on the design, lack of transparency and entry thresholds), regulatory barriers (lack of standards, market imperfections and distortions), technical barriers (metering and data exchange barriers as well as data access barriers) and social barriers (lack of customer acceptance) (Lampropoulos et al., 2018). Consequently, Lampropoulos et al. (2018) describe an action plan with priorities to overcome these barriers. This action plan contains actions such as establishing standards for metering, allocation, billing and data exchange. Moreover, the authors advice the Dutch regulator to make smart meter data easily accessible for market parties, 'so that these could establish commercial deals with each other, ensuring that energy positions can be established beyond doubt and imbalance volumes can be attributed to the correct market parties' (Lampropouls et al., 2018, p. 545).

3.4.4 Summary of findings

To end this chapter, a summary of the most important findings of section 3.4 is presented. More specifically, Table 5 shows an overview of the identified developments in this section and their descriptions, whereas Table 6 summarizes the (dis-)advantages of these developments.

Table 5 Overview of the identified developments and their definitions (based on literature review above)

Trend / Development	Definition	Source
Decarbonisation		
Renewable energy (only focussing on selling, not on production)	Energy that is derived from natural processes that are replenished constantly.	International Energy Agency (IEA) (2013)
Energy storage	Energy storage systems are used to 'move energy over time'.	Rastler (2010)
Power plant optimization and flexibility	The (temporal) optimization of the currently available power plants based on fossil resources, such as coal and gas. Flexibility is the capability of a power system to cope with the variability in load and production.	Helms (2016) (IRENA, 2018)
Decentralisation		
Distributed generation and prosumership	Distributed generation is the generation of electricity close to the point of consumption in small-scale generation units. Prosumers are consumers who both produce and consume renewable energy.	Pepermans et al. (2015) Inderberg et al. (2018)
Energy communities	Formal or informal citizen-led initiatives which propose collaborative solutions on a local basis to facilitate the development of sustainable energy technologies.	Bauwens et al. (2016)
Digitalisation		
Smart grids	Grids that integrate information and communication technologies (ICT) into the existing network to allow for a two-way flow of information and electricity between producers and consumers	Gerpott and Paukert (2013)
Demand side management	Demand side management programs involve actions from energy suppliers that manage the consumption of energy by the customer	Bahrami et al. (2012)
Aggregators, flexibility and virtual power plants	Aggregation is 'a function executed by a legal entity that aggregates the flexibility of prosumers and offers this to other actors in the energy system as a commercial and technical service' Virtual Power Plants are 'systems that rely on software and other technology to remotely and automatically dispatch and optimize distributed energy resources'	Altmann et al. (2010) Verhaegen and Dierckxsens (2016)

Table 6 Overview of the identified developments and (dis-)advantages (based on literature review above)

	Impact on energy suppliers' business model innovation	
	Drivers	**Barriers**
Decarbonisation		
Renewable energy (only focussing on selling, not on production)	Serving new customer groups Improving corporate image and increasing the customer's level of trust	Uncertain which part of the (potential) business-to-business customer base is willing to pay a premium for renewable energy
Energy storage	Increases the flexibility of the grid Enables to move energy over time	Institutional, economic and technical challenges Lack of supportiveness of the regulatory framework The different applications of ESS need to be combined for financial viability
Power plant optimization and flexibility	Decrease of the fluctuations in the amount of energy from renewable sources Economic drivers, as it is less costly in comparison to other options Option to timely react to unpredictable factors Minimizing slack resources in the system (such as costly backup storage systems)	Decreasing in revenues from reserve power Higher operational costs due to more experienced and higher educated staff High investment costs in communication technology
Decentralisation		
Distributed generation and prosumership	Financial support by the government Increasing environmental consciousness of the customers More efficient and dynamic energy consumption	Complex legislation, regulations and financial frameworks of governments
Energy cooperatives	Retain customers Increasing renewable energy rate Profit from investment returns	Organizational barriers Barriers regarding balancing the responsibilities and interests of the stakeholders Institutional and political support Sceptism of individuals Expected saturation levels
Digitalisation		
Smart grids	Energy savings due to more insights about the energy consumption	The payback time of smart grids is uncertain, while it is concerned with high investments

	Declining costs for maintenance of centralized assets and other operational costs Allow for safe plug-in of DERs and energy storage options into the grid Optimizing of the supply/demand balance and the time of energy purchases More efficient energy production	Barriers concerning data security and privacy Multiple options for the design of the smart grid and the connection of DERs to this grid
Demand side management	Increases the flexibility of the grid Replaces or suspends infrastructure expansion Facilitates energy efficiency measures	Lack of financial resources Insufficient communication between key stakeholders Lack of stakeholder involvement Lack of spread and availability of technology needed in some countries Poor response from and minor savings of certain customer groups Discussions about the rate structure design Lack of or changes in the policies and processes regarding DSM Privacy and data security risks Challenges in realising DSM for industrial firms, due to long term fixed contracts and processes that need to run constantly
Aggregators, flexibility and virtual power plants	Increases the flexibility in the energy market and stabiles the grid Earning additional income Enhancing the efficiency of the energy system	Market barriers based on the design, lack of transparency and entry thresholds Regulatory barriers based on a lack of standards, market imperfections and distortions Technical barriers: metering and data exchange barriers as well as data access barriers Social barriers: lack of customer acceptance

4 Methodology

In this section, the methods and techniques that are used to answer the main research question and sub-questions are described.

4.1 Research design

The main aim of this study is to investigate what business model innovations Dutch energy suppliers could use to respond to their changing environment. To reach this goal, data was collected from four sources: (1) multiple literature reviews (2) a review of non-academic sources (reports of the Dutch government and industry reports), (3) interviews with academic experts in the Dutch energy market and (4) interview with experts working in the Dutch energy sector. These data collection methods are discussed in more detail in section 4.2.

This research design is in line with the findings of Robson (2002). This author states that most research questions cannot be answered only using a theoretical approach, because the literature is bound to another context, is too specific or too broad. Therefore, (Robson (2002) suggest extending the literature with findings from empirical research, that is results from quantitative or qualitative research designs.

In this research, a qualitative research design is used. This research design is chosen because it fits in the objective of getting a (deeper) understanding of the drivers and barriers regarding business model innovation for Dutch energy suppliers. More specific, a qualitative research design allows for a more detailed and in-depth understanding of the phenomenon, while it simultaneously offers the possibility for flexibility and openness for new ideas (Creswell et al., 2007). This flexibility and openness are useful for this study, as the input of the interviewees can lead to additional questions. Moreover, this design allowed to gain insights into the perception and real-life experiences of the interviewees (Creswell et al., 2007). This makes that the interviewees can make clear whether the findings of the literature review are indeed the matters where energy suppliers need to deal with.

Moreover, this study is a case study. According to Yin (2015), a case study is 'an empirical inquiry that closely examines contemporary phenomenon (the case) within its real-world context' (p.194). Case studies allow retaining the meaningful and holistic characteristics of real-life events (e.g. organizational processes) (Yin, 2017). Because this study focusses on the developments in the environment of the energy supplier, it is important to know what energy suppliers themselves consider as developments in their environment. A case study design allowed us to do this, as it 'tries to illuminate a decision or a set of decisions' (Schramm, 1971, p.6).

4.2 Case description

This research is a case study performed at Company X. Company X is an energy supplier and supplies energy to customers with a large-scale consumer connection (see section 1.4), mostly large businesses and public institutions. Moreover, the company is active on multiple energy trade markets and acts also as a balance responsible party (BRP), meaning that it is responsible for purchasing and selling energy and predicting the amount of energy used by its customers. The company is located in the Netherlands but is part of a global energy distributor and provider.

As mentioned before, the energy industry is a dynamic and highly competitive market, that is highly influenced by external market conditions, such as the energy transition and its corresponding goals and governmental policies. The case company is aware of these environmental circumstances and therefore realised that it needs to deal with these circumstances. This research can serve as a part in the journey to a new corporate strategy that enables the company to deal with the challenges in their environment. Because this paper uses the business model innovation framework, it can deal with questions around value creation and value capture. These questions are often the core of strategic challenges for companies in the energy sector (Richter, 2012).

4.3 Data collection and analysis

This section elaborates on the methods that are used to collect the data analysed in this research. The data were collected in four ways: (1) multiple literature reviews (2) a content analysis of non-academic sources (3) interviews with academic experts in the Dutch energy market and (4) interview with experts working in the Dutch energy sector. Table 7 shows an overview of the data collection methods used per (sub-)question.

Literature reviews

To gain insights into the current scientific literature on the topics of this thesis, multiple literature reviews were carried out. Bryman & Bell (2015) and Yin (2017) state that literature reviews ensure that topics related to the subject of the research are recognized. In this research, the literature review is conducted using literature from multiple sources, because of the multidisciplinary nature of this research. Therefore, this research combines literature from the fields of business model innovation, with the literature on corporate strategy, servitization, energy and the IT sector (literature about smart grids and virtual power plants). The main platforms that are used to search for literature to incorporate in these literature reviews were Scopus and Google Scholar. Before every literature review is conducted, an overview of the strategy used to select the articles that are included in these literature reviews is given.

In short, most of the literature used in the literature reviews are found using the snowball-technique (Verhoeven, 2014). Based on the search terms used, literature that is often cited or written by well-known authors in the related field is selected. Afterwards, these articles are compared, and a summary of the findings is written in this paper. The findings of these literature reviews served as input for the semi-structured interviews with the academic experts and the experts working in the energy sector. Lastly, the findings of the literature reviews are used to come to a well-founded answer to the sub-questions and, eventually, the main research question.

Table 7 Overview of data collection methods used

(Sub-)question	Data collection method	Data source	Purpose
a. What is BMI?	Literature review	Academic papers from Scopus and Google Scholar	To gain an understanding of the topic BMI
b. Barriers to BMI (for Dutch energy suppliers)	Literature review	Academic papers from Scopus and Google Scholar	To gain an understanding of the reasons why BMI is not performed
c. Structure of the Dutch energy value chain	Content analysis	Reports from Dutch authorities and various industry organizations	To gain an understanding of how the Dutch energy sector works
d. Identifying developments in the environment	Content analysis	Annual reports and websites of energy suppliers	To gain general insights into untraditional business models in the energy sector
	Literature review	Academic papers from Scopus and Google Scholar	To formulate the developments in the environment according to the literature
	Semi-structured interviews	3 academic experts	To validate the developments identified in the literature review and the understanding of the researcher on these developments
	Semi-structured interviews	5 experts working in the Dutch energy sector	To make sure that the developments identified in the literature are recognized in practice and to extend these developments
e. Identifying the drivers and barriers of the developments for energy supplier business model innovation	Literature review	Academic papers from Scopus and Google Scholar	To identify the drivers and barriers of the developments for energy supplier business model innovation according to the literature
	Semi-structured interviews	3 academic experts	To validate these drivers and barriers and the understanding thereof by the researcher as well as to supplement these drivers and barriers
	Semi-structured interviews	5 experts working in the Dutch energy sector	To make sure if these developments and their drivers and barriers are recognized in practice and to supplement them with practical know-how
Main RQ: BMI to respond to the developments	Literature review	Academic papers from Scopus and Google Scholar	To formulate what business model innovations Dutch energy suppliers could use BMI to respond to the developments in their environment.
	Semi-structured interviews	5 experts working in the Dutch energy sector	To validate the findings of the literature review as well as to gain new insights on how energy suppliers should respond to their changing environment.

Content analysis / desk research

To gain insights about how the Dutch energy sector works and which actors are operating on the Dutch energy market, a content analysis was performed. This content analysis is based on internal documents of the case company, the websites and reports of Dutch authorities, such as the Authority Consumers and Markets (ACM), and different industry organizations such as Dutch Energy Data Exchange Association (NEDU) and the Association for Energy, Environment, and Water (VEMW). This content analysis aimed to become familiar with the Dutch energy sector, to get insights into how this sector works and to obtain insights that could be used when formulating the traditional energy supplier business model. Again, the used webpages and reports are obtained using the snowball technique (Verhoeven, 2014). Based on a figure describing the Dutch energy value chain by Kieft et al. (2013) (see Figure 5), document and webpages containing information about the actors in this value chain were looked for.

Semi-structured interviews with academic experts

After the literature was reviewed, it became clear which developments Dutch energy suppliers face. In order to make sure if (1) all (important) developments were tackled, (2) no other meaningful developments were missing, (3) and the understanding of the researcher on these developments was correct, semi-structured interviews with three academic experts were held.

Respondents

The respondents are all academic experts in the energy field. The respondents are chosen for their knowledge of innovation in the energy sector. For every of the three identified trends, an academic expert was approached for an interview. All three academic experts agreed to participate in these interviews.

The first interviewee is an expert on the emergence and development of renewable energy and the impact thereof on the organization of the energy market. Therefore, this interviewee was approached for an interview on the decarbonisation trend. The second interviewee is an expert on the development and integration of digital developments in the energy sector, such as smart grids and the virtual power plant. Hence, this interviewee was selected and approached to participate in an interview about the digitalisation trend. The last academic interviewee is an expert in the field of policy and governance in the energy sector. This interviewee studies how innovation in the energy sector can be stimulated or supported by the governmental framework. As this latter highly related to the decentralisation trend, this interviewee was selected and approached for an interview related to this trend.

All academic experts have an academic career of more than 10 years in their research field. Two of the three interviewed experts work for almost 30 years as (assistant/associate/full) professor. The other expert works for more than 10 years in the academic world as a lecturer and researcher. In other words, based on this experience in the (academic) energy sector, there can be stated that these interviewees are experts in their field of research and are therefore able to answer the questions and to contribute to the goals of the expert interviews (validating the theoretical concepts as described in Chapter 3).

The interviewees were contacted by e-mail. One of the experts originated from the network of one of the supervisors of this research. When an interviewee did not respond within a week, a reminder of the email with the request to participate in the interview was sent. The email contained information about the researcher and this research (its aim). Moreover, it was clearly stated what was expected from the interviewee in terms of time and expected knowledge. Moreover, the e-mail contained the contact details of the research, which allowed the approached experts to contact the researcher if the request was not (fully) clear for the expert. After the expert made clear that he was willing to take part in the interview, a video call via Zoom or Skype was scheduled. In addition, at this point, the expert received the topic list for the interview, so that he was able to prepare himself for the interview.

Designing the interview guidelines
The decision is made to use a semi-structured interview method because a semi-structured interview guides the researcher during the interview. However, unlike a fully structured interview, there is room for the researcher to follow additional, related topics brought up during the interview (Bernard, 2017). This allowed the researcher to gain insights on supplementary topics that were not mentioned in the literature review.

As suggested by Cohen and Crabtree (2006), Drever (1996) and Longhurst (2010), a general interview guide with a list of predetermined questions and topics was made. The exact structure of the interview was worked out during the interview. In this way, a more conversational way of interviewing was used, enabling the researcher to control the length of the answer on a specific topic and elaborate on issues that were not clear.

Because the interviews conducted were in Dutch (see '*Procedure during the interview'*), the original interview guide was also in Dutch. This interview guide, as well as an English translation, is shown in Appendix E. Based on the expertise of the interviewee, this interview format was adjusted. For example, the experts were asked more detailed questions about their expertise (decarbonisation, digitization or decentralisation) than about the other two trends.

In other words, all the academic experts were asked on questions about all the trends, but they were asked more detailed questions about their expertise. Consequently, the interview guide was adjusted for each of the three interviews. Detailed interview questions about the expertise of one of the experts were deleted, and the more detailed questions about the expertise of the next expert were included. Appendix E contains the general interview guide that is used for both the academic and the industry experts. However, the focus of the interviews with the academic experts was on the part of the interview guide that is called '*macro-environment'*, because the goal of these interviews was to make sure this literature review contained all the major developments in the energy sector, and if these developments were correctly understood by the researcher.

The academic experts were therefore not asked questions about the parts *'micro-environment', 'information processing, techniques and tools and BMI processes'* and *'business model innovation outcomes and impact'* of the general interview guide, as this is not their main field of research. The latter (having knowledge about business model innovation in the energy sector) was checked during the interview so that additional questions about (designing) business models based on the identified developments could be asked, if this was the case. However, the academic experts did not have (sufficient) knowledge about business model innovation. On the other hand, this was also not the aim of these interviews with academic experts.

The interview guide of the interviews with the academic experts was based on the literature review conducted in section 3.4, and the trends identified in this section, as the main aim of these interviews was to make sure if this literature review contained all the major developments in the energy sector, and if these developments were correctly understood by the researcher.

Procedure during the interview

The experts are interviewed using online video software such as Zoom and Skype, due to the restrictions of COVID-19. The interviews were all one-on-one and the spoken language was Dutch since all the interviewees and the researcher spoke the Dutch language. Sometimes English terms are used to clarify a concept because in this research, as well as the most other academic papers in this research field, are written in English. Before the interviewee started, the interviewees agreed upon their participation and were aware of their rights during the interview.

The interviews were recorded, upon agreement of the interviewee, as this leads towards more accurate data analysis than only taking notes during the interview (Opendenakker, 2006). Moreover, the audio recording allowed the researcher on the content of the conversation rather than reporting. Next to the audio recording, notes were taken, to monitor the main thoughts of the interviewee on the topic and topics that need additional clarification. In this way, a summary of the answer of the interviewee could be given, to make clear if the researcher understood the reasoning of the interviewee correctly. The interviews with the academic experts took about half an hour, long enough to tackle the most important questions and topics regarding the expertise of the expert. Table 8 gives an overview of the interviewees, the duration of the interview and their expertise.

Data analysis

Because the main goal of the interviewees was to (1) find out if all the (main) developments were sufficiently described in the literature review, (2) no other meaningful developments were missing, and (3) the understanding of the researcher on these developments was correct, these interviews were not fully transcribed. Only a summary, containing the most interesting quotes of the experts and the main message of the interview was made. Some of the quotes have been translated into English to be used as empirical data in Chapter 5 and 6.

Semi-structured interviews with experts working in the Dutch energy sector

The last data collection method used, is the semi-structured interviews with the experts working in the Dutch energy sector (hereinafter the industry experts). The aim of these interviews was two-folded: (1) gathering practical, in-depth insights into the developments in the environment and (2) identifying the consequences of these developments for Dutch energy suppliers, that is (2a) the impact on the current (traditional) business model and (2b) the drivers and barriers of these developments for energy supplier business model innovation. These interviews follow almost the same approach as the semi-structured interviews with academic experts.

Respondents

Five industry experts were selected for these semi-structured interviews, including two participants from the case company and three external participants (see Table 8). These interviewees are selected based on their function and years of experience in the energy sector. Two of the interviewees work for the case company. The insights of these interviewees were useful to identify if the identified developments are recognized in practice, and how these developments impact the traditional energy supplier business model.

However, to gain more insights on how the identified developments work in practice and what the drivers and barriers of these developments are, it was decided to also approach respondents outside the case company that work for companies that have more experience with the identified developments and designing and operating a business model around these developments. Three industry experts outside the case-company agreed upon participating in these interviews. The interviewees were selected based on their knowledge of the energy market and their role in the organisation. The interviewees had to have at least five years of experience in the energy sector and needed to fulfil a managing role in the organisation (currently or in the past).

The interviewees of the case contacted were asked face-to-face if they were willing to participate in this research. The external interviewees were contacted using a phone-call. If the interviewees agreed upon the request to participate or wanted more information before deciding if he or she was willing to participate, an e-mail with additional information about the research, its aims and the purpose of the interview was sent. Moreover, the interview guide with the topic list of the interview was included in this e-mail. After the expert confirmed that he or she was willing to participate, a video call via Zoom or Skype was scheduled.

Designing the interview guidelines
Following the same reasoning as in the interviews with the academic experts, a semi-structured interview design is chosen for the interviews with the industry experts. Moreover, the interviews with the industry experts were also in Dutch.

As stated in the section about the interviews with the academic experts, the focus of the interviews with the industry experts was mainly on the parts of the general interview guide that are called *'micro-environment', 'information processing, techniques and tools* and *BMI processes' and 'business model innovation outcomes and impact'*, as these parts fit the goals of these interviews with the industry experts. However, to find out if the identified developments in the literature review were of practical relevance, a shortened version of the questions in the 'macro-environment' part of the interview guide was also part of the interview.

Again, the interview guide was slightly adjusted based on the expertise of the expert that was interviewed. Additional, more detailed questions about this expertise were added to the interview guide to gain additional insights about this expertise and replaced for other question about one of the other expertises before every interview. The interview guide is structured using the theoretical framework of Wirtz and Daiser (2017) and based on the literature reviews in section 3.4 and Chapter 6.

Procedure during the interview
The procedure during the interview is the same as the procedure during the interviews with the academic experts. The experts were interviewed using video software such as Zoom and Skype and the interviews were recorded, upon agreement of interviewee. Moreover, notes were taken that were used to summarize the thoughts of the interviewee and to ask if the research understood the reasoning of the interviewee correctly.

Data analysis

In contrast to the semi-structured interviews with the academic experts, the interviews with the industry experts were fully transcribed. After this transcription, the data was coded based on the subject of the question. This method is called 'open coding' (Bryman and Bell, 2014), which creates an overview of the information and the subject thereof. After the open coding, all text fragments with the same code were grouped in a comparative table, and the number of codes was reduced by combining associate codes into axial codes (Bryman and Bell, 2014). This enhanced the comparability of the text fragments.

In addition, most of the codes axial were linked to the elements of the theoretical framework of Wirtz and Daiser (2017). As a consequence, the researcher could compare the literature with the findings of the interviews, as well as structuring the results section. Finally, the most relevant information in the coding table was selected to use in the result section of this research as quotes to illustrate the findings of these interviews.

Table 8 Overview of the interviewees

#	Position	Academic / internal / external	Duration (h:m:s)	Years of experience
1	Associate professor (expert digitalisation)	Academic	33:32	+/- 30 years
2	Full professor (expert decarbonisation)	Academic	49:51	28 years
3	Associate professor (expert decentralisation)	Academic	36:24	10 years
4	Accountmanager – Key accounts	Internal	1:10:19	10 years
5	Sourcingmanager Renewable Energy	Internal	1:06:46	6 years
6	Partner Channel Manager	External	45:28	14 years
7	Business Developer	External	51:43	9 years
8	Managing Director and Innovation Analist	External	58:22	14 years

4.4 Validity and reliability

According to Yin (2003), four tests can be performed to measure the level of quality of social empirical research: construct validity, internal validity, external validity and reliability of the research design.

Construct validity refers to the selection of correct operational measures for the concepts or constructs that are studied (Yin, 2003). To address the construct validity in this research, we have taken multiple actions. We have used various sources to acquire as much as possible measures about the energy sector and the activities of energy suppliers therein, as well as the developments in this sector. First, the framework of Wirtz and Daiser (2017) was used for structuring both the theoretical part of this paper and the interview guide. In this way, it was made sure that all the elements of this framework were, directly or indirectly covered and correctly measured during the interview. Furthermore, to gain more insights about the participating experts and the organisation for which they work, information from the websites of these organisations, and by articles on news websites that mentioned the company name was gathered. This information and articles were used to verify and validate the information given in the semi-structured interviews. Regarding the interviews with the experts of the case company, additional documentation provided by the company, such as presentations was used. In addition, the description of the energy market in Chapter 3 was reviewed by members of the case company. Hence, data triangulation was used to enhance the construct validity (Yin, 2003).

Internal validity tries to establish causal relationships, in which certain events are believed to lead to other certain events (Yin, 2003). Yin (2003) stats that achieving high internal validity is difficult in case study research, but proses four methods to increase internal validity. In this study, we compared the semi-structured results to capture the general line and deviations of this line between the results, which is known as pattern matching.

Third, external validity is about the extent to which the results of the study can be generalized (Yin, 2003). As multiple experts from different organisations, with different viewpoints, took part in this research, a broader picture of the different opinions became clear and the generalizability of the research increased. However, because of the small sample size, the overall generalizability of this research is limited. This research must therefore be validated and can therefore be seen as exploratory research that can serve as a starting point for future research.

Lastly, reliability is about the repeatability of the study and the used procedures. For this reason, each step of the data collection is documented, and pre-defined subjects are used to ensure consistency between the interviews. All interviewees received almost the same interview guide, with additional questions about their expertise. However, this study presents the current opinions of the interviewees about the current business environment, which is likely to change. Therefore, repletion of the questions about the current developments in the environment of Dutch energy suppliers could lead to different answers.

5 Results I: The changing environment of Dutch energy suppliers

This chapter contains the first part of the results of the semi-structured interviews with the experts in the energy sector. These results in this chapter are related to the 'Environmental BMI, 'Knowledge/Information Processing and Sense-making' and 'BMI Techniques and Tools' Dimensions of the framework of Wirtz and Daiser (2017).

The findings related to the remaining elements of the framework are described in Chapter 6. The current chapter describes which developments in the Dutch energy sector are identified by the interviewees and whether the interviewees consider these developments as drivers or barriers for business model innovation in the energy sector. Moreover, this chapter describes what business model innovations Dutch energy suppliers could deal with these developments (i.e. how they possess and make sense of these trends and which tools and techniques they use for this), and what the opinion of the interviewees on this topic is.

Therefore, this Chapter completes the answer to the fourth sub-question *'What are the developments in the environment of Dutch energy suppliers?'* and the fifth sub-question *'What are the drivers and barriers of these developments for Dutch energy suppliers?'.* Moreover, this Chapter makes a start with answering the main research question '*What business model innovations could Dutch energy suppliers use to respond to their changing environment?'.*

5.1 Environmental BMI Dimensions

As described in Chapter 3, the Environmental BMI Dimensions in the energy sector can be divided into three main trends: Decarbonisation, Decentralisation and Digitization. Therefore, this section is structured using these three trends. This section describes the findings of the interviews with the experts (both the academic and the industry experts). Overall, the interviewees agreed that these three trends are the three most important changes in the environment of Dutch energy suppliers.

5.1.1 Decarbonisation

The interviewees agreed that decarbonisation is one of the key developments in the macro-environment. Interviewee 7 says: *'Customers increasingly want to know where their energy is generated.'* Interviewee 6 also agrees upon this trend. '*Our business development department is involved in the development of solar parks, to set the future for later and to ensure that our energy label becomes increasingly sustainable.*'

Most interviewees see wind and solar energy as the most interesting type of renewable energy for the long term. Other renewable energy types, such as biomass, are heavily subsidized and are not (economically) interesting without these subsidiaries. Interviewee 4 says: *'Biomass is not interesting in my opinion. It is a substitute for coal ad heavily subsidized. At this moment they use biomass only because the climate goals have to be reached.'*

On the other hand, this interviewee sees great potential for energy storage. '*I believe in energy storage, which could become very important. There will be enormous price fluctuations because the share of renewable energy is much larger. This means a lot of fluctuations in prices, and energy suppliers can take advantage of that through energy storage.'* Overall, the other respondents agree with the potential of energy storage technology. However, one interviewee says: *'I see more potential in optimizing the flexibility of the grid. When this flexibility is optimized well enough, batteries and storage are unnecessary.'* (Interviewee 3).

Next, the interviewees draw constraints regarding the decarbonisation trend. Interviewee 2 argues that the changing policy framework can be a constraint for business models focused around decarbonisation: '*The investment depends on the changing subsidiary and legislative regulation. It remains to be seen how long the current regulations and subsidiary schemes are fixed. For example, if you know that this scheme will be the same for the next three years than you can plan accordingly. And you know that after that the scheme can look differently. At this moment, there is much uncertainty about the future. You do not know for how long you will receive a certain price.'*

Interviewee 1 also highlights the importance of clear and well-considered legislation: *'Currently, in the Netherlands, there is a problem with the integration of centralized renewable energy projects into the grid. Dutch legislation looks at peak power and if there is a peak when there is no peak demand, the DSO often says, "this project does not fit in the grid". The time aspect and the permitting aspect therefore also play a role in the chances for building a successful business model around renewable energy projects'.*

Moreover, he draws upon the constraints of the centralized renewable energy project.
'For centralized energy projects, such as wind farms, there is an acceptance problem. Once the permits have been completed and the period in which residents still have a say in the design of the permit or can object the permit, it may be promising. But the social acceptance, and the associated length that the process for a permit takes, often prevent this'.

5.1.2 Decentralisation

The interviewees agreed that decentralization is a key trend for Dutch energy suppliers. However, this trend does not mean that centralized generation becomes redundant. Interviewee 3 says: *'I am convinced that we will have a turnaround of the system. Not the top-down but the bottom-up system. There will be a kind of local energy communities that are very independent of the grid. However, a backbone of the grid will be needed. I do not believe that the central grid will disappear completely, but that is more of a backup function and a stabilization function.'*

The other interviewees agree with this. All interviews argue that prosumers and distributed energy will increase in the upcoming years. Interviewee 4 says: '*I see the decentralisation trend as promising. I believe that in 5-10 years every household with a roof that is suited for solar panels is obliged by the government to have solar panels on their roof, for the future generation.'* The other interviewees agree with him, is it not the question if decentralisation is a trend, it is a question of how long it will take before all customers have solar panels on their roof.

Interviewee 1 agrees on the potential of energy communities but states that their potential needs to be further analysed. '*Energy suppliers can use the decentralisation trend to organize and manage the assets of prosumers by grouping the prosumers in a community or by becoming aggregator. Both are promising business cases, but additional research has to be done to test different scenarios in practice.'* However, as interviewee 7 argues: '*At this moment, these cooperatives are only attractive for households. Businesses can provide from the subsidiaries of the government, so being part of a cooperative is less interesting for them.'*

5.1.3 Digitalisation

Again, the interviewees agreed upon the existence of this trend. Interviewee 2 says: *'The things that I just mentioned (related to decentralisation and decarbonisation) are only possible with a* *complete digitalisation of the grid, thus that is a smart grid. A lot of IT and communication resources are needed to be sure that the system will remain reliable. Digitalisation is a requirement for coordination and reliability of the grid, otherwise, the previously mentioned developments can not be executed.'*

Interviewee 8 adds: '*Digitization will play a major role in the electricity system. Because you want an electricity system is that it is as flat as possible. That there are no peaks in production and demand. From that perspective, the expectation is that the supply of electricity will be controlled much more real-time. To arrange this, we need a lot of digital technology.'*

Interviewee 1 also highlights the rise of real-time energy management and recognizes it as a driver for energy supplier business model innovation. '*Real-time energy management allows an energy supplier to benefit even more from offering differentiated contracts to their clients. In other words, contracts that enable the energy supplier to offer different products per 15 minutes. The real-time supply of electricity, with the possibility to interrupt the demand (load management), will play an increasingly important role in the electricity world. To make all this possible, you need a digital infrastructure that can communicate in two directions.'*

Moreover, Interviewee 3 states that new roles in the energy sector are needed to bundle distributed energy resources. He clarifies: *'It is important that other roles are added to the market, such as aggregators. These can, for example, open congestion markets when the energy supply is greater than the demand.'* Interviewee 7 agrees with this: *'It is very important that not only new business models, but also new roles are added to the market. These new roles will have a major impact on future business models of energy suppliers because these new roles allow the connection between energy trading and transmission and distribution to return to the market.'*

In the next section, we draw considerations for future energy supplier business models based on the identified developments and their drivers and barriers.

5.2 Considerations for future energy supplier business models

Combining the findings of the semi-structured interviews with the experts, the literature reviews conducted and the content analysis, three considerations for future energy supplier business models can be identified. Energy suppliers should consider developing business models that are able to:

(1) gain a secure position in the market for renewable energy (for utilities including centralized assets);
(2) respond to the need for increased flexibility and gain value from the assets owned by prosumers (e.g. by fulfilling the role of aggregator);
(3) sell energy services instead of volume (e.g. by becoming energy service providers (ESPs));

These three considerations are shortly explained in the remainder of this section.

<u>Gain a secure position in the market for renewable energy</u>

First, energy suppliers should gain a secure position in the market for renewable energy. Again, for highly vertically integrated energy suppliers (utilities) the need to generate energy from renewable sources is crucial and triggered by all kinds of regulatory frameworks and goals. Consequently, in recent years, utilities have increased their share in renewable energy production to an estimated share of 25% in the total global production in 2017 (Frei et al., 2019). Nevertheless, acceleration of this growth is needed to reach the goals stated by governments and in worldwide agreements such as the Paris Agreement and Kyoto Protocol (Frei et al., 2019; Gielen et al., 2018). More specifically, research of Gielen et al. (2018) showed that renewable energy should account for 85% in the total electricity production to reach the objectives stated in the Paris Agreement. Moreover, with the expected increase in the world-wide energy consumption, due to (1) increased energy access in rural areas, (2) further industrialisation and (3) increased transportation, an increase in the amount of energy that needs to be generated is also inevitable (Gielen et al., 2018). Therefore, utilities need to further investigate renewable power production technologies and become more active in this market.

For energy suppliers, renewable energy production offers also new business opportunities. Next to offering centralized renewable energy instead of or in addition to fossil-based energy, energy suppliers can provide their customers advice related to the equipment and optimization of the renewable energy installations and battery storage systems. For instance, energy suppliers could give tailor-made advice on which (combinations) of DERs could be interesting for commercial and industrial customers to reduce their energy bill. Together with data of smart-meters and other energy-efficient appliances, energy suppliers could make visible how customers could save energy and profit from the self-generation. Moreover, business models such as the build-own-operate (BOO) and engineering, procurement and construction (EPC) business models, in which energy suppliers reduce (financial) barriers for their customers, could be considered by energy suppliers to gain a secure position in the market for renewable energy.

<u>Respond to the need for increased flexibility and gain value from the assets owned by prosumers</u>

Because the amount of energy from renewable sources fluctuates, the reliability of the grid is under pressure. Energy suppliers need a reliable base load to ensure their power supply (IRENA, 2020). To maintain this base load and avoid the need for additional capacity to meet peak demand or curtailment (when there is more production than demand), the flexibility of the grid needs to be increased. Traditionally, the supply side of the grid provided this flexibility, as it adjusted the production to follow the demand. However, the current developments further increase this supply-side flexibility and allow demand-side flexibility and overall system-wide flexibility. Previously, this was not possible due to the unresponsiveness of the demand side of the grid.

On the demand-side of the grid, the emergence of distributed energy resources used by prosumers can increase the demand-side flexibility of the grid. Because of digitalisation prosumers can become active participants in the energy network. Prosumers use distributed energy resources (DERs) for the production and storage of (renewable) energy. Aggregators group (aggregate) these distributed energy resources of prosumers in a virtual power plant (VPP) to create a substantial capacity similar to the capacity of a conventional generator. Consequently, aggregators can sell capacity, excess energy and other ancillary services via the energy exchange in power system markets or through procurement by the system operator (Burger et al., 2016).

In sum, an aggregator is '*a new market participant that operates a virtual power plant that aggregates DERs to enable these small energy resources to provide extra services to the grid'* (MIT, 2016). The virtual power plant is controlled by a central IT system. Aggregators can use all kind of data to optimise the operation of the DERs in the VPP. Examples of these data are: consumption and power supply patterns, weather forecasts and electricity prices in the wholesale market (IRENA, 2019). The key benefits of aggregators are: (1) allowing agents (industrial or residential prosumers) to participate in different power system markets by providing local flexibility, (2) create load shifting possibilities and (3) introducing additional services to the grid and the whole energy system (IRENA, 2019).

By aggregating DERs, an aggregator can provide both supply- and demand-side flexibility to the grid. Supply-side flexibility is provided by optimizing the production from the DERs and the use of energy storage units, based on historical and forecasted data on energy prices and demand. There are three kinds of demand-side flexibility: (1) sector coupling (power-to-heat, power-to-gas and smart charging of electric vehicles), (2) smart appliances and (3) (industrial) demand response. For instance, industrial processes that require a high supply of energy, such as the production of paper, could provide demand-side flexibility by shifting the load that is required for these processes to a later point in time.

In sum, to gain an advantage of these possibilities and developments, **energy suppliers could consider becoming aggregators**. Verhaegen and Dierckxsens (2016) draw different archetypes for the role of an aggregator. For energy suppliers, the combined aggregator-supplier is interesting. In this archetype, both the aggregation and the supply are offered by the same energy company. This company offers an integrated proposition of supplying additional energy and using the flexibility of the DERs of the prosumer. Hence, this archetype is based around the 'one-stop-shop' in which the energy company fulfils the role of BRP and supplier, while at the same time monetizing the flexibility of and for the prosumer. Verhaegen and Dierckxsens (2016) argue that energy suppliers are in a good position to become aggregators because they already have a relationship with customers and connections to the energy market.

Several Dutch utilities (in the role of energy supplier) are already active as an aggregator. For example, the Dutch utility Essent is active as an aggregator in the project EnergieKoplopers (2016), in which it *'unlocks flexibility and offers this to electricity market players'* (EnergieKoplopers, 2016). Moreover, another large Dutch utility, Eneco, is active as an aggregator with the proposition AgroEnergy, in which it specializes in serving customers in agriculture (AgroEnergy, 2017).

Sell energy services instead of volume

Overall, to deal with the identified trends, we found that energy suppliers could considerate to sell energy services instead of volume. In other words, **energy suppliers could become an energy service provider (ESP)**. ESPs, also called Energy Service Companies (ESCo's), monetize the value created by the digitalisation and decentralisation trend (e.g. Hannon et al., 2013). ESPs can offer services to customers to (1) reduce their energy bill (energy advise on data from smart meters – digitalisation trend) and (2) provide them with options for more sustainable energy supply (for instance based on self-generation – decentralisation trend) and (3) manage the load of customers (energy management or demand response management – digitalisation trend) (Hannon et al., 2013; IRENA, 2020). *Energy-as-a-service (EaaS)* refers to the development of business models by ESPs in which energy-related services are offered instead of units of energy (Xu et al., 2018). Figure 7 shows which services ESPs can offer using an EaaS business model.

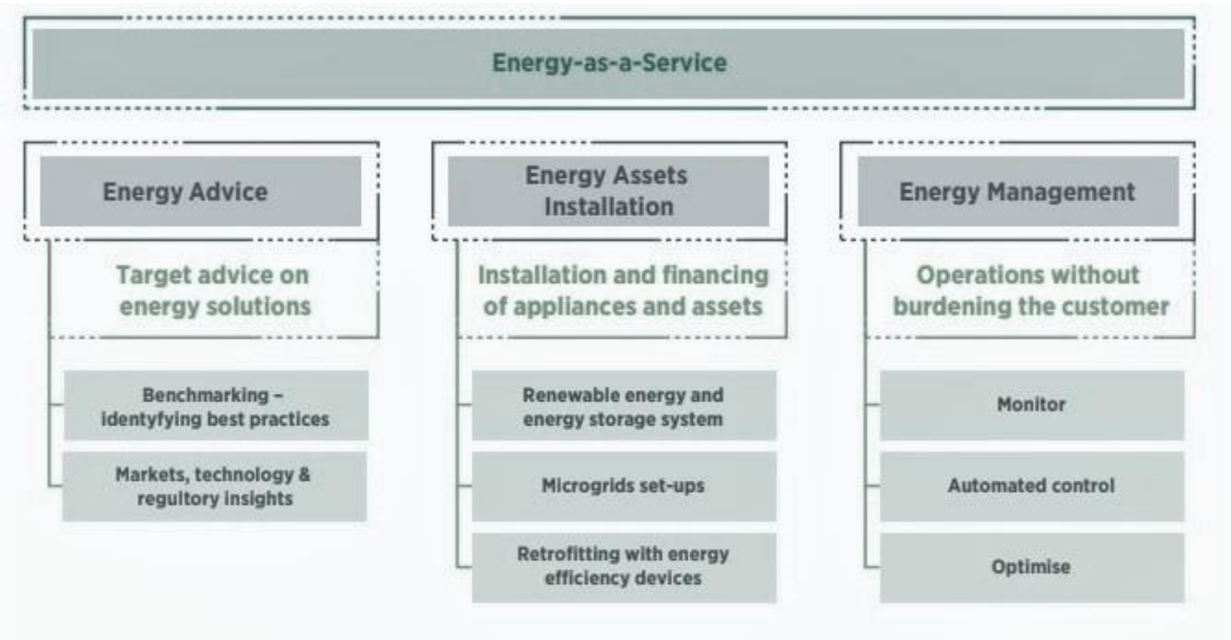

Figure 7 Services that can be offered in Energy as a Service business model (IRENA, 2020).

As is discussed in more detail in Chapter 6, how energy suppliers can incorporate these considerations in their business model, and how they can create, deliver and capture value from these characteristics, depends on some specific elements of the firm. First, the current chapter is completed by describing how Dutch energy suppliers (can) process and make sense of the developments in their environment, as well as which tools they use in this process.

5.3 BMI Techniques and Tools and Knowledge/Information Processing and Sense-Making

The dimensions ‘BMI Techniques and Tools’ and ‘Knowledge/Information Processing and Sense-Making’ are about the tools and techniques that are used by firms to gather and assess internal and external information, as well as to transform this information to knowledge that applies to the situation of the firm (Wirtz and Daiser, 2017). They serve as a systematic interface between the Environmental BMI Dimensions (covered in this Chapter) and the ‘Knowledge/Information Processing and Sense-Making Dimension’ (covered in Chapter 6). Therefore, they are discussed together in this section.

Regarding the energy sector, Boscherini et al. (2011) suggest two techniques to make sense of new know-how and create openness to innovation: (1) developing external partnerships and (2) establishing a new organizational structure. We elaborate on these two techniques in the remainder of this section.

External Partnerships

Several authors (e.g. Tayal and Rauland, 2017; Richter, 2013; Shomali and Pinkse, 2016; Erlinghagen and Markard, 2012) argue that incumbent energy suppliers should collaborate with external parties to make sense of the development and processing them. Moreover, Boscherini et al. (2011) state that developing external partnerships is beneficial for overcoming the complexity of the development and to reduce risks for the individual company. Two main forms of external partnerships could be derived from the literature: partnerships with universities and research centres, and partnerships with industry partners.

<u>Partnerships with universities and research centres</u>

Giordano et al. (2013) found that, in the Netherlands, energy suppliers have formed strong partnerships with universities and research centres to gain an understanding of the market as well as the technical and financial processes. Moreover, the authors state that these strong partnerships with universities and research centres show the relative novelty of the knowledge and technologies being used by energy suppliers to deal with the identified challenges (Giordano et al., 2013). On the other hand, universities are mainly involved in R&D programs of the energy firms, and when a project passes the development stage, the role of the universities and research centres declines or disappears to the background (Giordano et al., 2013). Richter (2013) found similar results and states that partnerships with universities outside the development stage can only be found sporadic.

<u>Partnerships with industry partners</u>

The work of Shomali and Pinkse (2016) shows that energy suppliers need to work together with regulators, network operators and ICT professionals to define the boundaries within with the data of customers can be used, shared and has to be stored. For example, smart grids make that new flows of information arise, that could be used by energy suppliers to provide additional services for their customers. However, the current regulatory framework does not comply with these new services (Shomali and Pinkse, 2016). Jacobsson and Bergek (2004) state that government support is a condition for energy firms to engage in digitalisation developments, such as smart grids, and even broader to sustainability-oriented business model innovation. The regulatory policies can help energy suppliers to make upfront investment decisions and can stimulate customers in the direction of the developing technologies, as was the case with electric vehicles (Jacobsson and Bergek, 2004). ICT firms have more experience and equipment to learn from data, that could be useful to draw the (technological) boundaries. (Erlinghagen and Markard, 2012).

Interviewee 2 also argues that the actors in the energy sector have to work together. He says: *'What I find difficult is that there must be an interaction between traders and the distributors of energy. With the unbundling of the system, these roles have been taken apart. Looking at the system now, it was perhaps one of the biggest mistakes we have made. During the liberalization, this separation was a logical step, but now that we have these roles apart, there are many problems. Traders trade with areas where energy can be purchased cheaply, but this increases the network costs for the customer. In other words, eventually, disconnecting these two roles does not have led to the cheapest solution for the customer. This can lead to conflicts. That is why better cooperation between the actors is necessary.'*

Second, Piccoli and Pigni (2013) argue that ICT firms could use 'big data' to derive knowledge of the needs and preferences of customers and their usage patterns, that could be used to, for example, sell energy efficiency and related services. However, Shomali and Pinkse (2016) state that energy suppliers on their own do not have to make sense of this big data on their own, due to lack of experience and equipment. Therefore, energy suppliers should collaborate with ICT firms (incumbents) and/or acquire ICT start-ups (Erlinghagen and Markard, 2012). In addition, the technology used for data-analytics, energy-efficiency solutions and other energy products, are currently being provided by large ICT incumbents such as IBM and Oracle (Giordano et al., 2013), so collaboration on this side is needed as well. On the other hand, Erlinghagen and Markard (2012) expect that these large ICT firms will become competitors of the energy suppliers in this field of energy-efficiency and smart girds, taking the role of general contractor in large (smart grid) projects.

Lastly, energy suppliers could collaborate with a third party. This is mostly used in solar PV and energy storage technology projects, in which the energy supplier collaborates with a third party to minimize the (financial) barriers for potential customers. In this way, the energy supplier can utilize the knowledge and experience of the third parties to enhance their customer engagement model (Rocky Mountain Institute, 2009; Tayal and Rauland, 2017). For instance, third-party-ownership and power purchase agreement (PPA) business model could be used in this regard. In these business models, the customer signs a contract with the third party to finance, install and manage the DER-installation (the third-party-ownership model is also known as the build-own-operate model (BOO)). Moreover, the customer signs a contract in which it buys electricity that is generated by the DER-installation at a pre-determined rate (the power purchase agreement (PPA)) (Pieper and Rubel, 2010; see also Appendix D). Often, these contracts are based on the lifespan of the DER installation. For example, the common lifespan of a PV-system is between 15-20 years, resulting in an enduring partnership with the customer (Tayal and Rauland, 2017).

The interviewees agreed upon the notion that partnering with other actors in the value chain becomes more necessary. Besides, they agreed that partnering with universities and research centres is a valuable tool to increase the knowledge in the firm and to make sense of the developments in the external business environment, tackling (a large part of) the barriers that occur when addressing these developments.

Figure 8 shows the relationship between energy suppliers (retailers) and other (future) participants on the energy market (Tayal and Rauland, 2017, based on Rocky Mountain Institute, 2015). As can be seen in this Figure, the energy suppliers (retailers) can get in contact with customers in three ways: (1) directly (same as the traditional business model), (2) via a platform that is developed and run in collaboration with software providers and (3) via a third party.

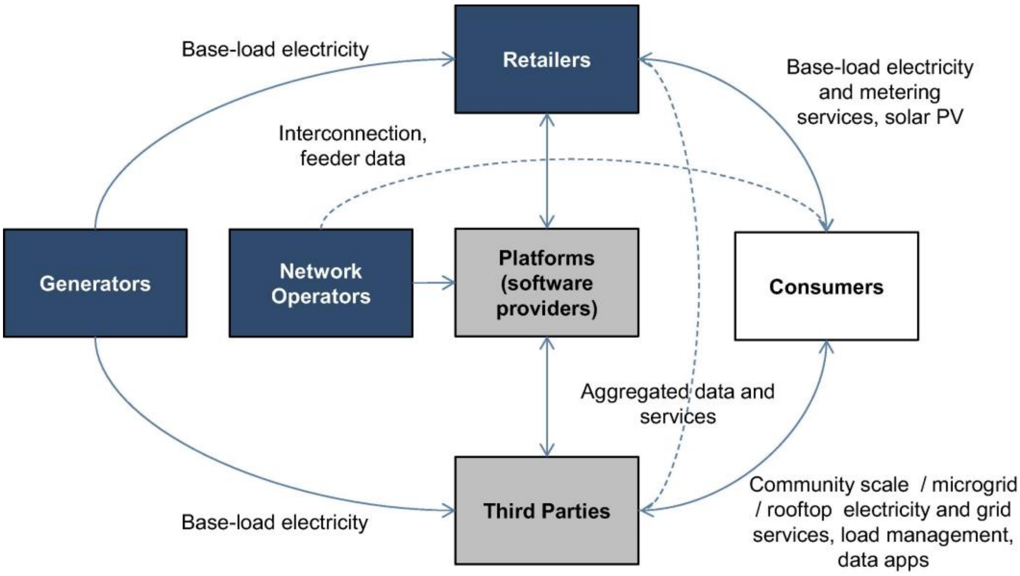

Figure 8 Future market participants and their relationships (Rocky Mountain Institute, 2015; Tayal and Rauland, 2017)

Organisational structure

As described in Chapter 2, incumbent energy suppliers face all kinds of barriers towards innovating their business model. For example, they face uncertainty about the amount of revenue that arises from their innovated business model (Sosna et al., 2010). This is what Chesbrough and Rosenbloom (2002) call cognitive barriers. In the case of the energy sector, managers that face cognitive barriers are not able to think of business models that are completely different from their current business model, while the current one (based on economies of scale) is still profitable (Sosna et al., 2010). As a consequence, multiple researchers argue that energy suppliers should establish a specialized business unit or separate venture (e.g. Tayal and Rauland, 2017; Klose, 2010; Richter, 2013) that is based on the new business model. In this way, the barriers and inertia of the parent company towards new ideas could be overcome. This allows the energy suppliers to be more creative and innovative, whilst at the same time the conflicts with the current business model could be minimized (e.g. Bessant et al., 2004).

<u>Conditions for energy supplier business model innovation</u>

Based on these findings, we draw two conditions for energy supplier business model innovation:

(1) Energy suppliers need to leverage partnerships with other organizations in and outside the energy industry.
(2) In order to overcome institutional barriers and cognitive constraints, energy suppliers should establish a separate, specialized venture or business unit.

Chapter 6 draws upon the consequences of the identified developments for the traditional energy supplier business model.

6 Results II: Business model innovation for Dutch energy suppliers

This chapter is about the core topic of this paper, namely business model innovation in the energy sector. It answers the main research question of this paper: ‘*What business model innovations could Dutch energy suppliers use to respond to their changing environment?’.*

The previous chapters made clear what the main developments in the Dutch energy sector are. Moreover, they clarified the drivers and barriers for energy supplier business model innovation. The current chapter describes what the consequences of the developments for the traditional energy supplier business model are and describes what business model innovations Dutch energy suppliers could use respond to their changing environment. This is done using the Dimensions ‘Central BMI’, ‘BMI Intensity’ and ‘BMI Output/Impact’ of the framework of Wirtz and Daiser (2017).

This chapter combines theoretical findings with the findings of the semi-structured interviews. The findings of the semi-structured interviews are used to (1) validate the theoretical findings and to (2) add a practical viewpoint to these theoretical findings. The literature review performed in this chapter mainly builds upon the same papers that are used for the literature review of section 3.4.

6.1 Central BMI Dimensions

This section is about the consequences of the identified developments for the traditional energy business model (ESBM). This is section is structured using the ‘Central BMI Dimension’ of the framework of Wirtz and Daiser (2017). This dimension contains the perspectives ‘BMI Factors’ and ‘BMI Areas’.

6.1.1 BMI Factors

The perspective ‘BMI Factors’ is in the core of the Central BMI Dimension. It describes changes in market and target group (who), the value proposition (what) and the value delivery system (how) (Wirtz and Daiser, 2017).

As described in more detail in section 6.1.2, there is not just one business model that fits perfectly to all developments in the energy sector. However, the literature review and the interviews with the experts made clear that customers will fulfil a more prominent role in the energy sector. Therefore, describing changes in the customer wishes, which new products or services could be offered to these customers and novel ways in which these products or services could be delivered to them, will provide energy suppliers with new insights.

The remainder of this section elaborates on these three BMI Factors. Between brackets, the corresponding elements of the Business Model Canvas of Osterwalder and Pigneur (2010) are shown to provide insight into the relationship between the BMI Factors and the elements of the Business Model Canvas. The elements of the Business Model Canvas are namely the business model components in the ‘BMI Areas’ perspective of the framework of Wirtz and Daiser (2017) (see Figure 4).

<u>Who – Target Group Customers (Customer Interface)</u>

Overall, the customers of energy suppliers will not change, they will still be (profit and non-profit) organizations in all industries and other energy sector players (mainly the TSO). For some suppliers, this will also include households, but this segment is not included in the scope of this research. On the other hand, there are three main changes in the needs of these customers: (1) customers want to be more environmentally friendly, (2) an increasing group of prosumers and (3) customers want to gain more insights in their energy consumption (Engelken et al. 2016; Shomali and Pinkse, 2016). For this reason, more customer segments can be formed.

Customer segments

New entrants on the energy market are specifically targeting these new customers segments. Leisen et al. (2019) analyzed the development of new business models by energy start-ups and small energy companies between 1998 and 2017. These authors identified six business models that are deployed by these energy start-ups and small energy companies. Moreover, they developed a matrix that classifies these business models along with their role in the value chain and their key addressee (customer segment) (Leisen et al., 2019). This matrix is shown in Figure 9 (Leisen et al., 2019).

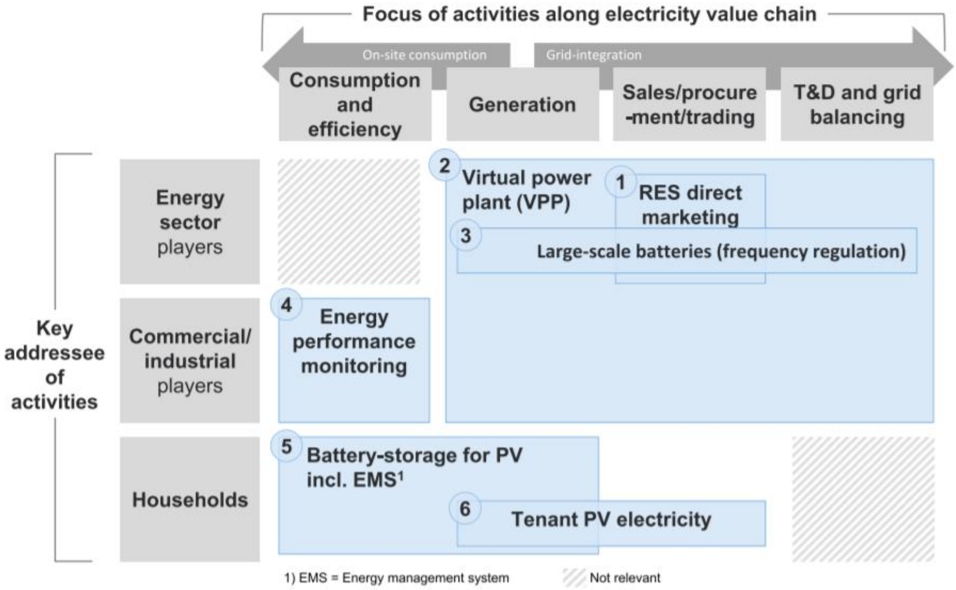

Figure 9 Matrix of the identified business models by Leisen et al. (2019). [2]

As can be seen in this Figure, these business models are also related to the three trends identified in this research: decarbonization (RES direct marketing, large-scale batteries), decentralisation (tenant PV electricity, battery storage for PV) and digitalisation (Virtual Power Plants, Energy performance monitoring, EMS). In other words, new entrants on the energy market, as well as small energy firms, already developed and work with a business model that follows (one of these) trends. As a consequence, customers that are willing to act upon of these three trends, are already able to switch to or join the initiatives of these new energy start-ups and small energy companies. In addition, the study of Richter (2013) showed that customers are increasingly willing to switch their energy supplier for environmental reasons.

In sum, as the possibilities for customers grow and become more tailor-made (Facchinetti, 2018), energy incumbents need to rethink which customers they want to serve, being more specific than ever before (Nilessen and Politt, 2016). The interviewees recognize that new

[2] T&D = transmission & distribution, RES = renewable energy sources, EMS = Energy management system, PV = (solar) photovoltaics

customer segments need to be formed. Interviewee 7 says: '*We need to better understand what customers want. For example, we used to have one large segment for households. However, we see their preferences change, and we need to segment much. We cannot speak of just the segment 'households' as one'.*

Customer relationships

Secondly, the identified developments have also their impact on customer relationships. Before the unbundling and the liberalization, customer relationships did not play an important role in the operations of energy suppliers, because customers were not able to choose their energy supplier nor able to switch supplier (Lampropoulos et al., 2018). However, the unbundling and liberalization made this possible for customers, new energy suppliers emerged, and customer relationships became more important. Interviewee 6 says: '*It was never necessary to focus on the customer. Twenty years ago, we did not talk about 'customers' we called them 'receivers'. However, times have changed and now we need to find ways to retain customers*.' Interviewee 7 agrees*: 'In general, the mindset of energy suppliers does not comply with that of a service provider. We are less involved with what the customer really wants.'*

The developments of nowadays, such as decentralized and distributed energy, make the customer relationships even more complex because customers turn into prosumers, which allows them to generate (a part of) their energy consumption themselves. Interviewee 8: *'People and organizations change. Our challenge is understanding what the new needs of customers are and why exactly these needs arise.'*

Channel

Moreover, the channel, how the company communicates with its customers, becomes more important, since the trends allow information and energy to flow in both directions. To be clearer, customers can generate their energy themselves, after which they can consume this energy, store this energy, or trade this energy. Moreover, they are still able to buy electricity from their energy supplier. Moreover, the digitalization trends enabled real-time, two-sided information flows that allow energy suppliers and customers to gain insights.

Developments such as smart grids, make this two-way flow of information possible (Shomali and Pinkse, 2016). Consequently, customers will have access to real-time data about their usage and production, which allows for more active energy management. Moreover, smart grids create an opportunity for customers to trade their energy with energy firms (Shomali and Pinkse, 2016). For energy suppliers, the data provided by the smart grid could be used for load and demand response management, as well as for the development of new pricing mechanisms (Haag et al., 2009). More specific, interviewee 6 said: '*We have to change our customer relationships and channels completely. If we have access to their data, our start position is good. We can offer them more tailor-made advice.'*

Conclusion – Who (Customer interface)

In short, previously, active customer relationship management was not of great importance for energy suppliers. However, the current developments make that the customer interface section of the business model canvas is essential nowadays. Increased differences in the preferences and expectations of customers make that new customer segments emerge and that energy suppliers need to be more specific on which segment they serve (Haag et al., 2009). The channel is of importance to serve the two-way flow of information that is needed for developments such as disturbed energy and demand response management. Finally, as not all customers show the same interest in the developments, active customer relationship management is needed to make clear what the preferences of the customer are (Richter, 2012).

What – Value Proposition (Value Proposition)

The second element of the 'BMI Factors' perspective, is the element 'what', also referred to as the value proposition. It refers to 'the bundle of products and services that create value for the customer and allows the company to earn revenues' (Richter, 2012, p. 2486). As described in Chapter 3, the traditional value proposition for energy suppliers is to deliver energy to the customer per unit of energy used at low costs that are generated in bulk at centralized power plants. However, the identified trends (decarbonisation, decentralization and digitization) make that this traditional value proposition is under pressure (Klose et al., 2010). For example, the increased number of prosumers and increased usage of smart energy systems will cause a decrease of the amount of energy that customers will purchase from suppliers (Graham et al., 2008; Klose et al., 2010). Consequently, these authors suggest that energy suppliers need to change their value proposition to maintain their relevance in the market.

Interviewee 4 agrees with this suggestion. He states: *'Customers' needs are also growing. You are no longer just a supplier of electricity and natural gas. You have to become a much larger and more complete service provider. You have to be a party that can facilitate their entire energy issue, in terms of sustainability and the supply of electricity and natural gas. You should also guide them to save energy. (…). You have to become much more complete.'*

As a response to this need to change the value proposition, many authors describe that energy suppliers need to transform from organisations that just sell a commodity, to organisations that sell full energy solutions, often called Energy Service Providers (ESPs) or ESCo's (Energy Service Companies) (Klose et al., 2010; Duncan, 2010; Frantzis, 2008). Hall and Roelich (2016) describe this business concept in more detail. The authors state that ESCo's provide energy services such as efficient appliances, illumination or full-concepts such as 'warm homes' instead of supplying unit-based energy. Other examples of the services that ESCo's offer are based on the full process of consulting, installing, financing, maintaining and warranting energy efficiency systems (Richter, 2012). The business model of ESCo's is completely different in comparison to the traditional business model, as the revenues arise from incentivising energy efficiency and thus supplying the fewest amount of units as possible, whereas the traditional business model benefits from increasing the number of units consumed (Hall and Roelich, 2016). For this reason, authors such as Bocken et al. (2014) argue that these energy-efficient systems make energy suppliers change their value proposition into one that encourages sustainable behaviour.

In other words, the value proposition of energy suppliers needs to shift from a purely product-based value proposition to one that also includes services and is more tailored towards the preferences of the customer. The identified developments can leverage several value propositions. For instance, the energy supplier could leverage value by making it possible for customers to become prosumers (third-party ownership business model), but they can also draw a value proposition around energy efficiency systems. Hence, specific value propositions need to be defined based on the (desired) position in the market. Knowledge about the different customer segments and customer demands will help to develop new value propositions (Valocchi et al., 2007).

How – Value delivery system (Infrastructure)
Lastly, the changes in the value delivery system will be described. The value delivery system describes how the firm internally creates the value for the customers and delivers this to the customers (Richardson, 2010). It is built around the 'Infrastructure' building blocks of the business model canvas of Osterwalder and Pigneur (2010): the key resources, key activities and key partnerships.

Resources
Changing the value proposition of the firm might cause that the resources of the firm are no longer appropriate for the delivery of the value to the customer. The identified developments make that this is the case for energy suppliers. First, the decarbonisation trend makes that energy producers need to shift from generating fossil-based energy, to generating energy from renewable energy sources such as solar photovoltaics. Secondly, decentralisation causes the key resources of energy producers will need to change from large, centralized power plants to small distributed renewable energy sources.

Third, the digitalisation trend causes the development of "asset-light" business models in which physical assets are of minor importance for the firm. For instance, this development allows the development of platforms, shared-investments and service-oriented business models that link the actors in the energy sector and their offerings, such as the distributed energy resources, energy storage systems and the flexibility (Fox-Penner, 2010; Helms, 2016). Moreover, the digitalisation trend causes that energy suppliers with the "asset-light' business models need staff with that might be qualified in other sectors (e.g. computer science) than is the case at this moment. This will cause higher expenses for attracting new employees or retraining existing employees (Leisen et al., 2019).

Key activities
The key activities of the firm are about the most important tasks of the firm. Traditionally, the key activities of energy producers were about the operation and management of the centralized large-scale power plants. However, the three identified trends cause that the number of energy producers will increase (prosumers), and their assets will change (small, decentralized assets). The impact of the change of the key activities is dependent on the size and abilities of the firm. For instance, large energy utilities can become fully integrated energy providers, that are active in all parts of the value chain, whereas small companies tend to focus their key activities on the changes in the distribution and retail part of the value chain (Richter, 2012). Thus, again, the level of vertical integration, influences how energy suppliers will change their business model. Highly vertically integrated firms will need changes in their key activities, as a large number of small, decentralized assets require other asset management and operations approaches than the current centralized energy power plants. On the other hand, smaller, not vertically integrated suppliers could specialize in the developments occurring from the digitalization trend, and therefore serve the new customer groups.

Interviewee 7 argues that energy suppliers need to focus more on one or two activities instead of being involved in many activities. *'It is better to focus on one or two activities than doing three or four activities because then the attention will have to be spit over too many things.*

Nowadays, energy suppliers are focused on too many activities. They do not focus, because they do not want to be outdone by others.'

Partnerships
Lastly, as described in section 5.3, energy suppliers should develop partnerships with (new) actors in the value chain, such as ICT firms, to fully benefit from the opportunities created by the identified developments. Thus, these developments make that the number of partners in the value network of energy suppliers increases (Jacobides et al., 2006). Partnerships with these new actors could leverage knowledge and experience that is not available in the firm itself. However, authors such as Valocchi et al. (2014) state that the rise of new actors in the market causes more complexity and competition in the market, increasing the need for firms to differentiate themselves from others.

Following the structure of the BMI Framework of Wirtz and Daiser (2017), how energy suppliers can capture value from the identified business models (the revenue model) will be described in the dimension 'BMI Output/Impact' in section 6.3.

6.1.2 BMI Areas
As described in Chapter 2, the dimension 'BMI Areas' consists of the factors 'Business Model Components' and 'BMI Processes'.

Business model components
According to the literature (e.g. Richter, 2012, Hall and Roelich, 2016, Nillesen and Pollit, 2016, Loock, 2012), energy suppliers need to drastically change their traditional energy supplier business model (ESBM) to gain advantage of the developments in their environment. Such a drastic change is often accompanied by a fundamental change of the orientation of the business model (Casadesus-Masanell and Ricart, 2010). Osterwalder and Pigneur (2010) describe that a business model can have four orientations: (1) resource-driven, (2) customer-driven, (3) offer-driven, (4) finance-driven. The traditional ESBM (see Chapter 3) uses a resource-driven approach. In this approach, the business model is based on the available infrastructure of the business and/or its partnerships (Osterwalder and Pigneur, 2010). This approach is also referred to as an inside-out perspective (Barney, 1991).

The research-driven approach was useful, because of the large number of centralized power plants and the corresponding economies of scale, but with developments in technology and customer desires, such as the rise of distributed generation and increasing interests in demand-side management (the digitalisation and decentralisation trend), this is no longer the case. In combination with the increasing competitive liberalized market, customer loyalty can no longer be considered as a given (Sprecht and Madlener, 2019).

However, several scholars (e.g. Richter, 2012, Hall and Roelich, 2016, Nillesen and Pollit, 2016, Loock, 2012) state that this resource-driven approach does not take into account the full potential in the market. For example, the rise of distributed energy resources makes that energy suppliers can offer all kinds of services to their customers and the grid operators (e.g. demand response management and energy efficiency systems). Consequently, these authors argue that the traditional ESBM needs to be changed in order to deal with its environment. The customer-driven approach can be used for this purpose. In this approach, the business model is based on the needs of the customer by facilitating in assets or increasing their convenience (Osterwalder and Pigneur, 2010).

In addition, scholars as Teece (2010) state that a customer-based approach is needed to fully capture and create value for the customers. In contrast to the resource-based approach, in the customer-based approach value is created from a “consumer value experienced” perspective (Priem, 2007). Following this perspective, the most important part of the value creation takes place outside the business, with the customer (Vargo and Lusch, 2004). Hence, services that enhance the customer experience emerged quickly, and the customer became “co-producer” of the value creation process (Vargo and Lusch, 2004).

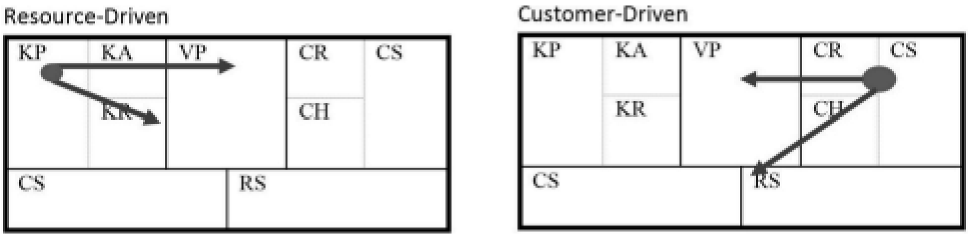

Figure 10 Resource-driven versus Customer-driven business model approach (Osterwalder and Pigneur, 2010; Specht and Madlener, 2019).

In sum, the business models of energy suppliers need to become more customer-based (Richter, 2012, Hall and Roelich, 2016, Nillesen and Pollit, 2016, Loock, 2012). Figure 10 shows a visualization of the difference between the two orientations using the business model canvas of Osterwalder and Pigneur (2010) (Specht and Madlener, 2019).

As discussed in Chapter 5, one way in which energy suppliers could become customer-based is by becoming an energy service provider (ESP), in which they monetize the value created by the digitalisation and decentralisation trend (e.g. Hannon et al., 2013), making use of the possibilities of the smart grid. However, becoming an ESP is not the only way in which energy suppliers could become more customer-based and respond to the developments in their environment. There is not one business model that fits perfectly to all the developments (Frankel et al., 2014). This can also be seen in (1) the sprawl of typologies created by researchers on this topic (Bryant et al., 2018; Burger and Luke, 2017; Verhaegen and Diercksesns, 2016; Hall and Roelich, 2016; Brown, 2018), (2) the number of different business cases in favour of the different DERs (Deilami et al., 2011; Nykamp et al. (2012), and digitalisation (Doleski et al., 2016; MIT, 2016) and (3) the number of different business models arising in practice. Appendix D provides a summary of the different business models arising in theory and practice. Because of the multiple different business model possibilities, energy suppliers have to (re)design their business model according to specific contextual elements of the firm, its position in the market and its desired risk profile (Frankel et al., 2014). A solid BMI Process can help energy suppliers to do this.

BMI Process

As described in Chapter 2, in this paper the Business Model Canvas of Osterwalder and Pigneur (2010) is used to structure the traditional business model of Dutch energy suppliers. This canvas is part of a larger framework, the Business Model Generation (BMG) framework that forms an approach that can be used to assess existing business models and to develop new ones (Osterwalder and Pigneur, 2010). This framework consists of five stages: (1) Mobilize (2) Understand (3) Design (4) Implement (5) Manage. These stages will be described in more detail below (Osterwalder and Pigneur, 2010). Figure A 8 gives a visual overview of this process.

Mobilize (Osterwalder and Pigneur, 2010)
In this phase, the company prepares itself for a business model project. The project team members will be determined, as well as the scope, objectives and planning of the project. The planning should mainly focus on the Mobilize, Understand and Design phases as the outcomes of these phases determine the actions that need to be taken in the Implement and Manage phases. The team for this business model project should contain organizational broad members, that are people with different backgrounds and different levels of industry experience. The Business Model Canvas can help to structure preliminary ideas of the team members, which can be used to define the objectives and the scope of the project. A 'kill/thrill session', in which a brainstorm session is followed by a discussion on why the generated ideas will or won't work, could be part of this phase.

Understand (Osterwalder and Pigneur, 2010)
The second phase of the BMG framework of Osterwalder and Pigneur (2010) is the phase 'Understand'. This phase is about understanding the relevant developments in the market, which is the aim of this paper. This phase includes market research (see section 3.4), interviewing experts (see Chapter 5 and the current Chapter) and studying existing business models (see Appendix D and the traditional business model described in Chapter 3). Osterwalder and Pigneur (2010) indicate that traditional industry assumptions and established business model patterns should be questioned in this phase.

Design (Osterwalder and Pigneur, 2010)
Third, the design phase is about adapting and modifying the business model as a response to market developments. In this phase, the team members should leave the traditional business model behind and generate breakthrough ideas for new business models. Focus and expansive thinking are key in this phase. However, the team members need to explore multiple ideas and take time to think about them before making a decision. Testing potential business models, including seeking feedback from experts and prospects outside the firm, is also important in this phase.

Implement (Osterwalder and Pigneur, 2010)
After the project team has designed a final business model, this business model needs to be implemented in the organisation. In this phase, a business plan is often made. This plan contains all the steps, such as a roadmap and a detailed budget plan that is needed to shift from the traditional business model to the newly developed business model. This plan is often made more concrete in a project management document in which the tasks are split up in small pieces and appointed to team members that become responsible for them. Moreover, in this stage, it is important that the consequences of the business model are closely monitored, so that differences between the expectations of the business model and the actual result can be minimized.

Manage (Osterwalder and Pigneur, 2010)
The last phase in the business model project is the manage phase. In the manage phase, it is about continuously scanning the environment of the firm and assessing the impact of this development for the newly designed business model. The project team, or a new team, should be held responsible for the resilience of the business model and its future design. Not just the management team, but all the employees should be involved in activities for identifying market signals and rethinking the business model. In other words, there should be a proactive mindset towards change and developments.

<u>The energy supplier case</u>
For energy suppliers, Tayal and Rauland (2017) argue that a phased approach could be used to assist energy suppliers in their shift from the traditional business model towards a new business model. In this approach, every identified development in the environmental analysis could be seen as a separate initiative, that is not necessarily dependent on the timing of the other initiatives. On other levels, the separate initiatives could be interrelated, but this is not the case regarding time. This means that energy suppliers could combine different initiatives based on their preferences, rather than the timeframe. In this way, energy suppliers could enhance the flexibility and adaptability of the business model innovation framework.

For instance, energy suppliers could be active on the solar photovoltaics market, while at the same time lobbying for more detailed or flexible regulation regarding data management. This phased approach allows energy suppliers to deal with different developments at the same time. On the other hand, the developments could be interrelated as well. For instance, the rise of the solar market allows energy suppliers to build new customer relationships (for example via third-party business models and power purchase agreements). This development is part of the trend 'decarbonisation'. In addition, solar photovoltaics allow energy suppliers to be active in the energy storage market as well, by controlling the amount of energy produced or consumed using smart grids (Tayal and Rauland, 2017). Smart grids are part of the trend 'digitization'. Moreover, because the contracts for customers with solar photovoltaics are mainly closed for the long term, solar photovoltaics would also accelerate higher customer retention levels.

The speed of the business model generation project and the intensity of the change will also have a great impact on the outcome of the project and the way in which it should be managed. Therefore, the next section will elaborate more on the intensity of business model innovation projects.

6.2 BMI Intensity

As described in Chapter 2, the intensity of the business model innovation could be classified as 'Moderate (Incremental) Innovation' and 'Radical (Disruptive) Innovation'. Many researchers argue that disruption is needed in the energy sector (e.g. Frankel et al., 2014; Richter, 2013).

Previously, developments in technology were considered as incremental innovations that followed the same traditional pathway as before, based on decisions made earlier. This made that the industry became 'locked-in' (Lee et al., 2015). This is also known as path dependence (Lee et al., 2015). However, the traditional business model of energy suppliers is under pressure, due to the identified developments. The shift towards low-carbon electricity, rapid technology innovation, increased interest and falling costs of distributed generation, increased demand and the possibilities for demand-side management make that disruption of the status quo is needed (Geels, 2018; Tayal and Rauland, 2017).

The increasing value and attractiveness of the developing technologies and services make that the energy industry is now being considered as an industry that is ripe for *disruption* (Frankel et al., 2014; Roberts, 2013). Some authors even argue that energy suppliers that fail to undertake actions to fundamentally change their business model will even worsen the challenges faced by these firms (Zinaman, 2015; Frankel et al., 2014). This is due to the increased value that can be created from the current developments for these energy suppliers and their customers, as well as the increasing competition as a consequence of the liberalization of the energy market.

Intensity of the business model innovation based on the BM change typology of Cavalcante et al. (2011).

On the other hand, Cavalcante et al. (2011) state that the intensity of business model innovation can be conceptualized by four different types of business model (BM) change. These different types of business model change highlight that different levels of innovation are accompanied by different levels of change of the traditional business model. Moreover, these types could help to understand how energy suppliers can incorporate the developments in their environment in their business model. The four types are: BM creation, BM extension, BM revision, and BM termination.

BM creation is the initial design of a business model, whereas BM extension is conducted by adding additional activities to an existing business model, without fundamentally changing its core business logic (Cavalcante et al., 2011). On the other hand, BM termination is about eliminating some activities of the business model, while BM revision is a radical or disruptive change that does require a fundamental change of the current business logic and activities, and is therefore about eliminating the whole business model (Cavalcante et al., 2011). Using these types, we describe what business model innovations Dutch energy suppliers could use respond to their changing environment according to the different levels of innovation.

<u>BM termination and BMI extension – the energy supplier case</u>

Again, BM termination is about the elimination of (parts of) the business model (Cavalcante et al., 2011). An example of termination in the energy sector is that digitalisation eliminates the need for employees to visit the workplaces of their clients because this can be done remotely.

On the contrary, BMI extension is about adding activities to the existing business model. In the case of energy suppliers, E.ON can be used as an example. This large energy supplier (tries to) incorporate(s) smart energy solutions and renewable energy sources in its business model, while it is simultaneously still being active in the bulk production of energy from fossil sources and the sale of units of energy (E.ON, n.d.). As stated earlier, energy suppliers can partner with IT-companies to make use of the potential of the digitalisation trend. In this way, the business model is extended as well. Another way to extend the existing business model is by creating spin-offs of the firm, acquiring innovative start-ups or by operating accelerator programs (like E.ON agile) (Calvalcante et al., 2011).

<u>BMI revision and creation</u>

BMI revision is about substituting the logic and activities of the current business model with a completely different logic and other activities. As stated before, currently energy suppliers sell units of energy. Therefore, their revenue increases for every unit of energy sold. However, if an energy supplier wants to change its business model into one that is based around the reduction of the amount of energy consumed by the consumer, the current business model needs to be revised. In the new business model, the energy supplier will earn money if it encourages the customers to save energy instead of by consuming more energy. For this reason, changing the business model from selling units of energy towards selling solutions to save energy, can be regarded as a business model revision.

BM creation is about the initial design of a completely new business model in a new venture. Often, this type of business model innovation is done by start-ups (Calvalcante et al., 2011). In the energy sector, we find start-ups like *Buzzn* that offers digital platforms for the operation of energy communities and a marketplace in which prosumers can provide their excess energy to peers. However, because we focus on business model innovation for existing energy suppliers, this type of business model innovation is not suitable for our study. However, partnering with these start-ups is possible and is covered with a business model extension.

6.3 BMI Output/Impact

The BMI Output/Impact Dimension consists of the elements 'BMI Sustainability', 'BMI Competitive Advantage', and 'BMI Value Creation/Capture'.

6.3.1 BMI Sustainability

With their element 'BMI Sustainability' Wirtz and Daiser (2017) refer to the concept of organizational sustainability. The main idea of this concept is the success of the business model innovation is based on the resources that protect and expand the sustainability of the business model (Wirtz and Daiser, 2017, p.23). The degree of organizational sustainability could be determined by three factors: exceptionality of the resources (asset-based sustainability), preferential access to resources or customers (relationship-based sustainability), and valuable experiences concerning working in a specific manner (tacit-knowledge-based sustainability) (Mahadevan, 2004). However, as these factors also highly impact the competitive advantage of the organization (Mahadevan, 2004), these factors will be discussed in more detail and applied to energy suppliers in the next element 'BMI Competitive Advantage'.

Consequently, for the element 'BMI Sustainability', we address the need for companies to operate in a way that creates social and environmental value and therefore creates value beyond the economic profits for shareholders as is pointed out by studies such as Carayannis et al., 2014, Stormer, 2003; Dunphy et al. (2003). Moreover, Stubbs and Cocklin (2008) state that companies need to incorporate social and environmental priorities in their innovated business model, in order to reach a higher degree of organizational sustainability.
A concept that is often referred to in the business model literature, is the concept of so-called 'sustainable business models' (e.g. Bocken et al., 2014; Boons and Lüdeke-Freund, 2013; Schaltegger et al., 2012; Stubbs and Cocklin, 2008). This concept combines sustainability with commerce and is therefore relevant for energy suppliers, who have to deal with all kinds of goals and regulations focused around sustainability but also have to deal with capturing economic value for itself and other stakeholders (Stubbs and Cocklin, 2008; Schaltegger et al., 2012).

The work of Bocken et al. (2014) categorizes the mechanisms and solutions that contribute to the design of sustainable business models. Most of these mechanisms and solutions can be applicated to the energy sector. The authors argue that sustainable business model innovation can be categorized into three categories: Technological, Social and Organizational oriented innovations (Bocken et al., 2014). Figure A 9 gives an overview of these categories and their belonging archetypes, as well as some examples of sustainable business models in each of the categories. As can be seen in the figure, there are many possibilities for business to make their business model sustainable. For energy suppliers, the Social and Organizational categories are the most interesting. The Social category includes archetypes with innovations in the offer to the customer and the behaviour of the customer, whereas the Organizational category is considered with changing the legal structure of the firm or in relation to the customer).

For example, following the Social Grouping, energy suppliers could adopt a sustainable business model (e.g. BOO) that delivers functionality rather than ownership to break the line between profit and production volume, which can reduce resource consumption. On the other hand, following the Organizational Grouping, energy suppliers can develop scale-up solutions using a sustainable business model on the basis of collaboration. Here, the energy supplier facilitates bringing together individuals, firms and investors with the same energy-related interests to (radically) change their consumption patterns (Bocken et al., 2014). Thus, there are many possible business models for energy suppliers that will embed sustainability into the business purpose and processes, contributing to achieving the corporate, national and worldwide sustainability goals.

6.3.2 BMI Competitive Advantage

As described in the previous section, the competitive advantage of a firm is impacted by the exceptionality of the resources (asset-based competitive advantage), preferential access to resources or customers (relationship-based competitive advantage), and valuable experiences concerning working in a specific manner (tacit-knowledge-based competitive advantage) (Mahadevan, 2004). Therefore, this section applies these three elements to the energy supplier case.

Asset-based competitive advantage

As stated before, energy suppliers have to change their current asset-based business models because of the goals originating from the energy transition. However, in the current business model, tangible assets, complemented by related intangible assets, are the core of the infrastructure of energy producers, because they control the energy infrastructure (Helms, 2016). Because most of the large Dutch energy suppliers are part of a large energy company, and therefore fully integrated into the value chain, the assets utilized by the energy production part of this large energy company dominates also the decisions made in the energy supplier part of the value chain (Meijer et al., 2019). Due to the current tangible asset-heavy infrastructure of these large energy companies, decisions are made based on the possibilities that these assets offer (e.g. maximum amount of energy that can be produced in a certain period, maintenance schedules etcetera) because these assets need to return their investment (Meijer et al., 2019).

However, new, innovated, innovated business models are needed to be more intangible oriented and therefore include the performance of labour and the transfer of competences. Consequently, the asset-based competitive advantage of energy suppliers will mainly be based on intangible assets. In other words, intangible assets such as human capital (skills, talent and knowledge of employees), informational capital (information systems, networks and technology infrastructure) and organizational capital (alignment of employees with the firm's strategic goals, knowledge-sharing capabilities, company culture, leadership style) become more important for the energy supplier for sustainable value creation and competitive advantage (Kaplan and Norton, 2004).

In contrast to tangible assets, the value of intangible assets is often difficult to capture (Kaplan and Norton, (2004). This is mainly to the fact that it arises from the alignment of the employees with the strategy of the firm (Kaplan and Norton, 2004). Therefore, financial-oriented energy suppliers face often barriers to the shift to a business model that primarily requires intangible resources/assets (Kindström, 2004). Nevertheless, Hall (1993) describes that the firm value of intangible assets can be estimated as 'the differences between the balance sheet valuation of a publicly quoted company and its market capitalization', whereas Kaplan and Norton (2004) argue that the value created by intangible assets can be estimated as the difference between the firm value and the value of the tangible assets.

Relationship-based competitive advantage
With the recommended shift to a service-based business model in the literature (e.g. Richter, 2013; Duncan, 2010; Klose et al., 2010; Schleicher-Tappeser, 2012), customer relationships become of crucial importance. In these service business models, specific customer needs are addressed and proactive forms of communication with the customer need to be established (Helms, 2016). Moreover, customer relationships need to have a long-term character in order to offset the higher costs that are made to acquire and serve the customer (Richter, 2013). Moreover, as described earlier, authors urge the need for energy suppliers to engage in joint value creation projects and partnerships with other actors in the industry (e.g. Tayal and Rauland, 2017).

In sum, relationship-based competitive advantage can be achieved by a customer-centred culture, that is based on customer needs. Therefore, customer contracts in service-based business models vary, from engineering and installation services to consultancy services and energy control. Moreover, the aforementioned 'build-own-operate' models in which a third party (for instance the energy supplier) finances the equipment needed for distributed energy generation, or needed for final energy serves such as heating or lighting to enhance the energy efficiency. Lastly, because energy suppliers have insights in all kind of customer data, that enable them to segment their customers and make customer profiles, which allow them to offer additional tailor-made services.

Tacit-knowledge-based competitive advantage
Finally, tacit-knowledge-based competitive advantage is of importance for energy suppliers as well. However, in service-based business models, tacit-knowledge can both be enabling and inhibiting competitive advantage. For instance, interviewee 8 says: '*for this (service-based) type of business models, we need all-rounders, people who know how our organization works, and who are able to assess the risks of their actions*'. Whereas others argue that tacit knowledge can inhibit the competitive advantage that an energy supplier could achieve, because of the cultural change that this shift needs. Interviewee 6 says: '*Energy suppliers are to some extent very classical organizations, they did not pick their staff because they wanted innovative ideas, but they wanted the job well done (…), you cannot say to someone that works for about 20-30 years for a company, do this completely different, turn 180 degrees, and be innovative (…)*, *you will face enormous inertia*'. Moreover, they highlight the difficulty to hire

new, young staff with enough knowledge of the sector and the skills to work interdisciplinary and is able to find the nature of the problem.

6.3.3 BMI Value Creation/Capture

The last element of the Dimension 'BMI Output/Impact' is the 'BMI Value Creation/Capture' element. This element is about the returns (financial or otherwise) that the firm derives in exchange for the value that this firm creates (Wirtz and Daiser, 2017). Regarding the financial returns, this element is related to the 'Revenue Model' pillar of the business model canvas of Osterwalder and Pigneur (2010). This pillar is about the relationship between the costs to produce the value proposition and the revenues that are generated by selling it to the customers (Osterwalder and Pigneur, 2010; Richter, 2012). Therefore, the Revenue Model consists of the building blocks 'Cost Structure' and 'Revenue Streams'.

Revenue streams

As with many projects, the revenue model is often the key element for the decision of managers about the realization of the project. Currently, in the traditional energy business model, the customer pays for every unit of energy they use. Thus, energy suppliers gain the most of their revenues from selling units of energy and earn more if customers use more energy. As more consumption leads to more production, and fossil-based production goes against the goals set by the European Union, energy producers need to think about the resilience of their revenue model in the future. For instance, energy producers could develop large scale renewable energy projects, such as large-scale solar PV parks or wind farms, that will generate returns similar to the conventional power plans. The revenues that emerge from these large-scale renewable energy projects can be supplemented with regulated feed-in tariffs or tax- or investment credits (Lüdeke-Freund and Loock, 2011).

However, as this paper does not focus on the production part of the value chain, the economic viability of different options regarding new forms of energy production will not be discussed. Instead, there will be focused on pricing systems and revenue models that break the coherence between the amount of energy used by the customer and the number of revenues earned by the energy supplier. These pricing systems stimulate energy suppliers to engage in energy efficiency measures that contribute to the goals of the European Union to reduce the energy produced from fossil fuels. In addition, there will be discussed how energy suppliers could earn revenues from offering additional services, such services that are part of the smart grid.

<u>Changes in the energy pricing system</u>

This section describes two additional ways in which energy suppliers could determine their energy prices (Chasin, Paukstaft and Gollhardt, 2020; Schmidt, 2010; Nimmons and Taylor, 2008; Thomas, 2018).

First, Nimmons and Taylor (2008) describe the concept of 'decoupling', in which the revenues are separated from the amount of energy used by the customer. It is a regulatory mechanism that aims to decline the intensity of the greenhouse gas emissions and to stimulate energy suppliers to perform energy efficiency efforts rather than just focusing on the upgrading the sales volume (Nimmons and Taylor, 2008). In this mechanism, '*the government makes sure that the revue of the energy supplier from fixed costs remains at the level the regulator determines to be fair and reasonable, including a fair return on investment and customers paying a fair amount for the services they receive*' (NREL, 2009, p.1).

Although the opinions about this type of pricing strongly differ, it is already used in some states in the United States (Schmidt, 2010). Critics argue that the mechanism does not stimulate energy suppliers to use their full potential in performing the energy-efficient options, because of the compensation (Nimmons and Taylor, 2008). However, others argue that the importance of the system increases in the upcoming years, due to the need to shift away from the traditional energy business model (Schmidt, 2010).

Second, the concept of 'flat-rate tariffs' is drawn in the literature (e.g. Chasin et al., 2020; Thomas, 2018). This concept is similar to a subscription model because the customer pays a fixed price regardless of the amount of energy this customer consumes (Chasin et al., 2020). More specifically, the energy supplier does not charge rates but is regarded as a service provider, that uses mechanisms to reduce the energy consumption of the customer (Thomas, 2018). Again, this energy pricing model is already used by two American energy suppliers, Inspire and Austin Energy (Chasin et al., 2020; Hamwi et al., 2017). These companies give customers access to energy between a pre-determined bandwidth in exchange for a set monthly fee (Thomas, 2018). In addition, the customers can, voluntarily, participate in so-called 'energy management programs', in which the customer allows the company to install distributed generation resources on its roof, as well as installing energy management equipment and appliances. This allows the energy supplier to increase energy efficiency (Chasin et al., 2020; Hamwi et al., 2017). The fee that the customer has to pay is based on an amount per square foot, and is higher if the customer does not want to participate in the energy management programs (Chasin et al., 2020; Hamwi et al., 2017).

<u>Changes in the revenue stream arising from smart grids</u>
Deploying smart grids are also a way in which customers can be empowered to decrease their amount of energy used. However, again, this will lead to a drop in the revenues from energy suppliers (Klose et al., 2010). Thus, it is necessary that energy suppliers develop new revenue streams that are not directly related to selling energy. As the smart grid fulfils the needs of customers that are related to gaining control over their usage, energy firms will be able to generate revenues based on these needs in two ways: by increasing and improving data analytics (big data) and partnering with interested parties.

First, the smart grid makes it possible for energy suppliers and their customers to gain insights into the (almost) real-time energy consumption pattern of the customer. Customers will need to give their permission for the usage of this information by the energy supplier. When this data is obtained, energy suppliers are able to visualize these data and provide the customer 'feedback' on their energy usage. This will lead to more awareness by customers and can be used for demand response purposes (Shomali and Pinkse, 2016). However, energy suppliers can use this data for much more purposes. For instance, they can use this information to optimize the grid, their existing product and service offerings and developing new ones.

In addition, Valocchi et al. (2014) describe that energy suppliers could sell this energy consumption data to providers of applications, devices or other products or services. For instance, the authors describe that energy suppliers could sell the data to external energy service providers that can offer energy efficiency consulting to the customers, becoming an information aggregator (Valocchi et al., 2014). In this case, with the permission of the customer, the energy supplier builds profiles around the usage patterns of customers and earns revenues from selling these profiles (Valocchi et al., 2014). Though, it remains to be seen how much companies will be interested in buying this data, and what the regulatory possibilities for this type of revenue model are. Figure 11 shows the network around the information aggregator (platform owner).

Second, the smart grid makes it possible for firms to develop new services in collaboration with other parties. For instance, Geelen et al. (2013) describe that energy firms can help customers to detect which appliances are due to replacement, and can offer, though a long-term contract with manufactures of these appliances programs in which customers can buy new, more efficient ones with a discount. Moreover, (Cappers et al., 2012) describes that energy suppliers could help customers with home energy systems in which automated software manages the operation of certain appliances. In other words, energy suppliers could create ‘multi-sided platforms’, that connects multiple suppliers with multiple customers (Eisenmann et al., 2006). In this way, the resources, capabilities and specializations of multiple stakeholders in the energy sector can be leveraged by all other actors in the network. Valocchi et al. (2014) describe that energy suppliers are in the best position to start these platforms because they have relationships in the value chain and the customer base to make this platform successful. However, again, the question remains about how interested customers and other actors are on this platform.

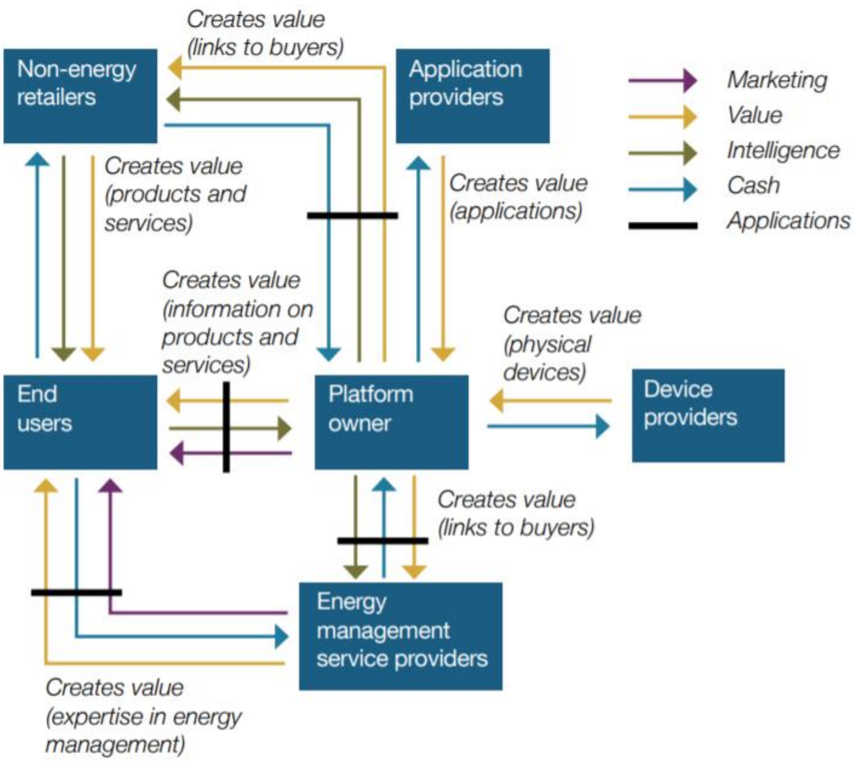

Figure 11 Information aggregator network (Valocchi et al., 2014)

Cost structure

The different developments all have their characteristics and therefore have different cost structures (Valocchi et al., 2010). For each of the developments, new costs have to be made. This is quite different than the traditional energy business model, which is based on economies of scale from large, centralized power plants (Bryant et al., 2018). For instance, regarding the decentralisation trend, for every customer, a plan about the type of distributed energy resource that will be used has to be made. This leads to higher and more tailor-made solutions than is the case in the traditional energy supplier business model. Therefore, from the start, more costs have to be made. Nevertheless, after a certain period, patterns in the projects can be found, which can, to a certain extend, lead to standardization.

The same holds for the other trends. For instance, the establishment of a smart grid includes investments in technology, software and communication facilities as well as costs for building a new infrastructure and connecting this to the current energy network. Moreover, the energy firm will make maintenance costs of the technology that is added to the infrastructure of the grid and will make costs for developing the new services such as the ‘customer engagement programs’, as well as costs for training existing staff or hiring new employees to perform all the tasks relating to the development and execution of the new programs (Giordano et al., 2012).

On the other hand, energy firms do not have to spend money in other areas. Innovations such as smart meters, make that operational costs (human and logistic) for reading, collecting and communicating the data of the meter every once in a while are no longer necessary, because smart meter automatically can send this data to the energy supplier (Giordano et al., 2012). Moreover, it can automatically send detailed information about the failure of the equipment to the energy company, so that problems with the meter can be solved more easily and fast (Giordano et al., 2012). The same holds for the assets of the current centralized grid. When connecting these assets to the smart grid, the ICT infrastructure could be used to decline the maintenance costs of these assets, as information about them will be visible digitally (Giordano et al., 2012). Even more drastically, in combination with distributed energy resources, smart grids will decrease the investments that energy firms have to make in the transmission phase of the value chain because the production takes place close to the point of consumption (Battaglini et al., 2009).

Furthermore, smart grids can lead to cost savings other than related to maintenance or operational costs. Smart grids empower customers with (almost) real-time access to their energy usage. In combination with information about the energy prices, Faruqui et al. (2010) found that a considerable group of the customers was willing to shift its energy usage to off-peak hours, resulting in more spread in the production capacity and a decrease of the production costs (Faruqui et al., 2010).

Lastly, the costs for centralized large-scale power plants increase every year, due to increasing taxes and the fluctuating prices of conventional power plants (Lehr, 2013). Taking into account these factors, as well as the increasing maintenance and replacement costs, authors such as Poudineh and Jamasb (2013) argue that shifting to distributed energy resources is advantageous in the long term.

Yet, due to the relative novelty of the developments, exact calculations of the revenues and costs of these developments have not been addressed in the literature. Some pilot studies try to find evidence from the cost reductions that (combinations of) the identified developments might leverage, but these studies are still in an early phase (Richter, 2012; Shomali and Pinkse, 2016). The effects of the developments on the cost structure are also very bound by a country-specific context, such as governmental support (McHenry, 2013). More extensive research needs to take place to make visible what the cost-related effects of these developments for energy suppliers are. To date, it is clear that the developments will increase the transaction costs per customer, but also will decrease other costs and tap other sources of revenue. Though, the exact composition of the interrelated revenue model has still to be determined (Richter, 2012*). Interviewee 7 describes this challenge: 'The challenges with innovative business models, is always the revenue model. But there is nothing that is not for sale.'*

6.4 Summary of findings

To summarize, Table 9 compares the traditional energy supplier business with the recommendations for future energy supplier business models.

Table 9 Comparison of the traditional energy supplier business model vs future energy supplier business models

Element	Building blocks	Traditional energy supplier business model	Future energy supplier business models
Value proposition	Value proposition	Low cost, efficient and reliable energy provision, generated in bulk at centralized power plants, distributed via the grid.	Change to Energy Service Provider (ESP), also called Energy Company (ESCo), selling services instead of selling units of energy. Focus on energy efficiency, energy management and renewable energy.
Customer interface	Customer relationships	Energy is seen as a commodity, limited attention for long customer relationships.	More complex tailor-made and highly service-based relationships, (can be) focussed on the long term (e.g. in the build-own-operate business model).
	Customer Segments	The energy supplier serves all entities that need energy: organizations, industrial firms and governments	The emergence of new customer segments (e.g. environmentally friendly, prosumers, data-driven/energy management, energy communities).
	Channels	The energy supplier 'communicates' with the customer using the monthly energy bill, new customers are attracted using sales representatives.	Real-time two-sided information flow of energy and information. Sales representatives offer tailored-made contracts with additional energy services.
Infrastructure management	Key partners	Key partners of the energy supplier in this business model category are the parties mentioned in Figures 5 and 6. Mainly energy producers and grid operators.	Additional partnerships with actors in and outside the value chain, such as ICT-firms, manufacturers and universities need to be developed.
	Key activities	The energy supplier is occupied with the retail of energy; trading the energy (gas, heat, and electricity) and customer contact.	Depending on the level of vertical integration, the key activities remain the same or will change drastically. Nevertheless, data

			management is highly important.
	Key resources	A small number of large, centralized assets that are owned by utilities.	A large number of small, decentralized assets on the site of the customer, or centralized renewable energy plants. Virtual power plants, more skilled IT-staff that is able to build/repair/work with these virtual power plants.
Revenue model	Cost structure	Costs for the deployment of the infrastructure as well as staff costs, costs for IT systems, and certificates.	Costs structures will become more complex because customers both buy electricity from the energy supplier and sell energy to this supplier. Costs of maintenance will decrease due to smart technologies, whereas investments in these smart technologies and qualified staff need to be made. Higher transaction costs due to tailor-made advice about energy services.
	Revenue Streams	Revenues generated by selling units of energy to customers and other parties such as traders and BRPs. Economies of scale from large energy production projects.	New revue streams for energy services, feed-in tariffs and big data, and possibly from being a central actor in multi-sided platforms. New pricing systems can be developed (e.g. '*flat-rate tariffs').*

7 Discussion and conclusion

In this chapter, we finalize this study by discussing the findings and comparing them to the existing theory. Afterwards, we draw on the practical contributions and the limitations of this study. Lastly, we finish with a conclusion and the directions for future research.

7.1 Discussion

The findings of this study have various implications for both theory and practice.

7.1.1 Theoretical implications

This study investigates what business model innovations Dutch energy suppliers could use respond to their changing environment. Based on literature reviews, content analysis and interviews with both academic and industry experts, we analyse the environment of Dutch energy suppliers and identified the trends and developments in this environment. Subsequently, we describe what the drivers and barriers for energy supplier business model innovation are. The business model framework of Wirtz and Daiser (2017) serves as a structure for this study.

<u>Elaborating the Wirtz and Daiser (2017) business model innovation framework</u>

Our first theoretical implication is related to this framework. In this study, we have elaborated on the framework of Wirtz and Daiser (2017) by giving the factors of this framework a definition. This framework was found helpful for this study because it combines both factors in the macro- and micro-environment of a firm. However, Wirtz and Daiser (2017) do not (clearly) define the elements of their framework in their paper. Based on a case study performed at Google, the authors illustrate the elements and their coherence in practice. However, to increase the understanding of the different factors in this framework outside the context of the Google case, we have drawn definitions of each of the factors in the framework of Wirtz and Daiser (2017).

<u>Validation of the Wirtz and Daiser (2017) framework and assessing its value</u>

Moreover, we have validated this framework and shown its relevance to the energy sector. we ague that is model is a helpful guide for business model innovation in practice. It can support managers with insights about the components of business model innovation in a comprehensive way. Taken this framework together with our extension that defines the perspectives and factors of this framework, we argue that this framework is a clear and useful tool for managers to design and implement business model innovation. We thus underline the value of this framework, as it is a comprehensive framework consisting of all important business model innovation elements. In particular, we argue that the dimensions ‘BMI Tools and Techniques’ and ‘Knowledge/Information Processing and Sense-making’ are two valuable dimensions of this framework, as they connect the ‘Central’ and ‘Environmental’ BMI dimensions. We have not seen such connection/integration in other BMI frameworks. The Dimension ‘BMI Intensity’ was also found as a well-chosen dimension for this framework, as it makes managers to consciously reflect on the pace and amount of change needed for the innovation process. However, looking at the perspective ‘BMI Factors’ and the factor ‘business model components’ of the perspective ‘BMI Areas’, we do not fully understand why these two elements are both integrated into this framework. In our opinion, these elements both deal with the structure of a business model, it is using the questions ‘Who?’, ‘What?’, ‘How?’ (BMI Factors) or the business model components of the Business Model Canvas of Osterwalder and Pigneur (2010). Both elements are about how value is created, delivered and captured.

Applicability of the Wirtz and Daiser (2017) business model framework outside the energy sector

Overall, we found this framework useful to structure this paper and to identify the steps that need to be taking during a business model innovation process. We argue that this business model innovation framework of Wirtz and Daiser (2017) can be applied in sectors other than the energy sectors as well because this framework combines (elements of) well-known, much-debated models and concepts in literature and/or practices. For example, it uses parts of the PESTEL (Political, Economic, Social, Technological, Environmental and Legal) model of Aguilar (1976) in the dimension 'Environmental BMI Dimension' and elements of the Business Model Canvas of Osterwalder and Pigneur (2010) in the dimension 'Central BMI Dimension'. Moreover, by just looking at the dimensions of the model, no sector-specific elements can be found. All dimensions are general, and can, if necessary, be enriched with industry and company-specific criteria that allow for identification of and reflection on industry- and company-specific issues. However, additional case studies, other than the energy supplier case, are needed to validate this statement about the usefulness of this framework outside the energy sector.

Changes in the macro-environment are (major) drivers for business model innovation

Second, our study revealed implications regarding the drivers for business model innovation. Our study showed that changes in the macro-environment of the firm (can) have an enormous impact on the business model of a firm, driving them to innovate their business model. The energy sector faces worldwide social and legal pressure to change their business model into a model that is more sustainable, based on renewable energy. To illustrate, the European Union wants to be fully climate neutral by 2050 and the share of renewable energy in the total energy consumption must be at least 32 percent (European Commission, 2018), which has major consequences for utilities having a business model based on fossil fuels. Moreover, technological developments made it possible for customers to self-generate a part of their energy consumption and to have real-time insights into the amount of energy consumed, which drivers energy business model innovation as well. In other words, we found that changes in the macro-environment of the firm, such as technological, social and legal developments, are major drivers for business model innovation. Consequently, we can confirm the relevance of the elements described in the PESTEL framework of Aguilar (1967). This framework describes that Political, Economic, Social, Technological, Environmental and Legal factors impact the performance of a firm. Our study recognizes that these elements indeed have a major impact on the (future) performance of the firm, and therefore the sustainability of the current business model, which drives firms to rethink this business model (and thus perform business model innovation).

7.1.2 Practical implications

Our findings revealed several implications for energy supplier business model innovation in practice. This research provides managers in the energy sector with insights into the developments in their environment, and even more important and practically meaningful, how they can respond to these developments using business model innovation. In the remainder of this section, we draw the practical implications of our study, using our three key elements: the drivers, barriers and conditions of energy supplier business model innovation.

1. *Drivers of energy supplier business model innovation*

We observed that the changing environment of energy suppliers consisted of three trends: Decarbonisation, Decentralisation and Digitalisation. The need for actors in the energy sector to mitigate climate change through a transition towards an energy system based on renewable energy (the decarbonisation trend) was the starting point for all actors in the energy sector to rethink their current way of working. At the same time, the rise of distributed energy resources (DERs) created an opportunity for consumers to generate their own energy needs (decentralisation trend). The digitalisation trend drives the development of these trends, by linking distributed technologies, customers and suppliers via digital technologies (e.g. Burger et al., 2019). In other words, we can state that these three trends are interconnected. Decentralisation is an important trend to reach the goals of the Kyoto Protocol and the European Union about decarbonisation, and digitalisation facilitates (the growth of) decentralisation. Thus, we recommend utilities to engage in activities related to the decentralisation and digitalisation trend.

Moreover, our findings suggest that the digitalisation trend enables more efficient and dynamic energy consumption and enhances the flexibility of the grid. The latter is needed because renewable energy sources, like wind and solar, are not as controllable as the traditional energy production based on fossil fuels. Consequently, there is an increasing demand for flexibility and need for new sources that can provide this flexibility, that can be linked using digital developments (e.g. virtual power plants) in the smart grid. Energy suppliers can fulfil a role in providing this flexibility, for instance by becoming an aggregator.

Furthermore, the combination of distributed generation and storage (decentralisation trend), together with the increase in digitalisation (e.g. smart metering, and smart grids) enable energy suppliers to collect and analyse more specific, real-time data of their customers and develop new energy-related services (e.g. demand-side management) based on these data. Thus, offering energy-related services is another way in which energy suppliers can profit from the combination of the decentralisation and digitalisation trend. This is necessary because of the decline in revenues through the customer empowerment and the energy savings measures arising from the digitalisation trend.

In sum, the decentralisation and digitalisation trend are drivers for energy supplier business model innovation, because these trends help energy firms to change their business model in order to:

- Decarbonize by integrating (centralized) distributed energy resources into the grid using digitalisation, therefore contributing to the goals of the UN and EU on stabilizing the greenhouse gas emissions;
- Allow customers to have access to the energy market, become partly self-sufficient and consume energy more efficiently, therefore again contributing to the goals regarding stabilizing the greenhouse gas emissions;
- Shift away from selling electricity to selling energy services, therefore fulfilling the need for more flexibility in the grid (e.g. by becoming an aggregator).

2. *Barriers for energy supplier business model innovation*

Next to the drivers, we found a couple of barriers for energy supplier business model innovation. In line with the findings of Haaker et al. (2017), we found that business models, in general, are often confronted with unpredictable changes in technology and regulation, resulting in the expectation of managers that new business models will incur high risk. Moreover, Chesbrough and Rosenbloom (2002) and Christensen (2013) argue that managers face cognitive barriers to business model innovation, that hinder them to radically change their business model while the old one is still leveraging revenues.

For energy suppliers, we found the barriers are mainly related to regulation and revenue and managerial and operational barriers. These barriers complement the work of Helms (2016), who studied served based energy supplier business models.

Regulation and revenue

First, regulation and revenues are barriers for energy supplier business model innovation. Managers have their concerns about the profits that sustainable business models can generate relative to the current, traditional business model. This is in line with the findings of Chesbrough and Rosenboom (2002) and Christensen (2013). Currently, governments are reducing the revenue risks for energy suppliers and producers. For example, mechanisms such as fixed feed-in tariffs and market premiums that supplement the revenues of energy suppliers and producers, by providing the difference between energy spot prices and a pre-guaranteed average price (Scheller et al., 2018). In this way, regulation impacts the revenue of energy suppliers and producers directly.

However, as the results from the interviews suggest, without these mechanisms business models based on selling renewable energy, are at this moment not profitable, but the interviewees recognize that a transition towards a more sustainable business model is necessary. Next to affecting the revenue directly, regulation can also impact the revenues of energy suppliers indirectly, by enabling or constraining the development of alternative business models. Regulation can hamper the development of a new business model by a company, while at the same time foster the creation of a business model by a competitor by creating a market opening for this type of business model. This finding complements the work of Wainstein and Bumpus (2016) who state that regulation impacts the implementation, adaptation and destruction of nice markets in the energy sector. Moreover, regulations affect the development of new business models because of the regulated character of the grid (in which DSO's have a monopoly). As the grid is an important part of the supply chain, regulations about the grid affect the processes of energy suppliers as well.

Managerial and operational barriers

Second, we identified organizational and organizational and operational barriers. For instance, we found that energy suppliers can perceive barriers regarding managing the new, customer-centred, flexible business models next to or within the traditional business model. The energy efficient solutions in the service-based business models conflict with the revenue model of the traditional business model, in which energy suppliers earn money for each unit of energy sold. Because these business models have very different attributes and require a different managerial approach, managing these business models simultaneous can be difficult. To deal with this challenge, a number of scholars propose to create a different business unit or spin-off to experiment with the new business model (Gebauer et al., 2006; Kindström, 2010). Other organizational and operational barriers have to do with difficulties to find qualified staff, risk avoidance and mistrust of financial institutions through lack of standardization (Hannon et al., 2013).

3. Conditions for energy supplier business model innovation

Third, our analysis has hinted at conditions for energy supplier business model innovation. In the previous sections, we have indicated the drivers and barriers for energy supplier business model innovation. However, we draw three conditions that increase the success of energy supplier business model innovation. These conditions are focused around organisational structure, governmental support and customer engagement (e.g. Shomali and Pinkse et al., 2016). These conditions are explained in more detail below.

Organisational structure

First, the degree to which energy suppliers are vertically integrated affects how energy suppliers (can) deal with the developments in their environment. Vertically integrated energy suppliers (for instance energy suppliers that are part of large energy corporations) often own centralized fossil-fuel based power plants and can therefore face barriers towards moving away from these centralized power plants. Therefore, energy suppliers that are not part of larger energy corporations can be more flexible and can more experiment with new forms of value creation and delivery. These energy suppliers might therefore benefit the most from the developments in the However, vertically integrated firms can benefit from the increase in information about the energy usage of the customer, when managing the transmission and distribution parts of the firm.

Second, because of the differences between the highly asset-based traditional business model and new types of business models based on services and the necessary split of managerial attention resulting from this, separating the activities of the traditional business model and the innovated business model is recommended. A separate venture or an independent business unit needs to be established for this purpose. This is also suggested in the literature (e.g. Kindström, 2010; Bessant et al., 2004; Gebauer et al., 2006) to overcome the internal barriers and predominant values in the parent company and therefore to protect the emerging innovative culture (Oliva and Kallanberg, 2003). However, because both the companies or the business units are still connected, fostering relationships can still be exploited (Apajalahti et al., 2015).

Third, energy suppliers have to cooperate with external partners to foster the accumulation of know-how and innovation capabilities that are needed to respond to the changes in the environment of the firm. As described, energy suppliers could collaborate with external stakeholders such as universities, research centres and NGOs. Moreover, they could cooperate with other firms in- and outside the value chain to gain access to complementary assets needed to innovate the business model and manage the value network. Regarding smart grids, energy suppliers can for instance work together with ICT firms to gain more insights into the energy usage patterns of the customers and offer additional services based on these patterns.

Collaborations between energy suppliers and external parties can already be seen in the market regarding large-scale renewable energy projects. External project developers and the energy suppliers share their experience and contacts to realize these projects. However, the smart grid allow new players, that are traditionally not engaged in energy provision, to become part of the value network. Consequently, the question arises how these new players (like software companies and equipment manufactures) will affect the market and if the current energy suppliers can maintain their central position in this market. Therefore, whether or to what degree energy suppliers perceive new entrants as a risk to their position in the market, will impact collaboration with these new entrants to find new ways of value creation and delivery. In sum, in order to decarbonize and enhance the energy transition, managers, policy makers and scholars need to collaborate to overcome the barriers towards energy supplier business model innovation.

Customer engagement

Next to the organisational structure, customer engagement crucial for business model innovation for energy suppliers. Customers need to become more active in the energy market. More specific, the changing customer preferences towards more sustainable forms of energy and insights in their energy usage patterns need to convert in actual demand for the new, more sustainable business models to take away revenue barriers. For instance, the added value of smart grids is mainly based on empowering customers via demand response and enable them to generate (a part of) their renewable energy and sell excess energy.

Energy suppliers tend to be rather technological and economical driven, but in order to gain customer engagement, services that are able to attract the emotions of the customer need to be developed. These services need to be developed in close interaction with the customers. In this way, energy suppliers can discover first-hand customer insights and potential new revenue sources. For example, energy suppliers could offer energy contracting solutions, in which they manage the energy usage of the customer and/or provide heating or lighting services. These services are a good start point to find out what the energy usage pattern of specific customer groups are and how they could be optimized (Sorrell, 2007). Even if these services tend to have limited financial potential, they have a valuable learning effect.

Governmental support

As stated, customer engagement is crucial for energy supplier business model innovation. However, authors such as Wüstenhagen and Billharz (2006) state that changing customer preferences alone is not sufficient for customers to take a more active role in the energy market. These authors argue that governmental support is necessary for customers to take this active role and change their engagement with the energy market. As is the case with green electricity and electric cars, policies for new value propositions of energy suppliers are supposed to increase the customer response to these new value propositions.

Moreover, the government regulates the energy market by providing subsidies to different types of technologies and setting regulations for operating in this market. These regulations can both enable and restrict opportunities for energy suppliers. Institutional inertia of governmental policies can therefore restrict the commercialisation of some of the developments in their environment of the firm. For instance, the 'netting' ('salderen' in Dutch) regulation of the government is beneficial for solar PV but inhibits solar thermal innovations as solar thermal innovations do not receive this financial compensation. Regulation, therefore, (indirectly) affect business model innovation in the energy sector. Consequently, policy makers should considerate supporting new business models and find a balance between subsidies for new, niche markets and specific, mature market segments that are currently preferred (Leisen et al., 2019). Additionally, privacy regulation has previously blocked plans for obligatory smart meter implementation in the Netherlands (Kema, 2010).

In other words, policymakers should be or should be kept informed about the developments of (new) energy supplier business models, because these business models are highly dependent on the regulatory framework. As a consequence, policymakers, directly and indirectly, influence the future of these business models.

As described in Chapter 6 there is no one-size-fits-all solution for the transition of energy supplier business models towards more sustainable ones. Each of the identified developments (or 'solutions') has different challenges, benefits and implementation costs. Depending on the characteristics of the energy supplier, some of the described developments may be more relevant than others. Chapter 3 and 5 elaborate on the identified developments and their drivers and barriers for energy supplier business model innovation. Each of the identified developments targets different customer needs or business opportunities (Lucas et al., 2013). Our research, therefore, serves as a starting point for energy suppliers to find out how they could transform their business model to respond to their changing environment.

7.2 Contributions

Our paper was about business model innovation for energy suppliers. We used the framework of Wirtz and Daiser (2017) to analyse the business environment of energy suppliers. In this study, we have elaborated on this framework by providing all of the factors of the framework with a definition. In their study, Wirtz and Daiser (2017) did not provide clear definitions of these factors but illustrated these factors using with examples from a case study performed at Google. Although the meaning of these factors became clear with this approach, to understand the framework properly taken outside the context of this paper, we have drawn definitions for these elements. Moreover, we have validated the relevance of this framework for the energy sector and the impact of the changes in the macro-environment as a driver for business model innovation.

By analysing the business environment of energy suppliers, we identified three major trends in this environment: decarbonisation, decentralisation and digitalisation. Although these trends are acknowledged by experts in the energy sector, they are (to our knowledge) not properly defined nor based on theoretical literature. By describing these trends, we contributed to a joint understanding of these trends. In other words, this research started with positioning and defining these trends as a joint theoretical concept, the 3D's.

Moreover, our study provided insights into developments related to these trends. In doing so, we grouped the developments stated in previous works into one of the three trends: decarbonisation, decentralisation or digitalisation. Moreover, we tested these identified developments with the opinions of academic and industry experts in the Dutch energy sector. In addition, we provided insights into the drivers and barriers for energy supplier business model innovation in the Dutch context.

Lastly, the findings to the call of Sosna et al. (2010) to explore the role of the established business model and its components for business model innovation. This paper showed that it is important to take all building blocks of the business model into account during the business model innovation process. Changing one building block impacts the other building blocks and could impact the business model as a whole. Although this paper focused on the transition towards new, more sustainable, business models for energy suppliers, this transition is not only limited to the energy sector. Other industries, such as the automotive sector face a similar challenge to decarbonise. Therefore, the findings of this paper about changing an established business model towards one that is more sustainable could be used as a starting point for other industries facing this transition.

7.3 Limitations

As every research, this research has its limitations. First, due to the limited sample size of this study, the generalizability of this study is limited. Although we interviewed interviewees from different organisations and academic experts with knowledge of the different developments, a larger number of interviewees from different organizations would have improved the generalizability of this research. Moreover, this research focussed on energy suppliers in the Dutch energy sector. In other words, the external validity of the findings is limited, because our findings might not be the same in other companies or geographical regions. The findings reflect the views of the particular group, namely managers working for Dutch energy suppliers.

Second, because this paper used the framework of Wirtz and Daiser (2017), certain topics that did not fit into the elements of this framework were not considered in this research. For instance, as the influence of regulation is mentioned in this study, we did not fully provide the specific regulations that need to change to enhance business model innovation in the Dutch energy sector. Moreover, for future research, we suggest that this framework of Wirtz and Daiser (2017) should be applied to other cases, to provide additional insights into the relevance of this framework outside the energy sector and business model innovation in general.

Third, the focus of this paper was on the innovation of established business models to respond to the developments in the environment. Hence, a more dynamic perspective, that studies how new business models emerge over time, without linkages to established business models was not studied extensively. We have sometimes referred to the emergence of new business models by start-ups, but to better understand the elements of these business models of these start-ups, additional research needs to be done. Thus, this study did not provide a general status of the industry but is limited to the latest developments that are relevant for incumbent firms.

Fourth, this study identified multiple developments, drivers and barriers for energy supplier business model innovation. Because we used a qualitative research approach, it was not possible to establish causal relationships, for instance between the drivers and barriers for energy supplier business model innovation. As a result, it was not possible to make an explicit statement about the relationship between the developments and their degree of impact on Dutch energy supplier business model innovation. To be clearer, a hierarchy between the different developments and their impact on business model innovation by Dutch energy suppliers is not yet discovered and can therefore be seen as a limitation for this research. The internal validity of this research would have been better if the interview guide contained a section in which the interviewees were asked to rank the developments based on their impact on energy supplier business model innovation.

Lastly, overall, the research methodology of conducting qualitative semi-structured has proven to be well-suited for this research. It enables us to gain first insights into the developments in the environment of Dutch energy suppliers and the impact of these developments on business model innovation performed by these Dutch energy suppliers. However, a qualitative research methodology bears bias risks because of ‘impression management’ and ‘sense-making’ (Eisenhardt en Graebner, 2007). This could lead to interviewer and response bias that could limit the reliability of this research (Saunders et al., 2009). The findings are based on the experiences and opinions of the interviewees. The interviewees may experience new situations, which influences their opinion on an interviewed element. Therefore, when this research is done again, the opinion of the interviewees might be different than the opinion described in this research.

7.4 Directions for future research

Based on the scope, findings and limitations of this research, some directions for future research can be made. The results of this study served as a starting point for business model innovation for energy suppliers. We observed that energy suppliers are aware of their need to innovate their business model, but fully sustainable and economic viable business models are still (far) away from the reality of today. This provides the need for future research.

First, because this study focussed on stage two ‘understand’ of the business model generation approach of Osterwalder and Pigneur (2010), stages three (‘design’), four (‘implement’) and five (‘manage’) have been passed. However, these stages, especially stages four and five, are important for the transformation of the business model of incumbent players. The shift of the traditional business model towards a new, innovated business model will be accompanied with (unforeseen) challenges and issues and managing this business model will require new insights. Therefore, the other stages of the business model generation approach need to be studied in the light of the energy sector as well.

Second, the impact of the identified trends and developments on the total value chain, i.e. other actors in the grid need to be studied. For instance, we described the potential of the aggregator concept for energy suppliers. However, because the aggregator will become a new player in the value chain, changes in the current value chain are needed to integrate this actor in the value chain. Consequently, actors need to work together differently to facilitate the integration of the identified developments, such as the smart grid and the role of aggregators, in the value chain. Therefore, additional research on the integration of these developments in the value chain and with this how new players can position themselves in this market, as well as how laws and regulations can facilitate this integration is a vast field for future research.

Third, although this research includes the expertise from some academics and industry experts, a broader discussion with experts is needed to identify and uncover all obstacles in this complex and interdisciplinary topic. Moreover, it should be noted that these experts were interviewed only once. Because the energy market is dynamic, the drivers and barriers for energy supplier business model innovation will change. For instance, when the market for sustainable energy solutions grows, energy suppliers, customers and other stakeholders will become more familiar with the used technologies and the cognitive barriers of customers and managers will decrease. Consequently, future research in the form of a longitudinal study on the drivers and barriers of energy supplier business model innovation can be recommended.

Fourth, this study is very case-specific. It is specially written for energy suppliers that do not own production capacity and are focused on the business to business market rather than on serving households. Moreover, this study focused on incumbents. In other words, to study does not provide a general status of the industry but intended to highlight the latest developments for this specific case. Additional research on the developments in the business to customer market or the drivers and barriers of different renewable energy sources on business model innovation can be recommended.

Finally, the focus of this study has been on the Dutch energy sector. Because business models are highly dependent on the regulatory framework, and markets in other countries have other structures and conditions, the results of this study concerning regulatory barriers might therefore not easily be transferred to other countries. However, the Netherlands was a forerunner in the liberalization of the energy market and aims to be progressive in their contribution to the energy transition. Hence, our findings regarding the Dutch energy sector can serve as learnings for other countries. A comparative study of the regulatory drivers and barriers for energy supplier business model innovation in different countries can be considered as a topic for future research. Comparing these drivers and barriers can offer valuable insights for a possible transition towards and integration of the national energy markets into one energy union.

7.5 Conclusion

The energy sector has long stood out for it is economic success and environmental impact. However, recently the environment of actors in the energy sector has changed. Therefore, this study examines what business model innovations Dutch energy suppliers could use respond to their changing environment. The objective of this paper was twofold: first, to identify the trends and developments in the environment of the Dutch energy suppliers and second, to examine what business model innovations Dutch energy suppliers could use respond to these trends and developments in their environment. Therefore, the main research question of this paper was: '*What business model innovations could Dutch energy suppliers use to respond to their changing environment?'*. The business model innovation framework of Wirtz and Daiser (2017) was used to answer this question. Based on literature reviews, interviews with academic and industry experts and content analysis, it was found that the changing environment of energy suppliers mainly consists of three trends: decarbonisation, decentralisation and digitalisation. Moreover, we were able to classify the developments in the environment of energy suppliers into these three trends. In addition, we described the drivers and barriers of these developments for energy supplier business model innovation. It was found that the need to decarbonise was the main driver for energy suppliers to develop and transform their business model, whereas organizational and operational barriers, risk averseness and a lack of regulatory support are the main barriers for energy supplier business model innovation.

Consequently, three possible conditions for future energy supplier business models were identified and discussed: gaining a position in the market for renewable energy, responding to the need for flexibility by gaining value from the assets owned by customers and selling energy services instead of volume. However, we found that there is not one business model that fits all the developments in the environment. Based on specific contextual elements of the firm, such as its degree of vertical integration and (desired) risk profile, the energy supplier needs to determine the intensity of the business model innovation process. Nevertheless, business model innovation is inevitable for energy suppliers to maintain their position in the energy sector. More specifically, new business models that go beyond the delivery of energy as a commodity are needed. This requires new organisational structures, a high degree of customer engagement and governmental support. In other words, by adopting new organisational forms, such as a separate venture or business units and a focus on external partnerships, a more active role of the customer as a 'co-creator' of new energy solutions and supporting policy frameworks, energy suppliers will overcome their barriers for business model innovation and will be able to use it as a strategic tool to respond to their changing environment.

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Appendix

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Appendix A Business Model Canvas

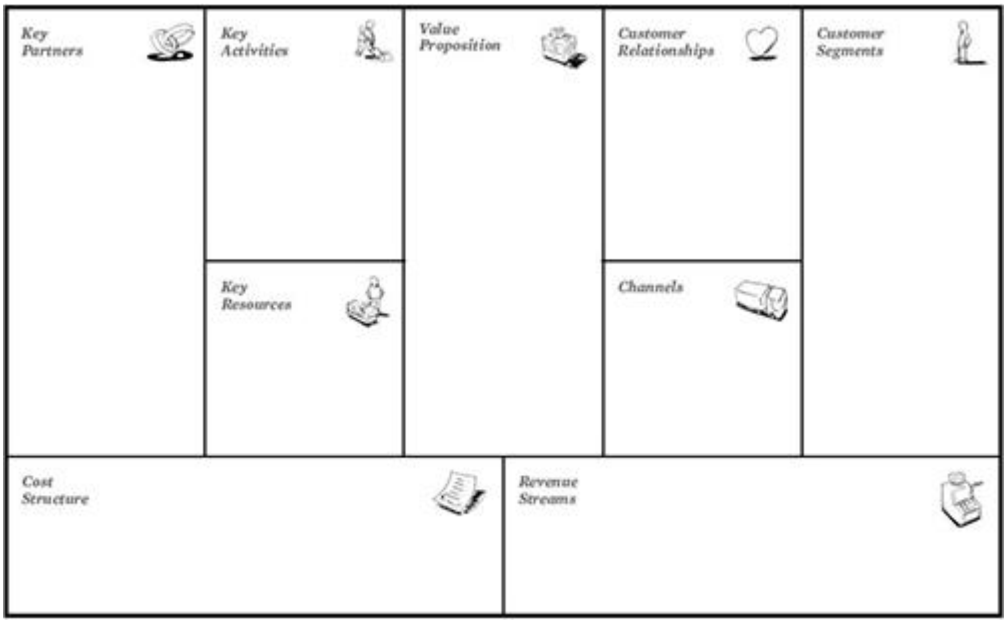

Figure A 1 The Business Model Canvas of Osterwalder and Pigneur (2010).

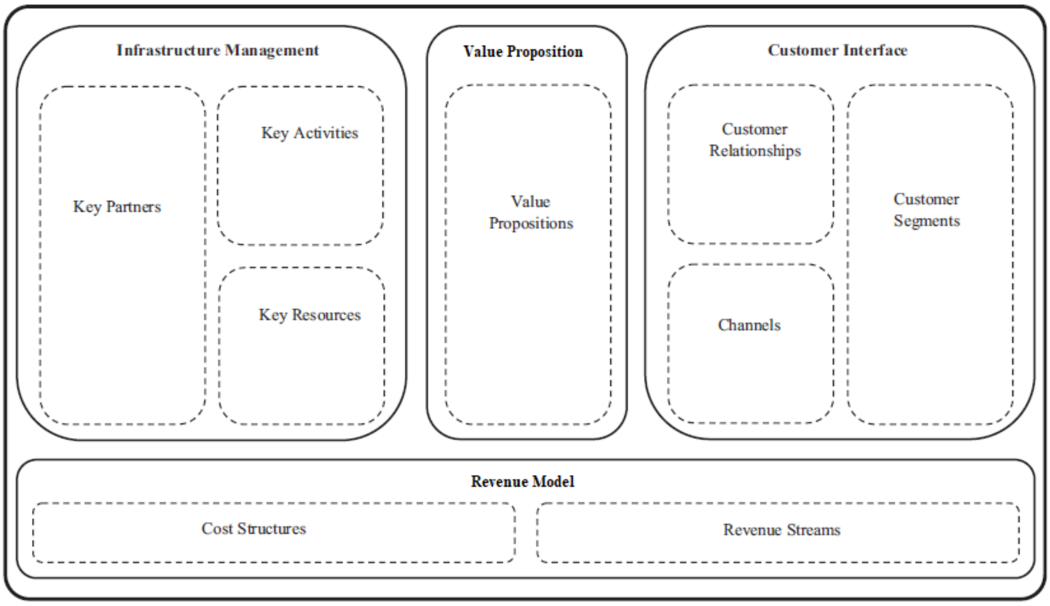

Figure A 2 The Business Model Canvas structured using the four pillars (Osterwalder and Pigneur, 2010).

Appendix B Simplified overview of the value chain

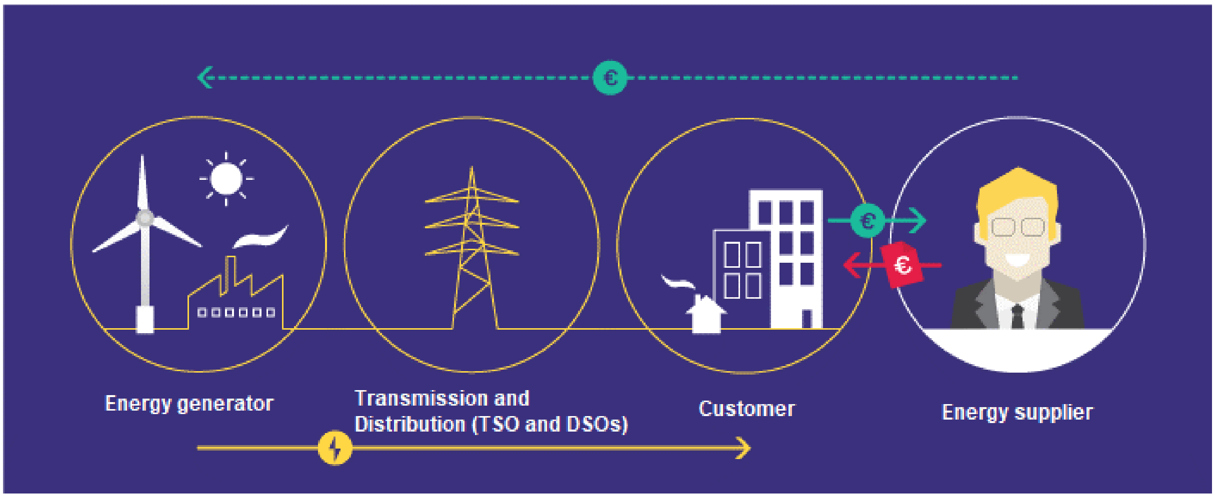

Figure A 3 Simplified overview value chain (translated from Nieuwe Stroom, n.d.)

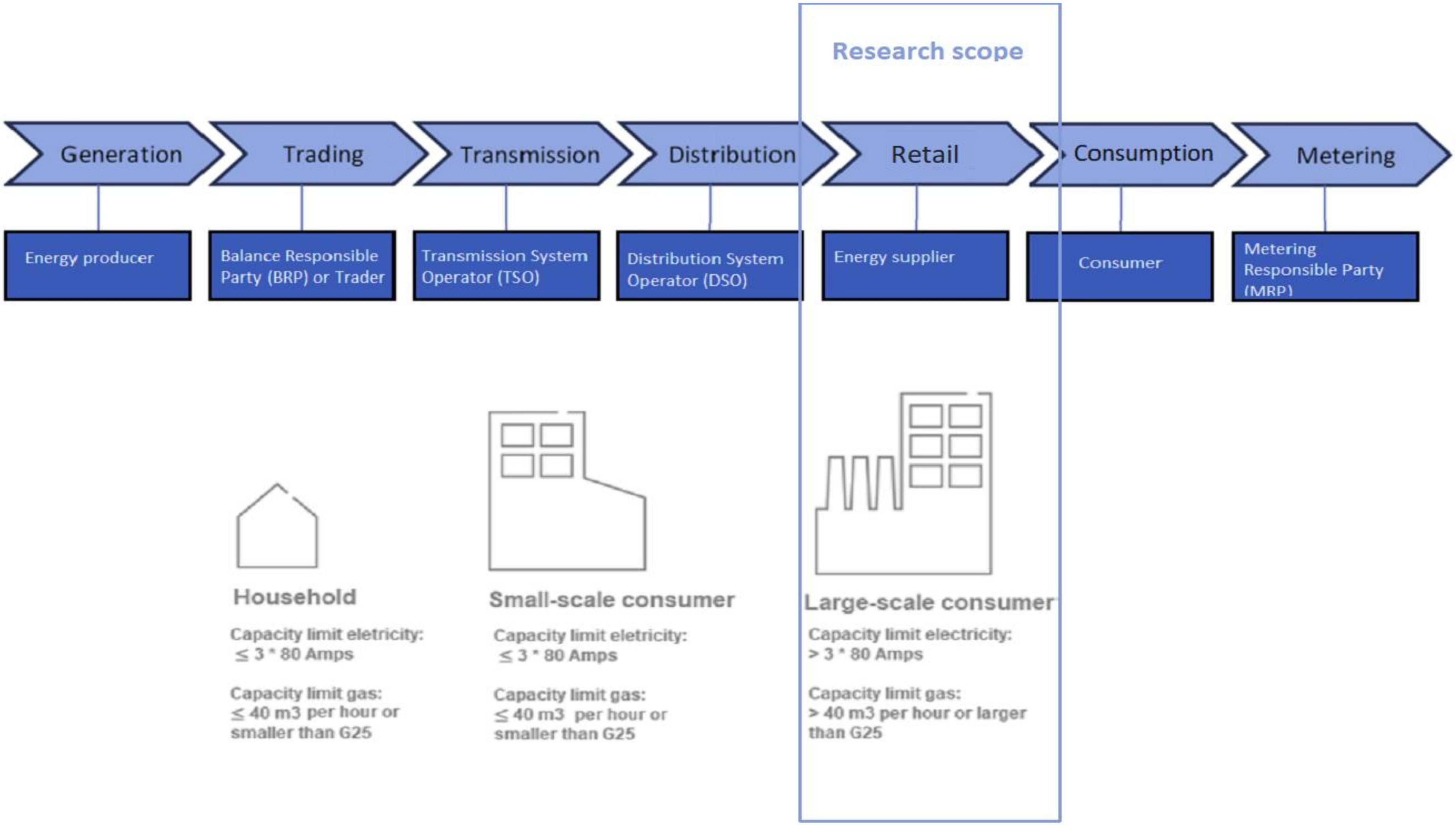

Figure A 4 Simplified overview electricity value chain and research scope

Appendix C Distribution System Operators in the Netherlands

Figure A 5 Distribution System Operators Electricity (Netbeheer Nederland, n.d.)

Figure A 6 Distribution System Operators Gas (Netbeheer Nederland, n.d.)

Appendix D Current untraditional business model typologies

In this section, an overview of current untraditional business model typologies is given. This overview is based on a literature review on upcoming energy supplier business model innovations, and desk research reviewing upcoming untraditional energy supplier business models worldwide. The methodology of this overview as well as the reasoning why this overview is based on energy supplier business models in other countries than the Netherlands as well, can be found in section D.1.

The business models described in this Chapter are all different than the traditional energy supplier business model discussed in Chapter 3 and can therefore be considered as business model innovations. This is due to the fact that these new business models capture value in a novel way by changing one or multiple business model components of the traditional business model (Frankenberger et al., 2013).

D.1 Current energy supplier business model research

This section contains a literature review on current energy supplier business models worldwide. First, there will be elaborated on the methodology used for this literature review.

<u>Literature search and review scope</u>

The studies included in the literature review of this chapter are included after a literature search on Scopus and Google Scholar. Starting with the basic search entry 'energy business model innovation', one of the key papers of this literature review, the paper by Hall and Roelich (2016) was shown in the search results. After reading this paper and recognizing its potential for this study, the articles that were cited by this paper and newer papers that cited the Hall and Roelich (2016) paper were assessed on their usefulness for this study. Moreover, other search entries adding more search terms to the basic search entry 'energy business model innovation' were executed. Examples of these search entries were 'energy business model innovation typologies' and 'energy business model archetypes'.

Consequently, the papers showing up in the search results were assessed on their usefulness for this research. The main criteria for this assessment were: the focus of the study on energy retail instead of energy production and a focus on business to business supply instead of a focus on the supply of households. However, studies addressing both these criteria were not found during this literature search. A lot of studies (e.g. Helms, 2016; Vasileiadou et al. 2015; Hellström et al. 2012) are about business model innovation for specific development in the generation of energy, such as the potential of the generation of energy using a specific source of renewable energy (e.g. solar photovoltaics, biomass) instead of 'solutions' for energy suppliers. In addition, studies such as Burger and Luke (2017), Leisen et al. (2019) and Brown (2018) identify all kinds of archetypes in the energy sector. However, these studies are focused on forming a business model all-around a specific development in the transmission of energy, such as the operation of virtual power plants or energy storage.

Therefore, the focus of the literature review was stretched to upcoming, untraditional business models for utilities, thus including the generation part of the value chain. This approach is chosen, because much more literature is written about new types of business models for utilities. The reason for this is that (the most) utilities also have to deal with energy supply. However, energy suppliers have to buy units of energy on the trade market or have power purchase agreements with energy producers, whereas utilities can generate energy themselves to supply their customers (see Chapter 3). Analysing (the energy supplier-related parts of) untraditional business models for utilities is therefore useful for this research, because utilities and energy suppliers have to deal with the same tasks and challenges in the supply part of the value chain. Moreover, studying the parts of these typologies related to energy supply, can provide insights into potential interesting elements for business model innovation in the energy sector.

In addition, this chapter is not only limited to the Dutch energy market. It is based on energy suppliers operating worldwide. Because challenges in the energy sector are not only limited to the Dutch market, and energy markets in other counties, such as Germany, are already more steps ahead in the restructuring of the market (Richter, 2012; Doleski, 2016), analysing untraditional business models of energy suppliers operating in other countries than the Netherlands is relevant for this study as well.

Moreover, the case company of the current study is part of a European business unit of a large, worldwide operating energy cooperation. This cooperation bases the strategy of the European business unit on European-wide developments, so analysing business models of energy suppliers in other European countries could help to identify possible business model innovations on the European-level, that could be translated or blended into the national business models.

Furthermore, the energy markets in almost all countries in Europe and Australia share the same principles starting from the liberalization of these markets in the 1990s (European Parliament, 2017; Australian Energy Market Regulator, 2017). Therefore, analysing business models in other European countries and Australia, will give a more complete overview of used business models by energy suppliers and their level of consideration of the trends in the energy sector. In this way, potential useful elements for business model innovation in the Dutch energy sector can be identified.

<u>Conceptualization</u>
The upcoming, untraditional business models identified in the literature review are structured using the developments defined in Chapter 3 and 5. These developments are structured using the 3D's: Decarbonisation, Decentralisation and Digitalisation. This chapter follows the same structure. Figure A6 shows the business models identified in this chapter and classifies them into one of the 3D's.

D.2 Current untraditional energy business models

In this section, current, upcoming, untraditional business models as defined in the literature will be described. Because these business models are all different than the traditional energy supplier business model described in Chapter 3, these business models can be considered as business model innovations. As stated above, these business models are classified using the 3D's: Decarbonisation, Decentralisation, and Digitalisation.

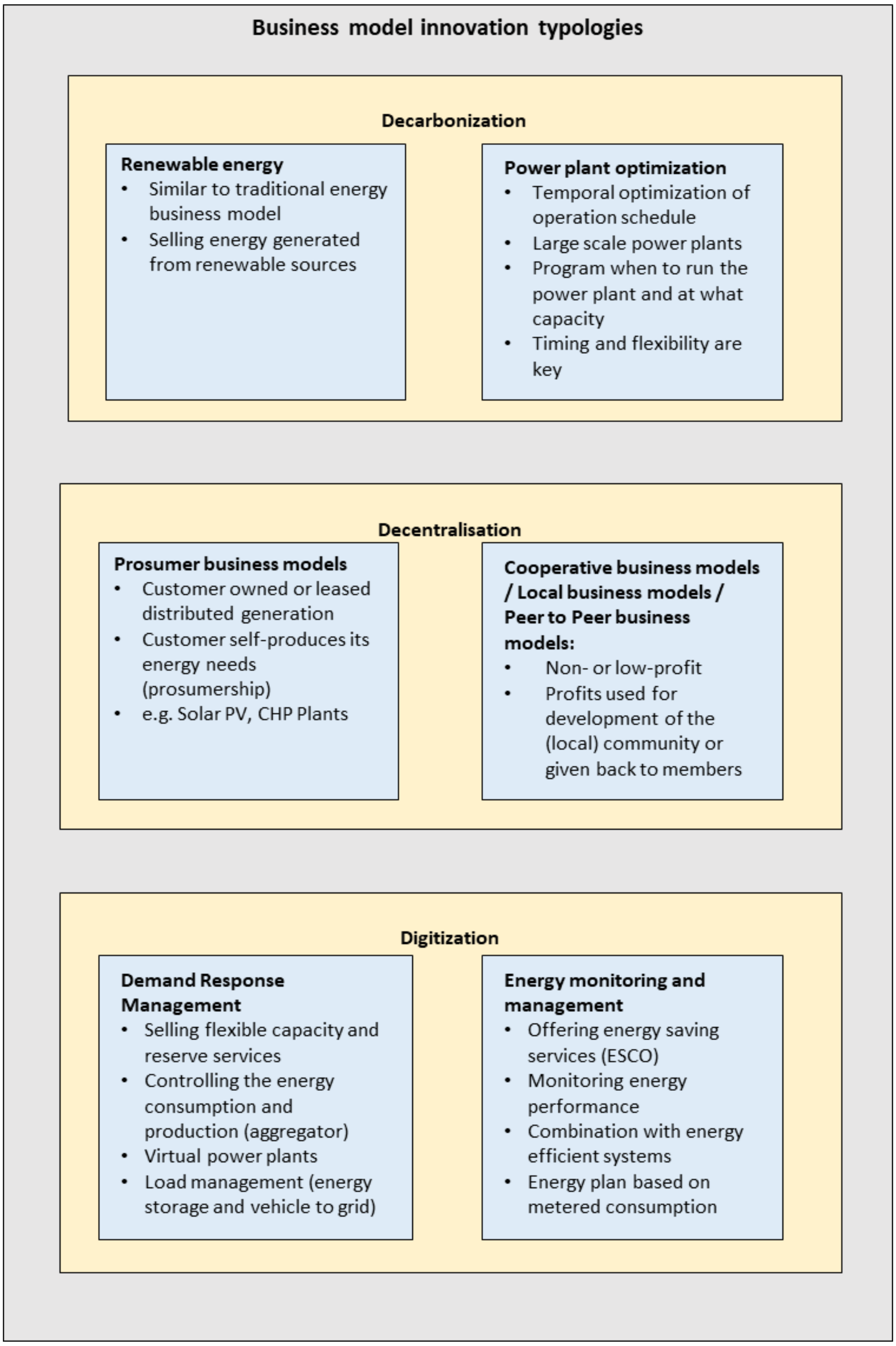

Figure A 7 Energy business model innovation typologies structured using the 3D's (own illustration, based on Bryant et al., 2018; Hall and Roelich, 2016; Burger and Luke, 2018; Helms, 2016; Frei et al., 2018; Chasin et al., 2020)

D.2.1 Decarbonisation

This paper distinguishes two types of business models that deal with the decarbonisation trend: business models based on selling the energy produced from renewable energy sources and business models based on power plant optimization.

Business models based on selling the energy produced from renewable energy sources

The first type of business model that deals with the decarbonisation trend, is the business model based on renewable energy. This business model is based on the 'Green Utility' business model of Bryant et al. (2018) and the 'utility-side renewable energy business model' of Richter (2013). This business model is similar to the traditional energy supplier business model. Like the traditional business model, the revenue structure of this business model is based on selling units of electricity, gas, or heat (Bryant et al., 2018; Nimmons and Taylor, 2008). However, in contrast to the traditional business model, suppliers using this business model sell energy originating from renewable energy sources, such as solar photovoltaics, wind turbines, and biomass and biogas plants (Richter, 2013). Nevertheless, these sources are still integrated vertically, and the infrastructure of utilities still consists of a small number of centralized large-scale power plants (Richter, 2013).

This business model targets mainly customers with an 'environment-friendly' mindset who are willing to pay a premium on the price they pay in exchange for emissions-free, green energy (Bryant et al., 2018). Because of the relative novelty of this type of business model and the often higher price charged, the customer-base is more limited (Richter, 2013). Consequently, energy suppliers operating by this business model are more dependent on their key resources and key partnerships. Therefore, more attention is given to customer engagement (Bryant et al., 2018). Figure A6 gives an overview of this type of business model (see utility-side business model) and compares it with the customer-side business model described as a response to the trend decentralisation.

Power plant optimization

The second business model that is that can be categorized in the decarbonisation trend, is the power plant optimization business model. This business model is based around a program that determines when the power plan needs to run, and at which capacity. This program takes into account different factors, such as regulatory and technical constraints about the maximum loads and maintenance needs (Helms et al., 2016). The power programs are mostly used at large scale power plants and are used for both fossil as well as renewable energy sources. Although these plants are also used at fossil power plants, they contribute to decarbonisation, because optimizing these power plants contribute to the decline of the amount of fossil fuel used at these power plants (Kublik et al., 2012). Moreover, as demand and supply must be perfectly in balance (to avoid power outages and because of economic limitations for power storage), power plant optimization is necessary for all energy sources, (Schleicher-Tappeser, 2012).

Power plants based on renewable energy, are highly dependent on the conditions of the weather. Therefore, the amount of energy produced fluctuates and are therefore little flexible Kublik et al., 2012). As a consequence, timing activities is in this case even more important for utilities, in order to efficiently balance the demand and supply of energy (Helms et al., 2016). A power plant program, based on aforementioned things, enriched with weather forecasts, can help utilities and BRPs with maintaining the balance on the grid (Helms et al., 2016).

Thus, power plant optimization business models create value based on generation and load management. Timing activities, mostly based on programs, are used to increase the flexibility of the energy supply (Helms et al., 2016). Next to influencing the timing of the supply by using programs, flexibility can also be created via the demand (customer consumption) of energy (Behrangrad, 2015). This can be done using demand side management using ICT infrastructure, which is described in more detail in section 6.2.3.

D.2.2 Decentralisation

For the decentralisation trend, two types of novel business model can be derived from the literature as well. These two types are the ‘prosumer business models’ and the ‘cooperative business models’.

<u>Prosumer business models</u>

In this type of business model, the customer becomes a prosumer (producer and consumer). In other words, consumers that also produce electricity (prosumers) generate electricity for self-consumption (Richter, 2013). Excess electricity can be fed in the grid and at moments of low production of the renewable energy source, the prosumer could withdraw electricity from the grid (Huijben and Verbong, 2013).

Scholars have described different designs for this type of business models. For instance, Schoettl and Lehmann-Ortega (2011) came up with five types of prosumers business models that, to a certain degree, are in line with the traditional business model of energy suppliers. Additionally, Franzis et al. (2008) determine three business model generations for prosumers, and Sauter and Watson (2007) propose three general deployment models. While comparing the works of these authors, there can be stated that different prosumer business models have developed on different markets, mainly due to factors in the local context (Ahlgren et al., 2015). Therefore, the success of a prosumer business model is closely related to the local context in the country in which the business operates.

In the Netherlands, the three categories of prosumer business models of Sauter and Watson (2007) are operated the most (Huijben and Verbong, 2013). These business models are mainly used for the operation of solar photovoltaics (PV) by customers and businesses (Huijben and Verbong, 2013). The three categories of business models of Sauter and Watson (2007) are: *Customer-Owned, Community Shares and Third-Party business models* (Sauter and Watson, 2007). The third-party business model and the customer-owned business models are described in more detail below. The community shares business model will be described in the section ‘cooperation business models’, as this business model is similar to the business model described in that section.

The *third-party business model* is the dominant prosumer business model in The Netherlands (Huijben and Verbong, 2013). In this type of business models, a third party offers help with financing, installing and maintaining the PV- (or other renewable energy sources) system that is located at the site of the customer (Sauter and Watson, 2007). The third party remains the owner of the system (Sauter and Watson, 2007). The customer pays based on a power purchase agreement (PPA) or based on a leasing contract. When the customer has a PPA, he or she has to pay a (fixed or variable) price for every kilowatt directly used from generated energy used (Strupeit and Palm, 2016). Mostly, this PPA is a long-term contract for a period of 15 to 20 years (Huijben and Verbong, 2013). In the case of leasing, the customer has to pay a fixed price per month for the usage of the system (Huijben and Verbong, 2013; Zang, 2016). For the third party (which can be an energy supplier), an advantage of this type of business models is that it offers a prediction of the revenue generated in the upcoming years.

The system is owned by the third party. Advantages of this type of business models is that the initial investment costs for customers (businesses or households) are (partially) removed (Frantzis et al., 2008). The customers do not need to invest initially, but the investment can be included in the (monthly) energy bill. Moreover, the technological aspects, such as installing and maintaining the system are not the responsibility of the customer (Huijben and Verbong, 2013). This type of business models is therefore particularly interesting for households and smaller or younger firms that do not have sufficient resources to invest in (PV-)systems at their own. However, for the third-party PV business model, the customer needs to be creditworthy (Drury et al., 2012; 2013). The third party gains revenues from the returns on the assets and the charge for services (Nimmons and Taylor, 2008).

Richter (2013) described the application of this type of business models by utilities. In his generic business model 'customer-side renewable energy business model', he states that this business model is about energy production close to the point of consumption, with the help of small-scale renewable energy systems (Richter, 2013). This is also called distributed generation. The size of these systems is varying from a few kilowatts to about one megawatt (Richter, 2013). Due to the small-scale, the position of a customer-side business model in the value chain is different in comparison to the large renewable energy products are a utility-based business model. The small scale allows energy suppliers to be more customer focused. Table A1 shows the difference between this type of business model (customer-side renewable energy), and the 'utility-side renewable energy business model' that is described in the previous section.

The second type of prosumer business models in the Netherlands, is the *customer-owned business model*. Again, several designs for this type of business models are drawn by scholar, such as the 'Plug and play' (Provance et al., 2011; Sautor and Watson, 2007); and 'Host-owned' designs (Zang, 2016; Huijben and Verbong, 2013). The main difference from the third-party business model is that in the customer-owned business model, as the name indicates, the renewable energy source is owned by the customer. Therefore, this business model mainly targets businesses and customers who are able to invest the necessary amount of money and are able to deal with future expenses. (Huijben and Verbong, 2013). Like the third-party business models, the customer becomes a prosumer and is able to feed excess electricity into the grid. Countries such as Germany encouraged this type of business models with legislation and attractive tariffs for feed-in these excess electricity (Richter, 2013).

Table A 1 Utility-side vs. Customer-side business model (Richter, 2013)

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

<u>Cooperative business models</u>

The second business model typology that is able to deal with the decentralisation trend, is the cooperative business model. Like the prosumer business models, many designs for this type of business model can be derived in the literature, such as ‘Energy community business models’ (Bryant et al., 2018); ‘Peer to Peer business models’ (Wainstein and Bumpus, 2016) and ‘Citizen Participation Initiatives’ (Huybrechts and Mertens, 2014).

These business models are all based on providing energy in a low- or non-profit way. The profit that is generated is used for the development of (local) community or is given back to the members of the cooperation (Bryant et al., 2018). The energy is mainly generated from renewable energy sources that are situated on the property of the members, or off-side for example at a farm (Strupeit and Palm, 2016).

The value proposition of this type of business model is that it enables customers to participate in renewable energy projects according to their own (financial or generation) capacity. Moreover, members are able to actively participate in the management of the community and the origin of the generated energy is clear (Yildiz et al., 2015). The daily management can also be possessed to an energy supplier or another third party (Küller et al., 2015). According to Huybrechts and Mertens (2014) some energy cooperatives are more transparent and have easy to follow pricing systems which can lead to lower prices. However, this transparency and active participation might harm the efficiency of the management of the cooperatives, as disagreements could arise quickly. Table A2 shows an overview of this type of business model.

Table A 2 Business Model Canvas for Cooperative business models (based on Bryant et al., 2018; Wainstein and Bumpus, 2016, Huybrechts and Mertens, 2014)

Element	**Description for Cooperative business models**
Value proposition	Providing renewable (green) energy to the members of the cooperation, without or with a low margin to support the (local) community
Customer Interface	Customer actively participates, by having ownership and involvement in the management of the cooperation. Mostly long-term relationships
Infrastructure	Generation of green energy on the side of the member (large scale of distributed assets) or off-side (small-scale of centralized assets), energy trading between members or feeding back into the grid.
Revenue model	Revenues arise from selling green energy (to other members or feeding back into the grid) or from member buy-ins. Costs arise from the deployment, operation and maintenance of assets, administration and management costs and member pay-outs

Appendix E Interview Guide

The interviews were held in Dutch. An English translation of this interview guide is shown after the Dutch one.

Vragenlijst interview Business Model Innovation

Beste lezer,

Bedankt voor uw interesse in / deelname aan dit interview. Dit interview maakt deel uit van mijn afstudeerscriptie naar business model innovation (bedrijfsmodelinnvoatie) in de Nederlandse Energiemarkt. Dit onderzoek focust zich op het identificeren van de kansen en bedreigingen in de Nederlandse energiemarkt en het geven van suggesties voor bedrijfsmodel innovaties waarmee energieleveranciers kunnen inspelen op de ontwikkelingen in de Nederlandse energiemarkt.

Goed om te weten is dat dit interview ongeveer 45 tot 60 minuten duurt en dat u het recht heeft om een vraag niet te beantwoorden als u zich hier niet prettig bij voelt. Deelname aan dit onderzoek is dus geheel vrijwillig. Verder zal het interview opgenomen worden, uiteraard alleen met uw toestemming. Met deze opname kan ik het interview nogmaals rustig terugluisteren en uitwerken. Deze uitwerking wordt zoveel mogelijk geanonimiseerd. Nadat het interview volledig is uitgewerkt wordt de audio-opname verwijderd.

Indien u akkoord bent met de bovenstaande informatie, ontvang ik hieronder graag een handtekening.

Met vriendelijke groet,

Manouk Meijer

Akkoordverklaring

Naam geïnterviewde:

Datum:

Handtekening:

Vragenlijst interview business model innovation

Algemeen

1. Kunt u omschrijven wat uw rol is binnen de organisatie?
    a. Wat is uw functie en wat zijn uw werkzaamheden?
    b. Bij een managende functie: hoe ziet u uw strategische rol binnen deze organisatie?
    c. Hoelang bent u al werkzaam binnen deze organisatie? En binnen de energiewereld?
2. Kunt u wat meer vertellen over de organisatie?
    a. Wat onderscheidt deze organisatie van andere energieleveranciers?
    b. Wat is de doelgroep van de organisatie?
    c. Werkt de organisatie (in het specifiek uw afdeling) samen met andere partijen om het leveren van de dienst (het leveren van energie) mogelijk te maken? In andere woorden, kunt u de waardeketen van de organisatie beschrijven?

Macro-omgeving

3. Wat zijn volgens u belangrijke ontwikkelingen in macro-omgeving van het bedrijf?
    a. Denk aan veranderingen met betrekking tot wetgeving, technologieën en dergelijke?

In de literatuur worden vier belangrijke trends onderscheden. Deze vier trends volgen hieronder. Zou voor ieder van deze trends kunnen aangeven wat uw visie is op deze ontwikkeling?

<u>Hernieuwbare energie en decarbonisatie</u>

4. Ziet u dit als een kans of bedreiging? Waarom?
5. Zou u voor ieder van onderstaande hernieuwbare energiebronnen kunnen omschrijven in welke mate deze bron kansrijk is voor energieleveranciers?
    - Zonnepanelen
    - Wind energie
    - Bio-elektriciteit (biomassa, biogas)
    - Aardwarmte
    - Waterkracht
    - (Nucleaire enegie)

6. Hoe wordt er binnen de organisatie omgegaan met de energietransitie?
    - Zijn hier strategische plannen voor?
    - Hoe ziet u uw rol/ de rol van uw afdeling in deze energietransitie?
    - Moet het bedrijfsmodel van de organisatie volgens u veranderen als gevolg van de energietransitie? Zo ja, welke veranderingen moeten er volgens u plaatsvinden?

<u>Digitalisatie</u>

7. Ziet u digitalisatie als een kans of bedreiging voor Nederlandse energieleveranciers?
    a. Welke ontwikkelingen gaan volgens u steeds belangrijker worden en waarom? Denk bijvoorbeeld aan smart grids, maar ook aan blockchain, artifical intelligence en dergelijke.
    b. Denkt u dat verdere digitalisatie van uw organisatie nodig is in de toekomst?
        - Zo ja, denkt u dat u dat uw bedrijf klaar is voor verdere digitalisatie? (denk bijvoorbeeld aan het hebben van voldoende knowhow voor verdere digitalisatie)

<u>Decentralisatie?</u>

8. Wat is uw mening over het verdere verloop van onderstaande ontwikkelingen met betrekking tot decentralisatie?
   - Prosumership en distributed energy[3]
   - Energieopslag en het management hiervan

     a. Ziet u deze ontwikkelingen als een kans of bedreiging?
     b. Denkt u dat deze ontwikkelingen het bedrijfsmodel of de winstgevendheid van het bedrijf aantast? Waarom?
     c. Zo ja, wat zal er in het bedrijf moeten veranderen om deze ontwikkelingen beter te faciliteren?

<u>Verhoogde vraag naar personalisatie en overige services zoals consultancy voor het besparen van energie die leiden tot voordeel of gemak voor de klant?</u>

9. Merkt u deze vraag in de markt?
10. Ziet u dit als kans of bedreiging voor uw organisatie?
    a. Wat voor een impact zal deze ontwikkeling hebben op het bedrijfsmodel van de organisatie?
    b. Zullen er processen in het bedrijf moeten veranderen om deze ontwikkeling te faciliteren?

<u>Overige ontwikkelingen</u>

11. Merkt u (overige) veranderingen in de vraag van uw klanten? Zo ja, welke?
    a. Wat voor een gevolgen hebben deze veranderingen op het bedrijfsmodel van de organisatie?
12. Ziet u overige kansen en bedreigingen in de Nederlandse energiemarkt?

Micro-omgeving

13. Welke veranderingen moeten er gedaan worden aan het bedrijfsmodel om deze ontwikkelingen te faciliteren? Op het gebied van:

    <u>Waardepropositie:</u>
    - Denkt u dat de waarde propositie van de organisatie moet veranderen om aantrekkelijk te blijven als gevolg van de veranderingen in de markt? Waarom?

    <u>Klantinteractie:</u>
    - Moeten er veranderingen plaatsvinden in de producten en bijbehorende service die het bedrijf aanbiedt?
    - En in de manier waarop er met de klant gecommuniceerd wordt?

    <u>Infrastructuur:</u>
    - Kunnen de veranderingen die voortkomen uit de ontwikkelingen in de markt geïntegreerd worden in het proces van het bedrijf of zal het proces hiervoor veranderd moeten worden?
    - Betekent dit een gehele verandering van het proces of alleen het toevoegen van een of meerdere activiteiten? Met andere woorden, is de intensiteit van de benodigde innovaties radicaal of incrementeel van aard?

    - Denkt u dat u in de toekomst meer (moet) gaat (gaan) samenwerken met andere bedrijven in de bedrijfskolom?

[3] Prosumership houdt in dat klanten niet alleen energie consumeren, maar tegelijkertijd ook produceren door middel van bijvoorbeeld zonnepanelen. Hierdoor vindt de energieopwekking niet centraal, maar verspreid (gedecentraliseerd) plaats.

Verdienmodel:

14. Op welke manier hebben de benoemde ontwikkelingen een impact op het verdienmodel van de organisatie?
    a. Denkt u dat projecten met betrekking tot hernieuwbare energie (bijv. zonneparken e.d.) genoeg inkomsten genereren op de lange termijn? En in vergelijking tot traditionele vormen van energie (rate-of-return e.d.)?

Informatieverwerking, technieken en tools en BMI processen

15. Hoe wordt er binnen de organisatie vormgegeven aan innovatie en innovatief gedrag?[4]
    a. Is hier beleid over?
    b. Wordt dit gestimuleerd binnen de organisatie?
    c. Weet het bedrijf hoe het de gesignaleerde ontwikkelingen in de markt moet omzetten naar interne acties (sense-making)?
        - Zo ja, welke technieken en tools worden hierbij gebruikt? (bijvoorbeeld brainstormsessies, samenwerkingen met universiteiten, evaluaties van geïmplementeerde veranderingen en dergelijke).
        - Zo niet, welke capaciteiten en resources ontbreken hiervoor?
    d. Beschikt het bedrijf over voldoende resources en handvaten om besluiten voor innovatie in goede banen te leiden?

Bedrijfsmodel innovatie uitkomsten en impact

16. Hoe kunnen bedrijfsmodellen gebaseerd op hernieuwbare energie toekomstbestendig worden ingericht (vanuit maatschappelijk en economisch perspectief)? Waarom?

- Einde van het interview, bedankt voor uw deelname -

[4] Het genereren, stimuleren en toepassen van nieuwe ideeën die de intentie hebben om de prestaties van (groepen in) de organisatie te verbeteren.

Questionnaire interview Business Model Innovation

Dear reader,

Thank you for your interest in / participation in this interview. This interview is part of my thesis to business model innovation in the Dutch Energy Market. This research focuses on identifying the opportunities and threats in the Dutch energy market and providing suggestions for business model innovations that enable energy suppliers to respond to developments in the Dutch energy market.

It is good to know that this interview will take approximately 45 to 60 minutes and you have the right not to answer a question if you are not comfortable with it. Participation in this study is therefore entirely voluntary. Furthermore, the interview will be recorded, of course only with your permission. With this recording, I can listen back to and elaborate the interview again. This elaboration is anonymised as much as possible. After the interview has been fully worked out, the audio recording will be removed.

If you agree with the above information, I would like to receive a signature below.

Sincerely,

Manouk Meijer

Statement of approval

Date:

Signature:

Topic list interview business model innovation

General

1. Can you describe what your role is within the organization?
    a. What is your position and what are your activities?
    b. In a managing position: how do you see your strategic role within this organization?
    c. How long have you been working within this organization? And within the energy sector?

2. Can you tell me a bit more about the organization?
    a. What distinguishes this organization from other energy suppliers?
    b. What is the target audience of the organization?
    c. Does the organization (in particular your department) work together with other parties to enable the provision of the service (supplying energy)? In other words, can you describe the organization's value chain?

Macro-environment

3. What do you think are important developments in the macro environment of the company?
    a. Think about changes related to legislation, technologies?

Four important trends are identified in the literature. These four trends follow below. Could you indicate for each of these trends what your vision is on this development?

<u>Renewable energy and decarbonisation</u>

4. Do you see this as an opportunity or a threat? Why?
5. Could you describe for each of the renewable energy sources below to what extent this source is promising for energy suppliers?
    - Solar panels
    - Wind energy
    - Bio-electricity (biomass, biogas)
    - Geothermal energy
    - Hydropower
    - (Nuclear energy)
6. How does the organization deal with the energy transition?
    a. Are there any strategic plans for this?
    b. How do you see your role / the role of your department in this energy transition?
    c. Do you think the organization's business model should change as a result of the energy transition? If so, what changes do you think should take place?

<u>Digitalisation</u>

Do you see digitalisation as an opportunity or threat for Dutch energy suppliers?

a. Which developments do you think will become increasingly important and why? Think of smart grids , but also to block chain, artifical intelligence and the like.
b. Do you think that further digitization of your organization is necessary in the future?
    - If so, do you think your business is ready for further digitization? (think, for example, of having sufficient know-how for further digitization)

<u>Decentralization?</u>

8. What is your opinion on the further course of the following developments regarding decentralization?

- Prosumership and distributed energy[5]
- Energy storage and its management

    a. Do you see these developments as an opportunity or a threat?
    b. Do you think these developments affect the business model or profitability of the company? Why?
    c. If so, what will have to change in the company to better facilitate these developments?

Increased demand for personalization and other services such as consultancy for saving energy that lead to benefit or convenience for the customer?

9. Do you notice this demand in the market?
10. Do you see this as an opportunity or threat to your organization?
    a. What impact will this development have on the business model of the organization?
    b. Will processes in the company have to change to facilitate this development?

Other developments

11. Do you notice (other) changes in the demand of your customers? If this is the case, which one?
    a. How will these changes affect the business model of the organization?
12. Do you see other opportunities and threats in the Dutch energy market?

Micro- environment

13. What changes need to be made to the business model to facilitate these developments? In the field of:

    Value proposition:
    - Do you think the organization's value proposition needs to change to remain attractive as a result of the changes in the market? Why?

    Customer interaction:
    - Should there be any changes to the products and associated service that the company offers?
    - And in the way in which communication with the customer takes place?

    Infrastructure:
    - Can the changes resulting from the developments in the market be integrated into the process of the company or will the process have to be changed for this?
    - Does this mean a complete change of the process or just adding one or more activities? In other words, is the intensity of the required innovations radical or incremental in nature?
    - Do you think that you will (should) collaborate more in the future with other companies in the supply chain?

    Revenue model:
14. How do the aforementioned developments have an impact on the organization's earnings model?

[5] Prosumership means that customers not only consume energy, but at the same time also produce by means of solar panels, for example. As a result, the energy production does not take place centrally, but rather distributed (decentralized).

a. Do you think projects related to renewable energy (e.g. solar parks, etc.) generate enough income in the long term? And in comparison to traditional forms of energy (rate-of-return, etc.)?

Information processing, techniques and tools and BMI processes

15. How is innovation and innovative behavior shaped within the organization?[6]
    a. Is there a policy on this?
    b. Is this stimulated within the organization?
    c. Does the company know how to convert the identified developments in the market into internal actions (sense-making)?
        - If so, which techniques and tools are used for this? (for example brainstorming sessions, collaborations with universities, evaluations of implemented changes and the like).
        - If not, what capacities and resources are missing for this?
    d. Does the company have sufficient resources and tools to guide decisions for innovation?

Business model innovation outcomes and impact

16. How can business models based on renewable energy be future-proofed (from a social and economic perspective)? Why?

- End of the interview, thank you for your participation -

[6] Generating, stimulating and applying new ideas that are intended to improve the performance of (groups in) the organization.

Appendix F Business Model Design Process[7]

Mobilize	Understand	Design	Implement	Manage
Prepare for a successful business model design project	Research and analyze elements needed for the business model design effort	Generate and test viable business model options, and select the best	Implement the business model prototype in the field	Adapt and modify the business model in response to market reaction
Setting the stage	**Immersion**	**Inquiry**	**Execution**	**Evolution**
Assemble all the elements for successful business model design. Create awareness of the need for a new business model, describe the motivation behind the project, and establish a common language to describe, design, and analyze and discuss business models.	You and the business model design team immerse yourselves in relevant knowledge: customers, technology, and environment. You collect information, interview experts, study potential customers, and identify needs and problems.	Transform the information and ideas from the previous phase into business model prototypes that can be explored and tested. After an intensive business model inquiry, select the most satisfactory business model design.	Implement the selected business model design.	Set up the management structures to continuously monitor, evaluate, and adapt or transform your business model.
• Business Model Canvas (p. 44) • Storytelling (p. 170)	• Business Model Canvas (p. 44) • Business Model Patterns (p. 52) • Customer Insights (p. 126) • Visual Thinking (p. 146) • Scenarios (p. 180) • Business Model Environment (p. 200) • Evaluating Business Models (p. 212)	• Business Model Canvas (p. 44) • Business Model Patterns (p. 52) • Ideation (p. 134) • Visual Thinking (p. 146) • Prototyping (p. 160) • Scenarios (p. 180) • Evaluating Business Models (p. 212) • Business Model Perspective on Blue Ocean Strategy (p. 226) • Managing Multiple Business Models	• Business Model Canvas (p. 44) • Visual Thinking (p. 146) • Storytelling (p. 170) • Managing Multiple Business Models (p. 232)	• Business Model Canvas (p. 44) • Visual Thinking (p. 146) • Scenarios (p. 180) • Business Model Environment (p. 200) • Evaluating Business Models (p. 212)

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Figure A 8 The Business Model Design Process (Osterwalder and Pigneur, 2010)

[7] The page numbers refer to the book ‘Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers’ of Osterwalder

Appendix G Sustainable business model archetypes

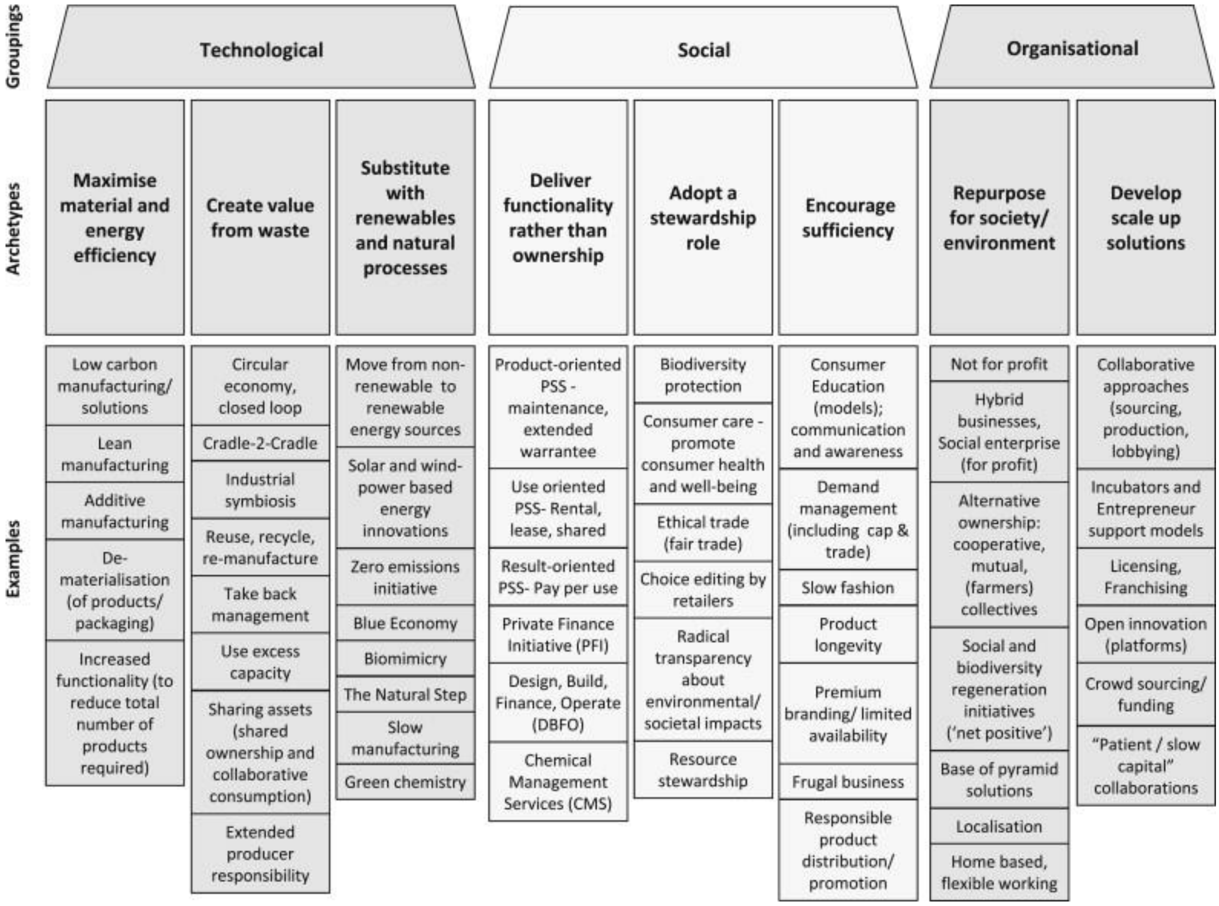

Figure A 9 The sustainable business model archetypes of Bocken et al. (2014)