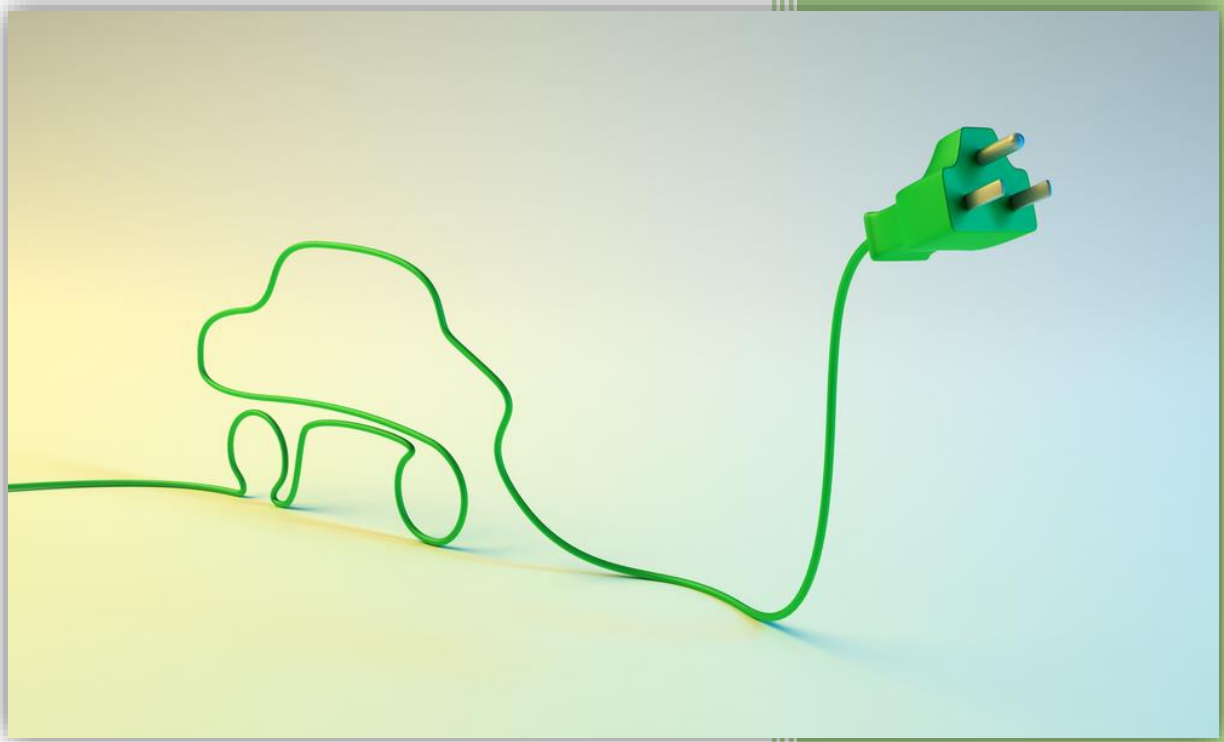
GEO4-2606 Master's Thesis Internship - Master Sustainable Business and Innovation

Exploring the relation between socio-technical regime dimensions and business model innovation



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Abstract

The link between actor level business activities and system level transitions is underexposed in the academic literature. This research aimed to expose these linkages in a case study. The case study focused on the transition towards electric mobility in the Dutch automotive regime. It explored the relationship between changes in the regime and business model innovation. It used the multi-level perspective to operationalize the regime. It used the six regime dimensions; policy, technology, science, culture, market and industry. The influences were tested per regime dimensions on innovation in three concepts of the business model, value proposition, value network and value capture. Qualitative data was gathered through fourteen interviews, with interviewees representing companies with innovative business model active in the electric vehicle sector. With companies providing mobility goods, mobility services, complementary goods and complementary services, the sample was an full representation of the electric vehicle sector. The findings showed the regime dimension had significant influence on business model innovation. Also they exposed that business model innovations also influenced the regime dimensions. Various examples were provided in which business model innovations destabilized the regime. The author of this research therefore proposes to expand the multi-level perspective with a seventh regime dimension, in which the business activities on actor level are described. This would allow deeper insights in transition, as it prevents the actor level business activities to be overlooked. Other recommendations that followed from the data were the inclusion of geographical demarcation and adjacent industries in the multi-level perspective.

Preface

Before you lies my Master's Thesis ´ Exploring the relation between socio-technical regime dimensions and business model innovation', which was written to fulfil the requirements of the Master's programme Sustainable Business and Innovation, at the Utrecht University. The thesis was written from November 2016 to May 2017. An internship at CROW, on the department Sustainable Mobility, was fulfilled during the same period.

I would like to thank my colleagues at CROW, in particular my supervisor Jurgen de Haan, for providing me with feedback and guidance throughout the process. Also I would like to thank all the interviewees, who not only provided me with data, but also linked me up with other interviewees and helped me familiarize with the electric vehicle sector in general.

Furthermore I would like to thank three specific person's. First of all my supervisor Joeri Wesseling, who helped me narrowing down my research topic and provided me with feedback during process. Also I would like to thank Max Luiten and Ralph Boersma for taking the time to check both my research proposal and final thesis on English grammar. Finally I would like to express my gratitude to my family, friends and girlfriend who supported my throughout the process.

Inhoud

1. Introduction

Since the publication of the Brundtland Commission´s report on global environment and development in 1987, sustainable development has been an issue on the agenda of policymakers worldwide (Redclift, 2005). The report defines sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their needs" (Brundtland Commission, 1987). Although interpretations of the concept of sustainable development have widely diversified over the years, consensus exists that the concept consists at least of a need for change (Hopwood, Mellor & O'Brien, 2005).

Driven by this need for change, stakeholders have forced established companies within almost all industries to pursue a transition towards more sustainability (Hockerts & Wüstenhagen, 2010). Typically, fixed and sunk costs, like capital equipment and R&D costs, and managerial cognitions cause incumbents to focus on incremental improvements (Christensen, Kaufman & Shih, 2008; Meadowcroft, 2009; Sydow, Schreyögg & Koch, 2009). However, these competency-enhancing incremental innovations are often insufficient to meet sustainable development pressures (Hall & Vredenburg, 2003).

Competency destroying radical innovations are needed, which are likely to create new capabilities that will challenge current business practices (Hall & Vredenburg, 2003). However, these radical sustainable innovations often do not fit the existing production processes, managerial expertise and customer preferences (Johnson & Suskewicz, 2009; Siegel, 2009). Reconfiguration, or innovation of the existing organisational structures can help to successfully capture value from the sustainable innovations (Chesbrough & Rosenbloom, 2002).

These organisational reconfigurations often affect one or more dimensions of the business model or the reciprocal interaction between those dimensions. The dimensions of the business model are the value proposition, value capturing and value network (Bohnsack, Pinkse & Kolk, 2014). Business model innovation can be defined as the implementation of changes in the key resources and processes of an organisation (value network), in the way value is offered to the customer (value proposition) or in the profit formula of a business (value capture) (Comes & Berniker, 2008).

Successful business model innovation is hard to achieve and failure rates are high (Chesbrough, 2010). Several papers discuss internal organisational features to explain success and failure of business model innovation (Amit & Zott, 2012; Chesbrough, 2010; Hwang & Christensen, 2008; Frankenberger, K., Weiblen, T., Csik, M., & Gassmann, 2013). Remarkably, the relationship between the external business environment and the success of business model innovation has been scrutinized less (Teece, 2010).

This is remarkable since the relationship between business model choice and enterprise performance is highly context dependent (Week, 2000; Teece, 2010). Conceptualizing sustainable innovation in terms of business models links the activities of firms to the larger systems of which the firms are part of (Boons, Montalvo, Quist & Wagner, 2013). Exploring the relationship between systemic factors and business model innovation may provide deeper insights in the influence of a business model's context on its success.

The multi-level perspective (MLP) is a theoretical framework which allows for analysis of socio-technical regime transitions (Geels, 2004; Geels, 2011). It explains how a socio-technical regime, which is typically held stable by the interactions between the six regime dimensions, can be destabilized by developments on macro-level and niche-level. This destabilization causes windows of opportunity and occurs due to the loosening of the six interrelated dimensions in the regime: industry, market, science, policy, technology and culture (Geels, 2004). The windows of opportunity allow niche-level innovations to breakthrough. A regime transition will take place if and when the regime dimensions align with the breakthrough innovation (ibid.).

The MLP framework is an instrument to analyse how the six regime dimensions interact and co-evolve during a transition (ibid.) However it overlooks the influence of these developments on individual actor behaviour. Farla, Alkemade & Suurs (2010) recognize this shortcoming and investigated the relationship between socio-technical system developments and the barriers that occur for actors, Bakker, Maat & van Wee (2014) investigated the influence of the system developments on the firm-level strategies. No literature yet combines the systemic perspective with the firm-level configuration of operations. Integrating the systemic perspective with the firm-level will be the main contribution of this paper.

A case study of the transition towards electric auto mobility in the Netherlands will function to test the relationships between firm and system level. This transition is an important part of the Dutch policy to reach CO2 reduction in the transport sector and improve the air quality (RVO, 2016). The government assigned itself the role of 'facilitator' of the transition. In order to fulfil this role adequately, in-depth understanding of the transition and its stakeholders is required (Bakker, Maat & van Wee, 2014). Various studies to the transition towards sustainable mobility of the Dutch automotive regime have been conducted (Bakker et al., 2014; Dijk, Orsato & Kemp, 2013; Farla et al., 2010; Sierzchula et al., 2014). Literature states that electric vehicles (EV) regained momentum in the Dutch automotive regime since 2005 (Dijk et al., 2013). Still, further research on the transition can provide even deeper understanding, allowing a better execution of the facilitating role by the government. Insights in how policy measures affect innovative business models can help governments facilitate entrepreneurial activities. This is important because these firms are a key driver of the transition (Bohnsack et al., 2014).

Investigating the following research question therefore adds to transition management literature and provides policy makers with insights in how their transition steering policies affect the configuration of operations on firm-level.

How does change in the six dimensions of the Dutch automotive regime affects business model innovation of companies offering products or services related to electric vehicles in terms of value proposition, value network and value capture over the period 2005 till present?

CROW-KpVV was the host organisation for which the research was conducted. As a knowledge institute for traffic, transport and infrastructure, mainly advising governments, they benefit from the research in multiple ways. Analysis of the relationship between the regime dimension developments and business model innovation can provide CROW-KpVV with insights in the effect of transition steering policies on firms, which they can use in their advising role to governments. Part of their operations as a knowledge institute is providing a platform (CROW-KpVV Dashboard) on which data related to traffic, transport and infrastructure can be found. Analysis of the six regime dimensions can provide data for this platform.

The next chapter (2) will describe the theoretical background of the paper. Business model innovation theory will be integrated with the multi-level perspective theory into a theoretical framework. Chapter three describes the methods that used to test this theoretical framework in a case study on the transition of the Dutch mobility market. Chapter four contains the findings, chapter five the conclusion and chapter six the discussion.

2. Theory

This chapter starts with a theoretical background on business models in general, followed by a more specific background on business model innovation. Hereafter an explanation of the multi-level perspective will be provided. Both theories will be integrated in the theoretical framework in the final part of this chapter.

2.1 Business Model Innovation

2.1.1 Business Models

Creating value from a technological innovation goes beyond managing just technical uncertainty, there is a significant uncertainty in the economic domain too, as well as in the mapping between these domains (Chesbrough & Rosenbloom, 2002). The business model can be regarded as the mediation construct in the value creation process between these domains (ibid.). The business model is a conceptual tool, containing objects, concepts and their relationships with which the business logic of a firm can be explained (Osterwalder, Pigneur & Tucci, 2005).

Since the late 1990's the popularity of the term business model in scientific literature has increased exponentially (ibid.). No consensus exists on which concepts should be included in the business model (Hedman & Kalling, 2003) resulting in a wide variety of concepts that are proposed to be part of the business model. The number of concepts varies from three (Bohnsack et al., 2014; Richardson, 2008) up to nine (Osterwalder et al., 2005). Richardson (2008) reviewed the existing scientific literature on business models and proposed a set of three concepts, consisting of value proposition, value creation & delivery and value capture. This paper will follow Richardson's concepts with one exception. The concept of value creation & delivery will be called value network, as proposed by Bohnsack et al. (2014).

2.1.2 Business model components

The most frequently recurring component in business model theories is the value proposition. No business can exist without a defined value proposition (Morris, Schindehutte & Allen, 2005). The value proposition can be split in two parts, the content of the offered product or service (Bohnsack et al., 2014), or as Richardson (2005) describes it the offering, and the target segment or target customer (Bohnsack et al., 2014; Richardson, 2005). A compelling offering of a product or service should satisfy the customer with the requisite quality at an acceptable price (Teece, 2010). Failure in adequately defining the target segment is a key factor associated with venture failure (Morris et al., 2005).

The value network entails the management of both the internal and external value chain (Bohnsack et al., 2014). The internal value chain refers to the internal resources, activities and competencies of a business (Morris et al., 2005; Osterwalder et al., 2005). External value chain management refers to the positioning in the value chain through links, relationships and partnerships with suppliers, competitors and customers (Morris et al., 2005; Richardson, 2008)

The value capture describes how the cost and the revenue model are designed (Richardson, 2008). Revenue streams, which typically depend on the value exchange with both suppliers and customers, and the

operational costs of the internal value chain determine the profitability of a business model (Gordijn, Akkermans & Van Vliet, 2000; Richardson, 2008).

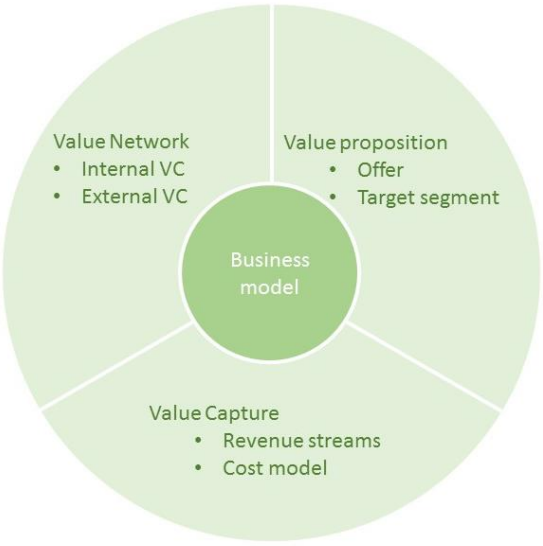

Figure 1 Business model components

2.1.3 Business Model Innovation

The economic value of an innovation remains latent until it is commercialized via a business model (Chesbrough, 2010). Sustainability related innovations are often not easily included in existing business models for two reasons. Firstly the costs of sustainable technologies are typically high due to its capital intensity, making the technology economically unviable in conventional cost and revenue models. Secondly, sustainable technologies often come with network externalities, which might lead to a lower value when the necessary complements are absent (Massa & Tucci, 2013). A way to make sustainable innovations, that do not fit within existing business models, commercially viable is through business model innovation. (Christensen, Wells & Cipcigan, 2012).

Business model innovation emerges typically, but not necessarily in turbulent economic, technological or regulatory contexts (Christensen et al., 2012). Experimentation with business model innovation often happens in niche markets, serving customers who are not, or not fully, served by incumbents and using resources which are not (fully) controlled by these incumbents. When an industry based on new technologies emerges, experimentation and selection often lead to a business model to become the standard (Morris et al, 2005). This converging towards a dominant business model occurs to create legitimacy and customer acceptance (Aldrich & Fiol, 1994). Business model innovation does not exclusively occur in emerging markets, but may also be deployed in existing markets, in which it has the potential to have a disruptive effect on the conventional business models (Massa & Tucci, 2013).

Business model innovation can be both a vehicle for innovation, in which case it serves to commercialize an innovative technology, as well as a source of innovation in and of itself (Massa & Tucci, 2013). The innovation can manifest itself in one or more of the components of the business model or the interaction of these components (Demil & Lecocq, 2010). For example, it can be the identification of new sources of value creation, which could be done by rearranging of, or repositioning in the value network (Zott, Amit & Massa, 2011). Another example is innovation in the value proposition, from offering the ownership of a product towards offering the functionality of a product (Kley, Lerch & Dallinger, 2011). Collecting revenue from multiple streams is an example of innovation in the value capturing. Take Flickr's multiple revenue

stream business model, that involves collecting subscription fees, charging advertisers for contextual advertising, receiving sponsorships and revenue-sharing fees from partnerships with retail chains and complementary photo service companies (Teece, 2010). Examplary of innovation in the interaction of the concepts are the so-called freemium business models in which a basic version of software is offered for free to win a large number of users and value is captured through offering advanced versions of the software or add-ons at high costs (McGrath, 2010).

2.2 Multi-level perspective

2.2.1 System perspective

The success of an innovation can not only be explained by the innovativeness of an innovation or actor itself, but should be interpreted in a wider societal context (Lee & Park, 2006). Interpretation in a wider context can be achieved through analyses of innovation that go beyond analysing the innovations itself, and instead look at a wider systemic level (Verbong & Geels, 2007). Various theories exist on how to make such a systemic analysis. Two prominent theories are innovation system (IS) theory and the multi-level perspective (MLP). Innovation systems are a heuristic attempt to analyse all societal subsystems, actors and institutions related to the development, production or distribution of innovation (Hekkert, Suurs, Negro, Kuhlmann & Smits, 2007). The multi-level perspective can be used to understand the dynamics of socio-technical transitions through the development on three analytical levels, which will be explained later in this paper (Geels, 2004). Weber and Rohracher (2012) compare both theories in their paper. They point out that one of the main distinctions between the two theories is that MLP puts more emphasis on the demand structures and a broader range of stakeholders, while IS focuses on adaptations of systemic contexts to foster firms' innovation activities. As described above, the business model innovation can be regarded as a tool to bridge the gap between technological innovations and the demands in the economic domain. MLP considers the existing regime, whereas TIS mainly focuses on the new system within transitions. Because BMI tries to reconcile existing (regime) institutions with new innovations and because of the emphasis on the demand side in both MLP and business model innovation, this paper will use MLP theory to place business model innovation in a systemic perspective.

2.2.2 Multi-level perspective

The multi-level perspective enables to understand (sustainability) transitions with a view of the multidimensional complexity of changes in socio-technical systems (Geels, 2010). MLP consists of three levels, the niche level, the socio-technical regime and the socio-technical landscape. By describing the dynamics of the interaction between these three levels, the MLP can help to understand how innovations within niche markets emerge and how they can lead to a breakthrough in the socio-technical regime (Verbong & Geels, 2007). Figure 1 visualises the interaction between the three levels.

The socio-technical landscape, or macro level describes the exogenous environment of the socio-technical regime (Geels, 2010). Typically, this level changes slow over time (Verbong & Geels, 2007). Changes in this level, such as economic developments or environmental problems may put pressure on the socio-technical regime (Geels, 2002). It also may influence the niche-level, for example through changing expectations due to increased awareness of climate change.

The socio-technical regime places technical developments in perspective to markets, user practices, policy and cultural meaning (Geels, 2004). Typically the regime is stable, coordinated around a dominant

technique, making it hard for innovations pioneered in the niche-level to break through (Geels, 2002). The regime can be described as a configuration of six dimensions. The alignment with the dominant technique of these dimensions causes the stability of the regime (ibid.).

These six dimensions are policy, technology, science, culture, market and industry. Kemp, Schot & Hoogma (1998) describe what each dimension contains, this paper will follow their description. The first dimension, policy is used to describe the policy framework. The technology dimension portrays the technological fit of the innovation within the regime and the required complementary technologies. The science dimension outlines the R&D pathways and results. The cultural dimension entails the norms and values within the regime. The market describes the customer groups and the position of the market in relation to other international markets. And the last dimension, industry, depicts the competencies and strategies of established companies in the regime.

The linkages between these dimensions can loosen up if the regime is confronted with problems or if tensions between the dimensions emerge. A cause of these tensions can be the above mentioned pressure on the regime level due to changes in the socio-technical landscape (Geels, 2002). Internal dysfunction of the regime is another possible cause of tensions and problems (Geels, 2011; Loorbach & Wijsman, 2013). This loosening of the dimensions creates windows of opportunity, through which innovations can escape the niche-level and be incorporated in the socio-technical regime (Geels, 2002).

The niche-level, or micro level, is the locus for radical innovation. On this level pioneers and innovators can experiment, build networks and articulate the expectations for further guidance of the learning process (Verbong & Geels, 2007). Customers on the niche-level are willing to accept a low price-performance ratio, as they are not served by incumbents. This causes little to no scrutiny of incumbents in the activities in niche-markets (Massa & Tucci, 2013).

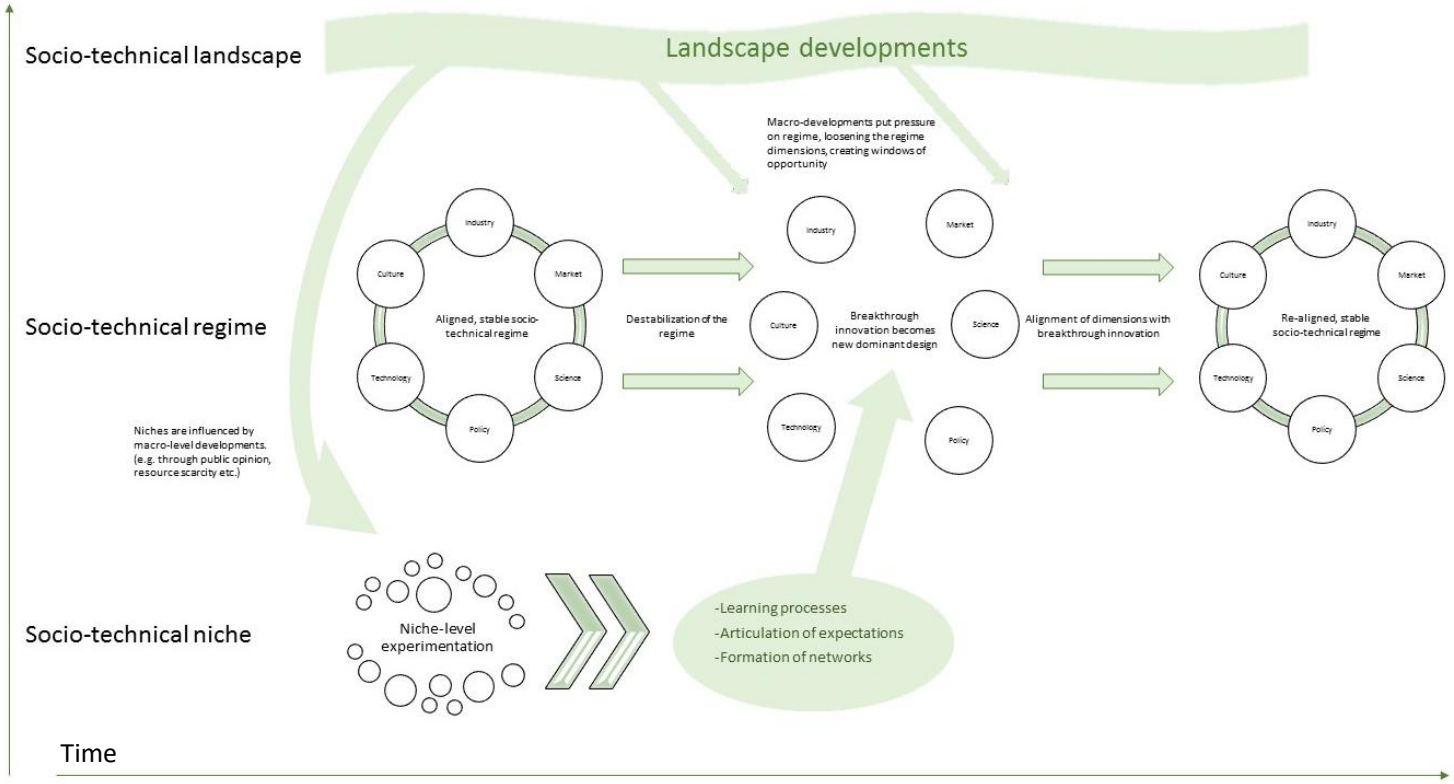

Figure 2 Interactions between the three levels of the MLP (Adapted from Geels, 2011)

2.3 Theory integration

Business model innovation theory and the multi-level perspective are integrated in the theoretical framework. The framework describes how, during a transition, each of the regime dimensions could be of influence on business model innovation. Exploring whether these assumed relations are existent and if so, of what nature they are in a real-life case study, will utimately provide an answer to the research question.

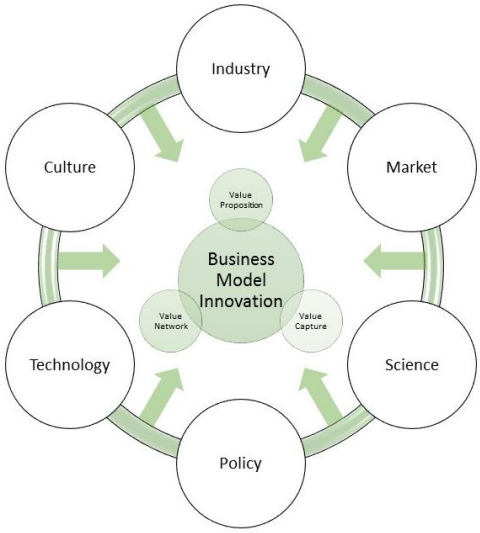

Figure 3 Theoretical framework

2.3.1 Policy

The policy dimension describes the policy framework of the regime. Borrás & Edquist (2013) identify three types of policy instruments that together make up the policy framework. These three types of instruments are regulatory, economic and soft instruments. Regulatory instruments are obligatory of nature, typically backed by sanctions. These regulations set the boundaries of what is allowed and what not. Regulatory instruments set the boundaries within which actors can act. These boundaries do not only apply for businesses, but for all actors within the regime dimensions. Therefore they are expected to have a direct effect, limiting the creativity to innovate business models in *all three components* as well as an indirect effect through the different regime dimensions.

The economic instruments provide pecuniary incentives or disincentives to support or discourage certain social and economic activities. In a transition economic instruments function to make the offering of the desired technology economically viable. A distinction can be made between economic incentives targeting the supply side, such as R&D subsidies, and incentives targeting the demand side of an innovation. Two demand side focussed economic instruments that have proven successful in studies are consumer subsidies and public procurement (Aschhoff & Sofka, 2009; Sierzchula et al., 2014). Demand side subsidies are used as market stimulation. They support the emerging technologies through financial incentives. This might help to create a big market, which may indirectly lead to more business models, but directly it takes away the necessity to find means to make the emerging technology competitive on price. Therefore it is expected that the direct influence of economic instruments is inhibiting business model innovations in the *value capture.*

Soft instruments are characterized by being voluntary and non-coercive. No direct incentives or sanctions are used to empower these instruments. Generally these instruments are based on persuasion, mutual exchange of information and on less hierarchical forms of cooperation between public and private actors.

Soft instruments mainly focus on voluntary agreements with incumbents and campaigns to influence public opinion. Therefore, solely indirect effects through the industry and culture dimensions are to be expected from soft instruments, no direct effects on business model innovation.

2.3.2 (Complementary) Technology

In case of a regime transition, the technology dimension can be used to describe what complementary goods are necessary to offer a technological configuration that works (Rip & Kemp, 1998). Two sorts of complements can be identified, specific and generic complements. Specific complements are goods that have a unilateral dependence with the innovation. Generic complements are commodity goods that can be transacted for on the open market (Rothaermel & Hill, 2005).

In this research complementary goods that are not distinctive for internal combustion engines (ICEV's) and EV's (e.g. tyres) are regarded as generic, distinctive complementary goods for EV's as specific (e.g. charging stations). The analysis will focus on the specific complements. Adequate development of these is key for the success of the transition towards electric auto mobility (Bakker, 2011). The analysis will describe the differentiation in complementary technologies and the availability of these. To elucidate the focus of this dimension, this dimension will be called *Complementary technology,* in the rest of this thesis.

The lack of a dominant business model in the charging infrastructure leads to a wide variety of offers on the market. Kley et al. (2011) provide an overview of the possible business models related to the charging infrastructure. In their review, business model innovations in all three components of the business model can be identified. Therefore expectations are that the changing technology dimension will lead to business model innovation in the *value proposition, value capture* and *value network*.

2.3.3 Science

In the science dimension analysis of the R&D pathways and results takes place. At the time a new technology appears, the established technology generally offers better performances (Utterback, 1994). If the new technology has merit, the development will typically enter a period of rapid improvement (ibid.). Purveyors of the established technology often respond to this invasion of their market with extra effort to improve the established technology based on the same architecture (ibid.). This is the R&D pathway of the established technology. Besides that, the possibility of alternative R&D pathways will be analysed as well.

Progress in R&D pathways of competing technologies will dimnish the relative advantage of the emerging technology and thus the value proposition through conventional business models will be less successful. Therefore it is likely that the developments in a changing science dimension will trigger business model innovation in the *value proposition* component.

2.3.4 Culture

The cultural dimension entails norms and values within the regime. Norms and values have a significant effect on consumers' behaviour, especially on their inclination to adopt new products (Daghfous, Petrof & Pons, 1999). These cultural preferences are often deeply rooted (Geels, 2012). Although they can change through social learning, which can be triggered by the framing strategies of established firms or by soft political instruments, they tend to change slowly if at all (Dowling & Pfeffer, 1975).

Innovations may have properties that conflict with existing norms and values. When change in the cultural dimension lags behind this can hinder the transition. The electric vehicle is a vivid example thereof. Strong values of freedom and autonomy are associated with auto mobility, whilst electric vehicles limit this freedom through limited ranges due to battery capacity (Geels, 2012).

Business model innovation has the potential to overcome cultural barriers due to conflicts with norms and values. Battery swapping or intermodal travelling are business models that could overcome the drawback of limited freedom. Conflicts with norms and values are expected to be solvable by innovation in the *value proposition* or *value network* components rather than in the value capture component of business models.

2.3.5 Market

During a transition the willingness to pay for and user acceptance of the new technology determine whether the market will adopt the innovation (Kemp et al., 1998). Willingness to pay differs per customer group, therefore insights in preferences per group are necessary (Potoglou & Kanaroglou, 2007). Five groups can be identified in the diffusion process of an innovation (Rogers, 2010). Typically an innovation will be adopted sequentially by innovators, early adopters, the early majority, the late majority and laggards. In this order the willingness to pay amongst the groups gradually shifts from depending on innovativeness and gaining social status and novelty to lowest price and risk aversion (Ibid). Consequently, it is expected that in the first stages value propositions will be innovated to highlight the innovativeness, whereas in later stages the value capture aims to enable lower prices and avoidance of risks for customers.

2.3.6 Industry

The industry dimension includes the established firms and their core competencies. In a stable regime, typically these firms focus on either cost-leadership or differentiation (Porter, 2008). Driven by uncertainties and sunk investments, they tend to defend existing regimes against changes through defensive response strategies. Penna & Geels (2012) identify political, economic, socio-cultural and innovation strategies. The political, economic and socio-cultural strategies are deemed to have only an indirect effect through the policy, market and culture dimensions. Because of that, the focus of the industry dimension is on innovation strategy, which is expected to have a direct effect on BMI.

Innovation strategies describe whether the focus lies on incremental or radical innovations and how to achieve these (Ibid.). Following the Porter hypothesis, firms that are put under stress by competition, regulation or demand, are more likely to innovate (Porter & Van der Linde, 1995). This stress is likely to be present in times of transition, due to landscape level pressures and new entrants from niche levels.

In times of transition firms are naturally expected to adopt more aggressive innovation strategies. Firms can pursue radical innovations through internal R&D and external knowledge acquisition or partnerships (Cassiman & Veugelers, 2006). Internal R&D aims to change the core competencies. Seeking partnerships aims to complement the core competencies with competencies of other firms to be successful in times of transition. Business model innovators can be engaged partners in the latter scenario to complement the capabilities of successfully commercializing the innovative technology.

Renewal of core competencies and the formation of partnerships will reconfigure the value chain. This provides opportunities for businesses to optimize their position within the value chain. Self-evidently, a changing industry dimension will predominantly affect the value network component of business models.

3. Method

3.1 Research Design

The aim of the research was to explore the effects of changes in regime dimensions on business model innovation through the real-life case study of the transition of the Dutch automotive regime from the use of internal combustion vehicles towards the use of battery electric vehicles (BEV). A case study was chosen since it is a suitable research design to test theoretical models and investigate causal mechanisms (Gerring, 2004). The design of a case study allows to gain detailed knowledge of the phenomenon under investigation (Baxter & Jack, 2008).

The research focused on the case of the automotive regime in the Netherlands as that is empirically found to be in a state of regime destabilization (Dijk et al., 2013). The Netherlands are, moreover, a leader in the transition towards electric mobility for several reasons. The Dutch society is in general relatively open for change; it has a closely-knit car mobility system; it has strong demand-side-oriented policy support (Wesseling, 2016). This case was selected through theoretical sampling. Theoretical sampling allows for purposeful selection of the unit of analysis in order to assure the enabling of testing the theoretical framework (Eisenhardt, 1989; Malterud, 2001).

The research consisted of two consecutive phases. In the first phase a desktop research provided in-depth understanding of the developments in the dimensions of the Dutch automotive regime. In the second phase semi-structured interviews were conducted to validate the desktop researcher's evaluation of the regime dimensions and to assess how these changing regime dimensions affect the business model innovation of entrepreneurs.

In the first phase the analysis was limited to the developments within the Dutch regime. For the market, policy and culture dimensions this limitation was clear and applicable. The industry, technology and science dimensions were often part of wider developments on global or European scale. For these dimensions the analysis focused on the part of these developments which were applicable or available within the Netherlands. For example within the industry dimension, the incumbent car manufacturers are often global players with headquarters outside the Netherlands. The analysis then focused on the strategy applied in the Netherlands, which could for example be a strategy that applies for the entire Western European market.

The selection of business model innovations was limited to businesses active on the Dutch market, including the business activities of foreign businesses on the Dutch market. It included all business with electric vehicles for personal transport or supportive technologies or activities for electric vehicles within their offering. Traditional car sales, lease or renting were considered to be the conventional business model, changes within one of the components of the business model or the interaction between the components are considered business model innovations. Interviewees were selected to cover business model innovation within all three components.

The desktop study analysed regime developments from 2005 until present. Dijk et al. (2013) argue there has been a new momentum for electric vehicles since 2005 due to concerns about climate change, urban pollution and peak oil. Identification of business model innovation will focus on business model innovations that occurred in the aforementioned period. It included failed business model as well, tis to possibly provide insights in the negative effects of the developments in regime dimensions which could be overlooked when exclusively interviewing successful business model innovators.

3.2 Data Collection

Case studies allow researchers to use multiple sources of data, including both qualitative and quantitative data (Baxter & Jack, 2008). This research started with a desk research, that provided qualitative and quantitative data. Thereafter interviews were held to gather qualitative data. The data from the desk research were used to gain insights in the dynamics of each of the regime dimensions and identify EV related companies with innovative business models. Qualitative data, gathered from interviews, were used to confirm findings from the desktop research and provide in-depth understanding of how business model innovators perceive the influences of the socio-technical regime dimensions. Figure 4 provides a schematic overview of the steps of data collection.

3.2.1 Operationalisation

The concepts of the framework are operationalized in table 1. This operationalisation scheme translates the concepts into assessable indicators. The last column provides indicators around which the interviews and desk research were designed.

Table 1 Operationalisation

Concept	Dimension	Indicators
Business Model	Value proposition	Offer
		Target Segment
	Value network	Position in value chain
		Internal processes
		Core competencies
	Value capture	Revenue & Cost model
Innovation System	Industry	Innovation strategy
	Technology	Availability
		Differentiation
	Market	Customer groups
	Culture	Norms & Values
	Science	R&D Pathways
		R&D Results
	Policy	Regulatory instruments
		Economic instruments
		Soft instruments

3.2.2 Desk Research

To investigate the relationship between the dimensions of the socio-technical regime and business model innovation during a transition, detailed understanding of the dynamics and ongoing transition processes within the regime dimensions were necessary. A desk research functioned to provide this understanding.

Literature, databases, policy documents, technology outlooks and company reports were the main sources of evidence.

The deeper understanding of the Dutch automotive regime, which was gained through this desktop research also helped to identify firms engaged with business model innovation within the regime. These insights allowed well-informed selection of interviewees. In a later stage of the research, the desk research was used to triangulate data from the interviews.

3.2.3 Interviews

After mapping the dynamics of the regime dimensions through the desk research, semi-structured interviews were conducted. Interviews provided targeted qualitative data, which provided insights in the investigated relationships (Tellis, 1997). The interviews were be semi-structured to provide guidance throughout the interviews and ensure coverage of each topic, while remaining flexibility to allow for clarification of relevant issues raised by the interviewee (Louise Barriball & While, 1994).

The interviews had basically two functions. The first was to triangulate the data found in the desktop research. The second was to investigate how changing regime dimensions affect business model innovations. The interview questions, which can be found in appendix A, were based on the indicators shown in table 1.

Interviewees were selected on the basis of their role in their respective companies. The interviewees were as much as possible decision makers within the company, who were involved in the company at least since the business model innovation establishment. Table 2 provides an overview of the interviewees, the associated companies and their roles within that company.

Table 2 An overview of the data sources and examples of interviewees

Interviewee	Company	Role
Hans de Boer	*Greenflux*	Founder
Michel Baying	*E-Car Cell*	Founder
Chris Heiligers	*EC-Rent*	Founder
Michiel Langezaal	*Fastned*	Founder
Mark Schreurs	*Mister Green*	Founder
Jorg van Heesbeen	*Jedlix*	Business Developer
Rutger de Croon	*Stichting E-Laad*	Project Manager
Gerrit Mudde	*Movenience*	Manager Business Systems
Gerben de Groot	*Elmonet*	Founder
Roderick van den Berg	*Eco-Movement*	Founder
Alain de Schutter	*Streetplug*	Sales Executive
Jaap Burger	*We Drive Solar*	Founder
Johan Janse	*Buurauto*	Founder
Koen van Walsem	*Renault*	ZE Consultant

The companies the interviewees represented for were determinative in the approach of interviewees. The companies were selected based on their business model innovation, making sure innovations in each of the business model components were represented. Besides that, the companies were selected on their role in the regime, covering both companies providing mobility goods and services as well as complementary goods and services. Figure 3 visualizes this differentiation and numbers the roles. Table 3 provides an overview of the business models of the sample. A brief description of the business model and their innovations is given in the table for each of the companies represented in interviews, the business models will be described in more detail in the findings chapter. The transition towards EV goes beyond the adoption of EV's. Services for EV's and complementary goods and services for those goods are needed for a transition as well. Business models form around these goods and services. The role(s) of the company in the regime have been indicated in table 3 with a number corresponding with figure 3. Representation of all four roles was taken into account in the sample selection.

Figure 4 Role in the automotive regime

Table 3 Description of companies represented by the interviewees

Company	Business Model	Business model innovation	Role in regime
Greenflux	*Started building a semi-fast charging network, which did not end up to be profitable. Now offering back office management systems for charging systems, mainly in foreign countries.*	*Value proposition (offering on-the-go charging)* *Value network (developing competencies for management systems)*	*3* *4*
E-Car Cell	*Offering BEV's to share with a group of acquaintances.*	*Value capture (shifting the payments of customers)*	*2*
EC-Rent	*Renting BEV's, mainly for special occasions, such as events or weddings.*	*Value proposition (unique offering for specific segment)*	*1*
Fastned	*Building a fast charging network*	*Value proposition (offering on-the-go charging)*	*3*
Mister Green	*Offering Tesla's for operational lease.* *Building a fast charging network.*	*Value proposition & capture (operational lease of BEV's)* *Value proposition (offering on-the-go charging)*	*1* *3*
Jedlix	*Offering a smart charging service, which allows people to earn money by charging at certain times, to avoid grid congestion.*	*Value capture (capturing value that lies in preventing grid congestion*	*4*
Stichting E-Laad	*Knowledge and expertise centre for a consortium of six grid operators. Started with a focus on building charging infrastructure. Then the focus shifted to making all charging systems interoperable. Now the focus is on (vehicle-2-grid)smart charging.*	*Value network (form partnerships and collaborate)* *Value capture (investments pay off in avoided investments)*	*4*
Movenience	*Developer of payment systems for charging stations.*	*Value network (offer same product in different value chain)*	*4*
Elmonet	*First and only official importer in the Benelux of the Th!nk Nordic, the first serial produced BEV.*	*Value proposition (unique offering of BEV's at that time)* *Value capture (payed off in other parts of the company)*	*1*
Eco-Movement	*Mapping all (semi-)public charging facilities, providing real-time pricing and availability information. Mainly for B2B purposes (e.g. for navigation systems), for consumers available on oplaadpalen.nl.*	*Value proposition (unique offer)* *Value network (started in another value chain and now placed in EV value chain)*	*4*
Streetplug	*Selling a charging facility that hides under the ground when unused.*	*Value proposition (unique offer)*	*3*
We Drive Solar	*Offering shared BEV's and a charging system coupled to local renewable energy sources. Testing the integration of vehicle-2-grid charging.*	*Value network (formation of partnerships to realise unique project)* *Value capture (shifting the payments of customers & capturing value that lies in avoidance of grid congestion)*	*2,3,4*
Buurauto	*Offering BEV's to share with a group of acquaintances.*	*Value capture (shifting the payments of customers)*	*2*
Renault	*Offering BEV's with leased battery* *Involved in projects researching vehicle-2-grid charging*	*Value capture (shifting the payments of customers)* *Value network (formation of partnerships to realise unique project)*	*1* *4*

3.3 Data Analysis

The data gathering was structured around 'bins' (Baxter & Jack, 2008). During the desk research six bins were formed, one for each regime dimension. These data bins provided the basis for mapping the developments of each regime dimension during the transition. In the second phase interviews were conducted to gain insights in how these regime dynamics affect the three dimensions of business model innovation. This data was structured around three sub-bins per bin. Figure 4 provides a schematic overview of the research methods and analysis bins.

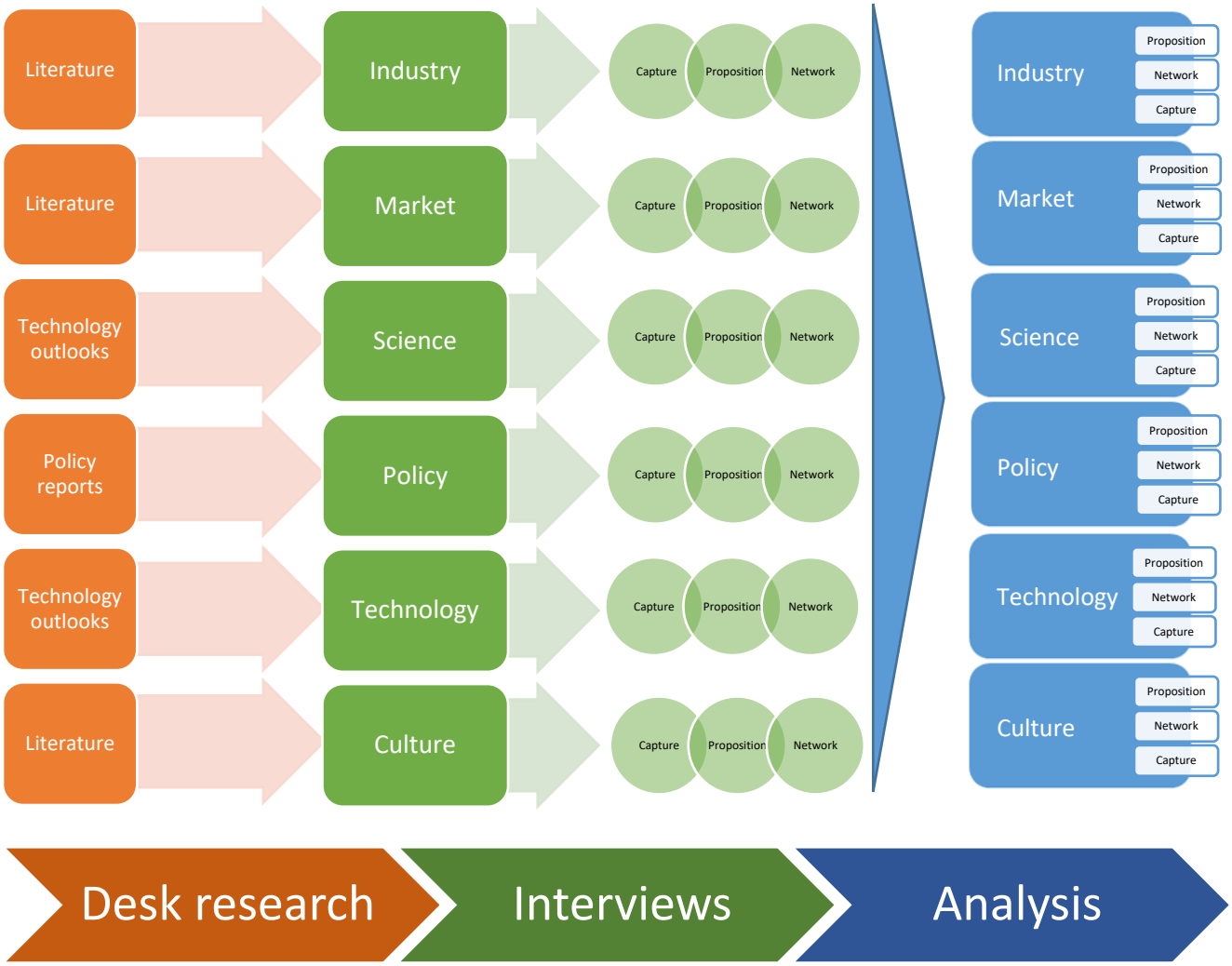

Figure 5 Schematic overview of data collection and analysis

3.4 Reliability, validity

The quality of a report can be determined by its validity and reliability (Bryman, 2008). Data triangulation, the use of multiple sources of evidence, together with method triangulation, which was achieved by the use of both desk research and interviews, increased the construct validity of this exploratory case study (Tellis, 1997; Andrade, 2009). Documentation and recording of all steps of the research provided reliability (Yin, 2011).

4. Findings

The desktop study focuses on the developments since 2005, in this year EV regained momentum (Dijk et al., 2013). For a regime as big and complicated as the automotive regime it is impossible to identify and describe each single development. The developments described in the continuation of this desktop study were selected on their potential influence on business model innovation. The correctness of the developments and the significance of their influence were validated during the interviews. Developments with significant influences that were missing initially, were added during the interviews.

The developments are described per dimension. Having said that, it should be kept in mind that developments are often combinations or sequences of developments throughout various dimensions. Therefore both direct influences of a regime on business model innovations are described, as well as indirect influences. Indirect influences have effects on other dimensions and have an influence on business model innovation in this way.

Per dimension, the indicators described in the operationalization table, are assessed. The developments per indicator are presented narratively. An analysis paragraph provides the most important findings per dimension.

4.1 Policy

4.1.1 Regulatory instruments

Approval

In 2009 the Th!nk Nordic became the first serial produced BEV that was allowed to be sold all over Europe, after the Rijksdienst Wegverkeer gave their approval (Rijksoverheid, 2010). This allowed the importer of this car for the Benelux, Elmonet, to sell without individual inspection for each car, cutting the costs significantly (Elmonet, 2017). This enabled Elmonet to sell the car. Their cooperation with Urgenda, was of significant importance, as Urgenda played an important role with both their lobbying activities in the approval of the Th!nk and bringing Elmonet in contact with potentially interested parties (ibid.). For Urgenda the cooperation was part of their project “Icoonproject Elektrisch Vervoer”, in which they offer workshops to organisations how to make their car fleet more sustainable, pressure ministers -at the time minister Cramer- to make their policy more sustainable by handing them manifests and create awareness of environmental problems amongst citizens through a variety of initiatives (Urgenda, 2017). Since the Th!nk was charged by a conventional 230V plug, no charging infrastructure was needed.

Also other business models were affected by the need for approval of their business model. For example Streetplug was hindered by regulations made for charging facilities. Those regulations did not permit their contemplated charging facility. The regulations demand the horizontal surface not to exceed 30cm x 30 cm, but as the Streetplug hides horizontally in the ground its surface exceeds these dimensions. The Dutch Knowledge Platform for Charging Infrastructure (NKL) helped Streetplug in their successful lobby to change this regulation. Only after a regulation change the Streetplug was allowed in public spaces (Streetplug, 2017).

Thirteen cities in the Netherlands, amongst which the biggest four, introduced ‘milieuzones’. These milieuzones are zones in city centres in which certain ICEV’s have restricted access. The specific rules differ

per city, but all aim to exclude vehicles with high CO_2 emissions from the city centres. Actively discouraging conventional ICEV's in the city centre stimulates people living in the city to rethink the usage and ownership of such vehicles. This helps sustainable alternatives such as EV-sharing projects (Renault, 2017; We Drive Solar, 2017).

4.1.2 Economic instruments

Market stimulation

Several economic incentives that fostered the development and diffusion of EV's and their infrastructure can be identified. The first one is the lower additional tax liability on electric company cars. From 2007 till 2016 a tax reduction applied for cars with low emissions. Since 2010 the additional tax depends solely on the CO_2 emission of the car. For every car with less than 106 grams of CO_2 per driven kilometre a tax reduction was in place. In January 2017 a gradual policy change was initiated to shift to a tax reduction only applicable for zero emissions vehicles (Rijksoverheid, 2015). There is also a tax exemption in place for motor vehicle tax (MRB) purchase and import (BPM) tax of zero-emission vehicles (RVO, 2017a). Besides this, investments in sustainable technologies are stimulated by the Milieu-investeringsaftrek (MIA) and the Willekeurige afschrijving milieu-investeringen (VAMIL), allowing entrepreneurs to deduct the investment on their income tax (RVO, 2017b).

Another economic incentive is the so-called Greendeals deriving from the Greendeal Laadinfrastructuur, which led to the installation of 15.000 public charging points. This Greendeal was followed by the Greendeal Openbaar Toegankelijke Elektrische Laadinfrastructuur in which the Rijksoverheid provides 5.7 million euro to stimulate the further development of charging infrastructure. On average this will lead to a federal contribution of 570 euro for each charging point (RVO, 2015).

The respondents unanimously identify the lower tax liability as the most important economic incentive for the Dutch EV market. Without this instrument the EV market would have been much smaller. Especially the companies with cars in their value proposition perceived direct incentives from it. For companies selling or leasing EV's, such as MisterGreen, Renault and Elmonet, it has lowered the costs for their customers, making the value proposition more competitive, resulting in higher sales numbers (Elmonet, 2017, MisterGreen, 2017; Renault, 2017). Others such as Fastned, E-Laad and Greenflux, who offer services for the EV drivers, were influenced indirectly by the lower tax liability, through market growth and thus a bigger target segment. For Greenflux the lower tax liability, and their expectations of its effect on the market, was the reason to focus on offering services for the market, first charging infrastructure, later back office management systems for charging infrastructure. The founder of Greenflux even states that without the economic incentives for the market, they might have chosen another business model, focussing more on research (E-Laad, 2017; Fastned, 2017; Greenflux, 2017).

The MIA and the VAMIL and tax exemptions for MRB and BPM on EV's were perceived as useful drivers of EV diffusion and in case of the MIA and the VAMIL to charging infrastructure, however they were not as important as the lower tax liability (EC-Rent, 2017, Elmonet, 2017; Fastned, 2017; MisterGreen, 2017). Significantly, none of the respondents identified the Greendeals as important.

Several respondents pointed out the negative effects of the variety of economic instruments. It would lead to too much complexity (Eco-Movement, 2017) or even a 'grant fatigue', an overdose of EV stimulation making it harder to get grants for new initiatives (We Drive Solar, 2017). Others point out that business models based on subsidies are undesirable as they would fail in case of the disappearance of the subsidies (EC-Rent, 2017), would cause unfair competition (Fastned, 2017) or make entrepreneurs lazy and less

perfectionistic, as it would not impel and allow market forces to punish underperformance (Eco-Movement, 2017).

R&D stimulation

As showed in figure x. expenditures on EV stimulation are relatively high. However this stimulation takes place mostly through market stimulation. Less funding is available for R&D on EV's. The respondents who use R&D subsidies to innovate were using either European funding or general innovations subsidies.

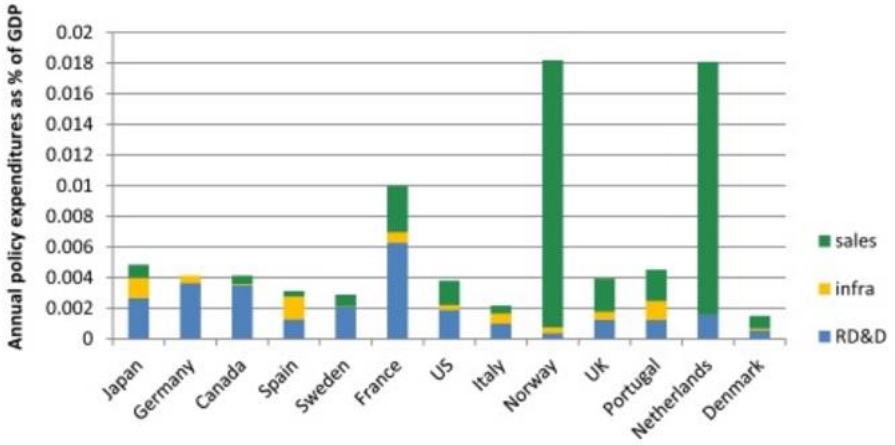

Figure 6 Country's annual expenditures as % of their GDP on stimulation EV sales, R&D and infrastructure (Wesseling, 2016).

Greenflux uses funding from the Horizon 2020 programme. For long and lasting innovation project, as executed by Greenflux this funding is indispensable (Greenflux, 2017). E-Car cell uses subsidies that were given by the E Car European Network of Electric Vehicles and Transferring Expertise (ENEVATE), in which E-Car Cell is part of a interregional project to stimulate EV in non-urban regions. The project aims to find business models for EV's in rural areas that can exist on their own, without relying on permanent subsidies (E-Car Cell, 2017; ENEVATE, 2017). EC-Rent is planning to use a subsidy for the development of technological features to develop a payment system for their smartphone application (EC-Rent, 2017).

4.1.3 Soft instruments

Public-Private Partnerships

Two major soft instruments used to stimulate the transition towards EV can be identified. The first one is the public private cooperation, the so-called Formule E-team. This team was founded in 2009 to stimulate the introduction of electric vehicles in the Netherlands through consultancy, knowledge transferring and building networks, between governments, research institutes and entrepreneurs. Government reports state that the team has contributed to several breakthroughs (Kwink, 2016), however none of the respondents underpins this. Some see the team as a driver for EV in general in the Netherlands, mainly causing awareness of EV (E-Car Cell, 2017; Elmonet, 2017; MisterGreen, 2017). Others doubt the team's usefulness describing it as 'talking shop', not believing it has an significant influence on innovation at all (Eco-movement, 2017; Fastned, 2017; Jedlix, 2017).

The second soft instrument was the establishment of a variety of Partners for International Business (PIB's), by which the governments aims to take away barriers for international business activities (RVO, 2017c). Two respondents stated the PIB's helped them to get in touch with international clients, however both stated they would have also gone international without the PIB's. So the PIB's were supportive, but not

decisive in expanding their business models. (Greenflux, 2017; Streetplug, 2017). None of the respondents identified the soft instruments as a significant influence on their business models.

4.1.4 Analysis

The findings show that without policy change crusted regulations can form barriers for business model innovations. Regulations may cause high costs, through recurring costs of inspection fees and man hours put in the approval of propositions. Change in regulations can have an enabling effect on business model innovations, through approval of the value propositions and cutting costs in the value capture. Economic instruments mainly have an indirect effect on business models through their influence on the market dimension. They also have a certain effect on the value capture, making it easier to come to a profitable value capture, but the economic incentives mainly stimulate the conventional capturing of value, through incentives on lease and purchase of cars. Despite a sample throughout the complete EV system, the soft instruments do not have a positive effect on any of the business models.

The findings showed that regulatory instruments are only of influence if and when they are not in line with the value proposition of a business model. In these cases they may cause high costs or even rule out business models. Economic incentives are in place, but are mainly demand side orientated. These demand sided economic incentives have supported business models that offer EV's, but also have had an indirect effect on other business models through market growth. How this market growth, and the international position of the Dutch EV market as consequence of this, influence business models will be discussed in the market dimension. Soft instruments demonstrated to be of insignificant influence on business model innovation.

4.2 Complementary Technology

4.2.1 Availability

Numbers

The number of (semi-)public charging points has risen in the last four years from just under 4.000 in 2013 to 19.200 in 2016 (CROW, 2016). The respondents providing (lease, rental, shared) cars perceive this development as positive, regardless whether the charging points are fastchargers, or (semi-) public chargers (Buurauto, 2017; EC-Rent, 2017; E-Car Cell, 2017; MisterGreen, 2017). The development of the charging infrastructure decreases the range anxiety of people and thus helps taking away a barrier towards adoption of EV. How range anxiety affects business models will be discussed further in detail in the culture dimension.

The current number of charging points is not considered an influence on their business model by any of the respondents. The respondents think the current charging infrastructure is not a barrier for the maturation of the EV-market for two reasons. Firstly, the increasing battery performances due to technological development will decrease the intensity of use of the public charging infrastructure as people tend to charge at home as much as possible (E-Car Cell, 2017) and most of the chargers are home chargers (Greenflux, 2017). Secondly, it is believed that if there is demand, a charging point will arise due to market forces (Buurauto, 2017).

4.2.2 Differentiation

The availability of charging infrastructure is indispensable for the success of BEV's, however within the sector of charging infrastructure differentiation exists. More specifically, two different business models can be identified, destination charging and on-the-go charging. The difference lies within the charging rhythm, in other words: the moments of charging. Destination charging takes place at home or at ones destination, e.g. work or city centre. The chargers used for this kind of charging are usually relatively slower, but cheaper than chargers used for on the-go charging. For on-the-go charging the charging rhythm is comparable to the current refuelling rhythm. There are different pros and cons to both technologies. Amongst the repsondents there is no consensus on whether the future pathway will be destination charging, on-the-go charging or a hybrid form.

Destination Charging

In 2009 Stichting E-Laad was founded by a partnership between seven energy grid operators who saw an enormous opportunity in the transition towards EV. To stimulate the market they placed 3.000 public charging stations between 2009 and 2013 (E-Laad, 2017). In 2013 the Ministry of Economic Affairs decided there should be no competition within the regulated domain of the energy grid, which meant Stichting E-Laad was no longer allowed to place charging stations (E-Laad, 2017; Kwink, 2016). This was the reason for Stichting E-Laad to split up in two organisations, EVNetNL and E-Laad.

EVNetNL became responsible for the placed charging stations. They had to transfer the possession of these to other parties, mainly municipalities. EVNetNL provides these other parties with the management and maintenance of the public charging stations.

E-Laad became the knowledge and expertise centre for the energy grid operators. E-Laad is meant to smoothen the integration of EV and the energy grid. The main concern for grid operators with the prospect of high EV adoption numbers is grid congestion and unbalance of the grid (E-Laad, 2017). E-laad's business

model is based on development of new capabilities to avoid future grid problems due to EV. Their income is based purely on financing from the grid operators and is expected to pay off through avoided investments (E-Laad, 2017). The focus of their research agenda and activities is based on the needs of the grid operators. It started with the stimulation and testing of basic charging infrastructure, followed by providing an interoperable paying system by developing protocols. Now the focus lies on avoiding grid congestion through smart charging and in the future the focus will shift to blockchain technology and vehicle-2-grid systems (E-Laad, 2017).

Another business that originated from foreseeing the problem of grid congestion is Jedlix. This spin-off of Eneco offers EV drivers money to let Jedlix manage the charging of their car. They use their knowledge of the energy grid dynamics to avoid grid congestion through managing the time and speed of charging. Charging at the right speed and times helps grid operators to avoid fines they get for causing grid congestion. Grid operators pay Jedlix for avoiding these fines and Jedlix shares these earnings with their users. For Jedlix cooperation with charging point operators is indispensable for this business model, as they need access to the management systems of the charging stations. Currently they are able to provide their service for the public charging stations of EVNetNL and the home charging stations of Tesla (Jedlix, 2017).

A third organisation involved in balancing the grid is We Drive Solar. We Drive Solar offers shared BEV's, which are charged with locally generated renewable energy. The idea of We Drive Solar arose while finding ways to optimize the use of the locally generated renewable energy of the Smart Solar Charging project, consisting of 700 solar panels. By making it fully transparent where the energy was generated and, if possible, connecting the solar panels directly to the charging stations, We Drive Solar is able to offer an unique 'green' value proposition. In the near future We Drive Solar plans to use the shared cars as energy storage systems and use them to charge power back in to the energy system, using the cars' battery to compensate for the fluctuation of renewable energy sources. This is now done by adjusting fossil energy generation. This will make the project even greener and effectively create a smart grid[i] (We Drive Solar, 2017; Kempton et al., 2008).

Smart Grid[i]

The Smart Grid is regarded as the next generation power grid, It uses two-way flows of electricity and has a wide range of advantages, such as improving energy efficiency, profiling demand, maximizing utility, reducing cost, and controlling emission (Fang et al., 2012).

Because the founders of We Drive Solar did not possess all the internal capabilities to realise the project, partnerships are vital. To investigate the possibilities of vehicle-2-grid charging they cooperate with Renault and E-Laad, they use the expertise of Jedlix for controlled charging and have other partnerships for the placement and maintenance of the charging points (We Drive Solar, 2017).

Besides grid congestion another problem arose from the placement of the (semi-)public charging stations. Some municipalities had invested in making their city centres obstacle free, out of safety and authenticity concerns. The transition towards EV caused a need for charging stations, but charging stations were seen as obstacles, by some municipalities. This led to the municipalities inquiring with a variety of parties to find a solution for this problem (Streetplug, 2017). One of these parties was PIA Mechanical, specialized in automatization solutions. Together with TecForRec, a company that just entered the market of charging stations, they developed a charging station which hides under the ground when unused. This product now forms the unique value proposition of Streetplug B.V., which was founded in 2016.

On-the-go Charging

In 2010 a breakthrough in charging speed occurred at the R&D partnership of The Tokyo Electric Power Company, Nissan, Mitsubishi and Fuji Heavy Industries. The breakthrough allowed for DC fast charging 62.5 kW, which has developed up to 150kW today and has no theoretical limit for further development (CHAdeMO, 2017).

This breakthrough innovation, called CHAdeMO, was the trigger for Michiel Langezaal and Bart Lubbers to found Fastned. Believing in a transition towards EV, they identified the lack of charging infrastructure and started building fast charging stations along the highway in 2012 (Fastned, 2017). Fastned aims to provide on-the-go charging, which is similar to the current habituation on gasoline refuelling (Bakker, 2011).

MisterGreen and Greenflux are two other organisations that started building fast charging stations in the same period. Greenflux, who started building them next to roadside restaurants in 2011, decided after having built 30 of such charging stations that the usage of the stations was too low to pay off for the high investments done and subsequently changed their business model. They used the knowledge and expertise they gathered of managing these stations as the value proposition of their new business model, controlling the back offices of charging networks. They now offer their services in foreign countries with rising EV numbers (Greenflux, 2017).

Mister Green started the Fast Charging Network in 2008. They now exploit 15 fast charging stations and are planning to grow that number in the future. They believed in a hybrid form of 70% charging on the go and 30% at home. Their focus was on fast charging because of the higher throughput. Although the initial investments were ten times higher, they believed investing in hardware that could charge 50 times more cars would pay off eventually. To support the value capture, they offer their charging stations to other parties, offering them to 'adopt' a charging station and give it their brand colours and name, making the station into a billboard (MisterGreen, 2017).

4.2.3 Analysis

The success of business models that offer mobility goods or services in the EV sector is partly dependent on the availability of charging infrastructure. The interviewees representing these companies considered this availability to be sufficient. The differentiation of the sort of charging infrastructure appeared to be a big influence on business model innovation. A clear distinction can be made between two value propositions of business models, offering on-the-go charging or destination charging. On-the-go charging offers fast charging on strategic roadside locations, while destination charging offers slower charging in places where the car stands still, one's home or destination. On-the-go charging requires a higher initial investment, but is easily scalable due to the higher throughput of charging cars and lower investments to add extra chargers at a station. Destination charging requires a lower initial investment, but could encounter problems in case of mass adoption of EV's. Charging multiple EV's in a small area at the same time could cause grid congestion. The smart management of the time and speed of charging helps to avoid such grid congestion. Business models are formed to capture the value that lies in this smart charging. Destination charging also offer possibilities of further integration of EV's and the energy grid. Further development of this integration, the development of a 'smart grid', offers potential for more efficient use and storage of sustainable energy. This integration will be discussed in further detail in the industry dimension.

4.3 Science

4.3.1 Pathway

Two major alternatives for the current ICEV regime exist, fuel cell technology and BEV's (Thomas, 2009). Although the technologies do not exclude each other, scientific interest seemed to have shifted from fuel cell technology in the early 2000's to BEV's in the late 2000's (Van den Hoed & Vergragt, 2004; Dijk et al., 2013). Triggered by the rapid developments of BEV's, carmaker incumbents invested in R&D focused on the efficiency of ICEV's. This resulted in incremental efficiency gains (Dijk et al., 2013; E-Car Cell, 2017; Greenflux, 2017; MisterGreen, 2017).

ICEV

The renewed investments in ICEV efficiency are thought to have no or little retarding effect on the transition towards electric auto mobility. Whereas most business models benefit from a fast transition, which will be discussed in detail later in the market dimension, two exceptions exist. Greenflux, which considers the Dutch EV market as a 'living lab' to develop unique capabilities, which they offer internationally in their value proposition, might lose their place 'on top of the wave' when the market develops too fast (Greenflux, 2017). Another business model that will have to change when the market develops further rapidly is EC-Rent, which's value proposition is now mainly based on the 'newness' and thus specialness of BEV's, mainly targeting the events rent segment. When the market develops further they will have to split their value proposition in functional renting and electric sports cars for events (EC-Rent, 017).

Fuel Cell Technology

Fuel cell technology is seen as a promising technology by most of the respondents, however not in the role as powertrain for passenger cars. For Elmonet, the importer of the first BEV, their choice for BEV was based on the availability of BEV's. At that time no fuel cell car was available (Elmonet, 2017). Others point out other factors to choose investing in BEV's over fuel cell cars, such as the efficiency loss of fuel cell technology (E-Laad, 2017; MisterGreen, 2017;), the safety issues due to the needed high pressures (Buurauto, 2017) and the conception of the reputedly promising prospects of fuel cell technology as merely 'window dressing' and distraction by, amongst others, Shell, to extend the global dependency on fossil fuels (Fastned, 2017; MisterGreen, 2017. Fuel cell technology is recognized as useful for the storage and transport of energy, heavy transports and range extenders (Buurauto, 2017; Eco-Movement, 2017; MisterGreen, 2017; StreetPlug, 2017).

BEV

With the exception of one, Movenience, all respondents believe the transition towards BEV's will carry through. The trend of declining battery prices, increasing battery performances, fiscal stimulation and positive driving experiences being the main reasons (Accenture, 2015). The battery price and performances are seen as the most important factors for the successful commercialization of BEV's, as the battery price is the main reason for the high price of BEV's (Nykvist & Nilsson, 2015; Sierzchula et al., 2015). The development of the price of batteries will be discussed below, as this is the most important result of R&D for commercialization of BEV's. The performance of the battery expresses itself in the range of the BEV. The influence of the limited range of BEV's on business model innovation is discussed in the cultural dimension.

4.3.2 R&D Results

Increasing performances

In 2008 batteries energy density was approximately 60 Wh/L at a price of around 1000 USD/kWh. In 2015 this was 295 Wh/L at a price of 268 USD/kWh (IEA, 2016). The target for the development of batteries is 400 Wh/L at a price of 125 USD/kWh in 2022 (ibid.). Figure 4 shows the development of battery prices and density over time as reported by the US Department of Energy (DOE). It is commonly understood that the cost of battery packs needs to fall below S$150 per kWh in order for BEVs to become cost-competitive on par with internal combustion vehicles. (Nykvist & Nilsson, 2015). This wider trend of declining costs and increasing densities of batteries causes increased faith in EV amongst 'outsiders'. This strengthens the position in networking activities (Eco-Movement, 2017) and makes it easier to find investments, either through crowdfunding (EC-Rent, 2017) or from parenting companies (Jedlix, 2017).

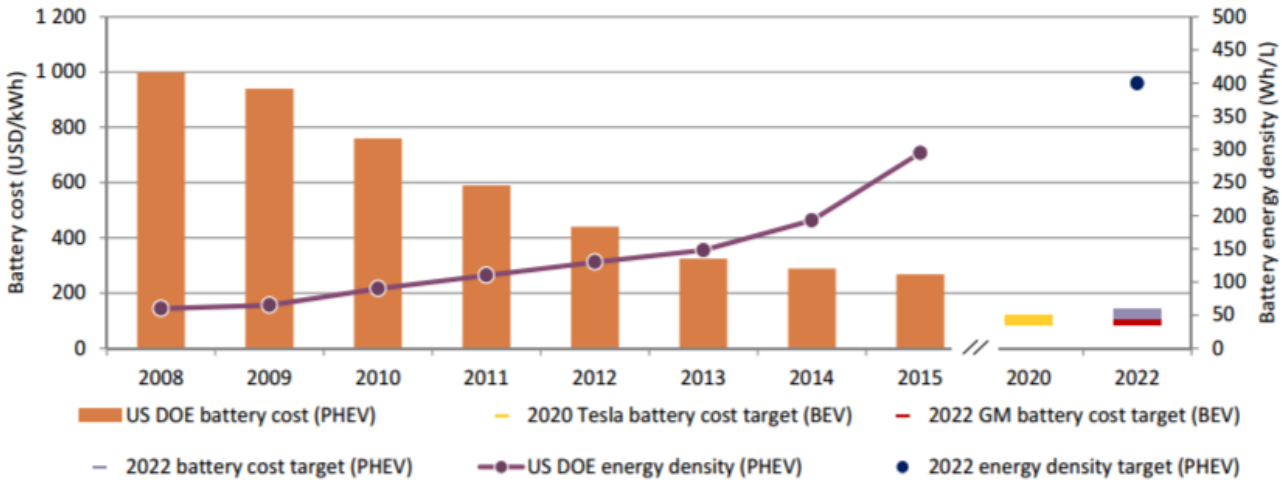

Figure 7 Battery price and density over time (IEA, 2016)

At the time of the introduction of the first serial produced BEV, it was not competitive with the ICEV in terms of performances and price. At that time, the only respondent active in the market as a car provider was Elmonet. Elmonet operated with an guaranteed market demand, coming from municipalities and organisations who wanted electric cars in their fleet. By being unique in offering electric vehicles, the price and range of the cars did not matter (Elmonet, 2017).

The announcements of the Nissan Leaf and the Tesla Roadster and Model S meant the Th!nk would no longer be unique as a BEV. The shortcomings of the Th!nk Nordic, in terms of battery and general performances, and the specifications of the announced competitors, made the owners of Elmonet decide to allow Autobinck the acquisition of Elmonet in 2010. Autobinck was looking to offer an electric vehicle at that time. In 2011 Th!nk Nordic went bankrupt, meaning the end of Elmonet (Elmonet, 2017).

Although major car manufacturers, like Renault-Nissan, Tesla, BMW and Volkswagen, are active on the BEV market now, the battery price and performance are still not on a competitive level for ICEV, especially if there were no economic policy instruments in place. In the high-priced segment the battery has a relatively lower influence on the total price of the car, allowing MisterGreen to successfully offer the Tesla Model S for operational lease. They chose to completely focus their value proposition on the Model S because of its range and high residual value, which is high due to the low battery depletion. Especially the residual value is of great importance for their business model, offering operational lease and thus remaining owner of the

car. Since there was much scepticism regarding the depletion of batteries and the importance of this for the residual value of a BEV ,and thus their business model, MisterGreen decided to do a research together with the TU Delft on the depletion of Tesla batteries. The positive results of this research triggered them to base their value proposition on offering Tesla's for operational lease completely (MisterGreen, 2017).

In the mid-priced segment, the two most sold BEV's in the Netherlands in this segment, the Renault ZOE and Nissan Leaf, still have significantly higher initial purchasing prices than comparable ICEV models. The batteries of respectively 42 kWh (ZOE) and 30 kWh (Leaf) offer ranges of 300km and 250km (RVO, 2017; Renault; 2017). Due to the low price of electricity compared to gasoline, and the lower maintenance costs of BEV's compared to ICEV's, the costs for a BEV in the use phase tend to be lower than for an ICEV. The high initial costs, but lower use costs cause business model innovation in the value capture part. Car sharing organisation subsequently aim to 'enable everyone' to drive electric. By shifting the costs of driving a car more towards the use phase and sharing or outsourcing the initial costs, car sharing eminently fits with the characteristics of BEV's: higher initial costs, but lower total costs in the use phase (Buurauto, 2017; E-Car Cell, 2017; We Drive Solar, 2017). Also, and alternatively, Renault aims to lower the initial costs of the ZOE by taking the battery out of the initial purchase and offering it for rent. In this way Renault lowers the initial costs of the most basic model of the Zoë from €30.390 to €22.490, but adds a monthly fee starting from €69/month to the usage phase costs (Renault, 2017).

Among the respondents, consensus exists that competitive battery prices will cause the BEV to become the dominant option for personal transport. The prognosis of respondents vary in their prognosis on whether this will happen in 2018 (MisterGreen, 2017), or 2022 (Greenflux, 2017), or anywhere in between, but they all agree that it that the BEV will become the dominant option for personal transport. This will mainly affect the market dimension, which will grow exponentially and will be less dependent on policy instruments to succeed (Eco-Movement, 2017; Greenflux, 2017; Jedlix, 2017; MisterGreen, 2017). How business models are affected by market growth will be discussed in the market dimension.

4.3.3 Analysis

Although a survey amongst over 900 executives from companies in the automotive industry shows that over half of the respondents of that survey doubts the future success of BEV's because of charging infrastructure issues (KPMG, 2017), amongst the respondents of this research consensus exists that BEV's will become the dominant technology. Efficiency gains in the field of ICEV have the potential to slow the transition down and fuel cell technology has the potential to become a viable technology for alternative use cases, but none of the respondents fear their business model will be affected by the two alternative options and thus no business model innovation was caused by the possibility of alternative pathways.

The most important results of R&D for the successful commercialization of BEV's are the developments of the price and performance of the batteries. The price of the BEV is high compared to comparable ICEV alternatives, mainly due to the high battery prices. To reach a wider group of adopters, business model innovations occurred. Especially in the middle segment the high price of a BEV, caused by the high battery price, caused shifts in the value capture, shifting the costs for customers from initial purchase towards the user phase.

4.4 Culture

4.4.1 Norms & Values

Freedom

Mobility habits in the Dutch culture entail deeply rooted feelings of autonomy and freedom (Geels, 2012). The feelings of autonomy and freedom, strongly associated with the possession of a car, are infringed by the phenomenon of range anxiety. This is the fear to strand in the middle of a trip due to a fully depleted battery. Although often unjustified, it is still one of the foremost barriers to adoption of BEV's (Neubauer & Wood, 2014). Range anxiety is influenced by the science and technology dimension, through battery performance and charging infrastructure developments.

To convince people range anxiety is mainly an irrational psychological barrier (Greenflux, 2017), businesses expand their value proposition with additional services to convince potential consumers. EC-Rent offers route planning with the renting of a car, helping people to plan their trip in such a way they will find a charging station on time (EC-Rent, 2017). We Drive Solar organises information gatherings, to explain people how to overcome the limited range (We Drive Solar, 2017). MisterGreen offers extended test drives, to let people experience that the limited range forms a smaller barrier than often thought (MisterGreen, 2017). And Nissan offers a free rental ICEV for 12 weeks in the first four years after the purchase of a Nissan Leaf to use for far distance trips such as holidays (Nissan, 2017).

Not only does range anxiety influence business models, but business models can in their turn influence range anxiety reciprocally. Fastned explicitly states it is their mission to provide EV drivers with feeling freedom through their value proposition of a fast charging network (Fastned, 2017). Also Eco-Movement extended their value proposition with Oplaadpalen.nl, a website providing an independent mapping of charging stations. This overview helps consumer to find available charging stations (Eco-Movement, 2017).

Status

The social role of the car goes beyond merely the functional means of transportation. A car is traditionally regarded as a representation of social status (Gatersleben, 2007; Altenburg, Schamp & Schaudhary, 2015). The representation of social status through a BEV can be split in two effects (Buurauto, 2017). Two groups can be identified, with both other reasons for BEV adoption.

The first group uses their car to express their wealth or power, the second group to express their sustainable lifestyle (Noppers, Keizer, Bolderdijk & Ste, 2014). For the first group the respondents agree that Tesla made the first status enhancing BEV. Tesla is thought to be one of the most important drivers of the market and to be responsible for the image shift of electric vehicles from a 'tree-hugging' alternative to a 'cool' alternative for ICEV.

This cool image is the basis of the value proposition of EC-Rent, who rents luxury EV cars for special occasions, such as shuttle services for events or weddings. The introduction of the Tesla Model S was even identified as the reason to start the company (EC-Rent, 2017).

Also Streetplug finds its most important target segment in Tesla drivers. These drivers often do not aim to express their sustainable lifestyle trough their car and thus see a visible home charging station as undesirable. Streetplug offers an invisible alternative, with the charging station hidden in the ground. The enthusiasm amongst Tesla drivers made them decide to put the main focus on this market segment, while originally offering an alternative for municipalities to make their city centres obstacle free (Streetplug, 2017).

The second group of BEV-users consists of people who use their car to express their sustainable lifestyle or organisations or municipalities to show their sustainable policies (Hidrue, Parsons, Kempton & Gardner, 2011). This is part of a wider societal transition towards more sustainability, in which climate change has led to CO2 reducing measures in the policy dimension.

Elmonet did not sell a single car without a wrap, a layer on the car that allows for prints on the car, or stickers, to enhance the visibility of the sustainable practices of the buyer (Elmonet, 2017). For We Drive Solar 'green energy' was not enough, their complete value network is configurated around sustainability, offering energy for their shared cars which is traceable to its renewable source. In this way they aim to make their value proposition of shared cars more appealing to their target segment, the people who don't want their car to be visible evidence of their fossil fuel dependency (We Drive Solar, 2017).

For companies offering complementary services intended for all BEV's, instead of actually offering BEV's, this division between the two groups pursuing different statuses expressed through the BEV's is less important, since these services are equally important to both the groups (Movenience, 2017; E-Laad, 2017; Jedlix, 2017; Fastned, 2017).

4.4.2 Analysis

Range anxiety, which is an expression of the infringement of the freedom associated with automobility, forms a barrier to adoption of BEV's. Business models offering mobility goods and services expand their value proposition with various innovative solutions to overcome this barrier. Business models offering complementary goods, can help to take away this barrier with their value proposition.

The status that the BEV's offers can be divided into two groups. The first group is based on the "*coolness*" of BEV's, a status that is acquired after the introduction of the Tesla Model S. The second group is based on the "*greenness*" of the car. Both the statuses may form the key *value* of the *proposition* itself for mobility providers, but also offer possibilities for business models to profile themselves as the '*cool',* like Streetplug, with their hiding charging point, or '*green',* such as We Drive Solar, with their transparent coupling of sustainable energy sources to the charging infrastructure for their shared BEV's.

4.5 Market

4.5.1 Customer groups

The market development of EV´s can be divided in three phases. In the first phase the market consists of ´innovators´, the true pioneers who adopt the new technology despite technical deficiencies or higher prices (Laurischkat, Viertelhausen & Jandt, 2016, Rogers, 2010). The second phase contains the 'early adopters', who are often higher educated and more willing to try new technologies, especially when it enhances their social status (Rogers, 2010). The third phase is the phase of mass adoption, which will start when the new technology is competitive with the older and established technology in both price and performance (ibid.).

Innovators

In the first phase the market of BEV's in the Netherlands mostly consisted of conventional cars, that were converted into BEV's. Mobility Service Nederland experienced a lot of demand from mostly semi-governmental parties for BEV's. These parties were looking for options to make their fleets more

sustainable. Triggered by this demand, the owners of Mobility Service Nederland decided to found Elmonet to introduce the Th!nk Nordic on the Dutch market. Being the only company offering a full electric vehicle, Elmonet was able to grab a monopolistic position. Urgenda, which was a widely known organisation, stimulating the transition towards more sustainability, was an important partner for Elmonet. As Urgenda was well known for its sustainability stimulating activities amongst municipalities and other organisations interested in more sustainable forms of doing business, Urgenda could use their network to bring Elmonet in contact with interested parties (Elmonet, 2017).

These parties were often interested in BEV's for a small part of their fleet and were willing to pay a high price and accept technical deficiencies. They were willing to accept the high price because the BEV's could be used as paragons of their 'greenness'. The technical deficiencies were acceptable because the BEV was often used for specific purposes. For example G4S, a security company, used the BEV's for their surveillance routes only, which made the limited range and long charging times surmountable (Elmonet, 2017).

A beneficial side effect for Elmonet was that they now had contact with certain interested parties, not only for BEV's, but also for their core business: leasing conventional cars. Being the first importer of an EV gave them a lot of free publicity too and they quickly gained the status of an authority within the EV market. These beneficial side effects made up for the fact that they were not able to put high margins on the Th!nk, since cost-wise it was a relatively expensive car. This was also the reason for them to keep the business model lean, without expensive marketing campaigns or showrooms (Elmonet, 2017).

Early adopters

The second phase, the phase of early adopters, is the current phase in the Netherlands (Laurischkat, Viertelhausen & Jandt, 2016). Although growing rapidly over the last five years, the market for BEV's is still small, with a percentage of 0.9 % per registration being a BEV (RVO, 2016). These early adopters are mainly business car-owners, as a result of the used policy instruments (PBL, 2016). Another result of the used policy instruments is that a big part of the money used for stimulation ended up stimulating Plug-in Hybrids (ibid.).

For Streetplug the share of business car owners meant their product had to become smarter, to allow the users to invoice their charging costs (Streetplug, 2017). For Renault, who offered the ZOE only with a leased battery at first, the fact that mainly business car owners were financially incentivised to adopt low emission vehicles was the reason to offer the battery as part of the deal as well. The reason for this was that both companies offering the car for lease, as well as the companies leasing the car, prefer not to have the battery as an extra asset to manage (Renault, 2017).

The large part of plug-in hybrids (PHEV's) is seen a regrettable side-effect of the used policies. It resulted in people using the financial incentives to drive a big car, such as the Mitsubishi Outlander, relatively cheap, while the intended environmental benefits would have been greater if the policy would have focused on zero emission vehicles from the start (MisterGreen, 2017; Renault, 2017). As these users charge less and are less dependent on their battery, this group is less interesting for charging infrastructure and smart charging services providers. Both destination charging and on-the-go charging would have benefited more from a bigger share of BEV's. For destination charging the PHEV's form a group of vehicles that have short charging sessions on a lot of places, forming a relatively uninteresting group for smart charging while in the meantime occupying a lot of charging points for small sessions. On-the-go charging is virtually not done by PHEV's. For on-the-go charging compnies PHEV's are not interesting, since PHEV's often do not support fast charging. Both charging options would have had a more valuable proposition if the policy would have focused on BEV's from the beginning (Fastned, 2017; Jedlix, 2017).

Majority

As driving a BEV is perceived as cleaner, more comfortable and more fun, it is expected they will become the dominant force if and when the battery price and performance become competitive with ICEV's (Nykvist & Nilsson, 2015; RVO, 2016; Ruhrort, Steiner, Graff, Hinkeldein & Hoffmann, 2014; Sierzchula et al., 2015). For MisterGreen this was the reason to enter the market of BEV's (MisterGreen, 2017). Others based their business model on preparation for the consequences of mass adoption, such as the possibilities of grid congestion as discussed in the technology dimension (Jedlix, 2017; E-Laad, 2017).

Also Fastned counts on mass adoption in their business model. With low numbers of EV, their business model is not yet profitable, however the higher throughput of BEV's allowed by fast charging allows them to grow without investing significantly more. The Fastned founders believe the success of their business model lies within this scalability. Destination charging would need a lot more charging stations, especially in public spaces since 70% of the households does not have a private driveway. This requires huge investments, besides the investments needed for the avoidance of grid congestion. They expect the value of their proposition to rise with the increase of BEV's on the market, as the business model of destination charging will be hard to scale (Fastned, 2017).

For businesses offering complementary goods or services mass adoption will influence their business model through organic growth. For Eco-Movement the value of their proposition is expected to rise when the number of BEV's rises. They mainly offer a B2B proposition, providing parties such as TomTom and Volkswagen with locations and real-time information, such as availability and pricing of charging stations. The value of this information for these and similar parties will grow as the segment of people driving BEV's will grow (Eco-Movement, 2017). For Movenience and Streetplug, their target segment will grow in case of mass adoption of BEV's (Movenience, 2017; Streetplug, 2017).

4.5.2 International market position

Leading market

As discussed in the policy dimension, the Dutch policy has been mainly focused on stimulating the demand side of EV's. This has resulted in relatively high EV sales and the development of an adequate charging infrastructure. The Dutch market being a leading market in Europe gives Dutch actors a strong position (PBL, 2016). Technologies and competencies, such as management systems of charging infrastructure, or the hiding charging facility, can be tested in practice, due to the presence of a BEV market and charging infrastructure in the Netherlands. Proven functionality in practice makes these goods and services in demand in foreign countries (Greenflux, 2017; Streetplug, 2017).

Furthermore the Dutch market is an interesting market for foreign parties to enter, making it easier for Dutch actors to form collaborations with foreign parties. Examples of these collaborations are Jedlix with Tesla, in which Tesla allows Jedlix to manage the Tesla homechargers, We Drive Solar with Renault, in which Renault develops vehicle-2-grid charging controlled from the car and the Amsterdam ArenA with Nissan, in which Nissan Leaf batteries are given a second life as back-up power source (Jedlix, 2017; We Drive Solar, 2017; E-Laad, 2017).

4.5.3 Analysis

The various stages of the market development have different influences on business model innovation. In the first stage, in which innovators are targeted the value to capture does not lie in the revenue but in the beneficial side effects of being the first mover. The group of early adopters consists mainly of business car

owners due to the policy instruments used in the Netherlands. This group has specific demands on which value propositions have been adjusted. The expectations of mass adoption provide the prospects of a need to upscale the charging infrastructure. Anticipation on this prospect is the source of various business model innovations. For on-the-go charging the scalability of the business model was leading in the decision to form the value proposition around this. For destination charging, value lies in the avoidance of future investments.

The frontrunner position of the Dutch EV sector has two main influences. It provides a strong export position for Dutch companies on the one hand, making it easier to expand their target segment internationally. On the other hand it makes the Dutch market attractive for parties from other country's to develop and test their capabilities. This provides opportunities for the Dutch actors to form partnerships with these parties and allow value network innovations to collaboratively develop new capabilities.

4.6 Industry

4.6.1 Response strategy

The transition towards BEV's goes beyond the change of the powertrain of a vehicle. The need for charging infrastructure, the integration of this infrastructure on the power grid and the software to manage charging make it relevant not only to discuss the response strategy of the automotive industry, but also those of the energy industry and IT industry.

Automotive

The automotive industry traditionally is a slow moving industry, with its focus on incremental and long-term improvement of core technologies (Magnusson & Berggren, 2012). The respondents identified only three major car manufacturers as innovative, Renault, Nissan and Tesla. In 2010 Nissan was the first major carmaker to introduce a mass produced BEV, the Nissan Leaf. The leaf was introduced on the Dutch market in 2011, later followed by the Renault with the ZOE in 2013. The Leaf is globally recognized for its 'greenness' (Nhamo, 2014). With their Roadster, introduced in the Netherlands in 2012, and Model S in 2013, Tesla successfully invaded the higher segment of the automotive market (Karamitsios, 2013). The introduction of the second generation of the ZOE enabled We Drive Solar to start their business, since before this introduction no car with in their opinion enough range was available for an affordable price (We Drive Solar, 2017).

Renault stated being a first mover, in their own words five years earlier than other major car manufacturers, was not only beneficial through higher sales numbers, but also through knowledge, expertise and experience. For Renault zero emission vehicles were a logical step in their Eco-Deux project, in which they were developing more sustainable forms of mobility. This project had been started because they foresaw a global rise in car sales due to the rise of modal income in formerly third world countries, which allows more people to buy cars. Without more sustainable forms of mobility this would have devastating consequences for the earth (Renault, 2017).

The other car manufacturers are considered less innovative and protective of their market by the respondents. This goes for the German car industry especially, which can probably be explained by the large amount of jobs in the conventional car industry. With over 575.000 jobs depending on the car industry in Germany, the transition towards BEV, is likely to have an enormous impact. BEV's need less maintenance and parts, such as batteries are, contrary to conventional powertrains, not produced domestically (E-Laad,

2017; Greenflux, 2017; VDA, 2017). Therefore the German automotive industry tries to control as much aspects of the transition as possible.

For example, this happens within the fast charging domain. Instead of adopting either the Japanese plug of CHAdeMO, or Tesla's Supercharger, which were both readily available, The Combined Charging System (CCS) was introduced by the German car industry. This extra variety in chargers drives up the costs for Fastned's fast charging stations, as Fastned wants all fast charging options incorporated in their value proposition and thus has to invest in all three. And introducing CCS has increased charging complexity for EV drivers. This complexity adds to the range anxiety, nourishing the unsureness about the possibility to charge, especially for unexperienced consumers who hire cars. This forces EC-Rent to expand their value proposition with extra information on charging and services, such as route-planning (EC-Rent, 2017; Fastned, 2017).

Recently a joint venture of five major car manufacturers, BMW Group, Daimler AG, Ford Motor Company and Volkswagen Group, announced their plans to start building an ultra-fast charging network in Europe, based on CCS (Daimler, 2017). This focus on fast charging holds on to the idea of on-the-go charging. This contrary to the strategy of Renault and its alliance partners Nissan, PSA/Peugeot-Citroen and Mitsubishi Motors. Together they have formed the technical reference EV Ready, in which they focus their research on vehicle-2-grid charging (Renault, 2017). This is mainly because of the fact that Renault believes BEV's will be integrated as part of the power grid, which will develop into a smart grid. EV Ready actively seeks cooperation with energy parties, such as E-laad, to collaboratively smoothen this integration (Renault, 2017).

The rise of car sharing has also been noticed by car manufacturers, who have responded with the introduction of Car2Go and DriveNow, car sharing projects, by respectively Mercedes and BMW. The respondents offering car sharing projects think it is impossible to stay ahead of parties so financially strong (Buurauto, 2017; E-Car Cell, 2017). Therefore Buurauto and E-Car Cell try to stand out, not only by offering a BEV, but also by focussing their value proposition on the social aspect of car sharing. In their projects the car is only shared with a select number of people. In this way they try to fill the gap between car ownership and conventional car sharing (Buurauto, 2017; E-Car Cell, 2017).

Vehicle-2-grid charging and car sharing come together in the We Drive Solar project. Renault, who also operate free fleet car sharing projects, such as DriveNow and Car2Go, noticed the financial gains of this kind of car sharing are low. In We Drive Solar they found a partner to lease their BEV's and function as the car sharing operator, which is more desirable for Renault, as they have guaranteed value capturing (Renault, 2017). Furthermore they use the We Drive Solar project, to test vehicle-2-grid charging in which the car delivers AC to the grid. Currently vehicle-2-grid charging is only possible with conversion of DC to AC in the charging station. Conversion within the car is desirable because of the much lower costs thereof (Renault, 2017; We Drive Solar, 2017).

To Jedlix cooperation is crucial for scaling their business model. Their cooperation with Tesla allows them to spread their service amongst all Tesla drivers at once, whilst without cooperation with automotive parties they would have to spread their service amongst the scattered market of charging point exploiters (Jedlix, 2017). The respondents experience the German automotive industry less open for collaboration (E-Laad, 2017; Greenflux, 2017; Jedlix, 2017). With their focus on the new 15118 protocol, the German car industry tries to incorporate the management of smart charging in the car, which would side-line the energy companies and would cancel out efforts of E-Laad for example (E-Laad, 2017).

Not only the carmakers adjust slowly to the changing regime, also existing car dealers and lease companies have trouble to adjust their business model to the emergence of EV's. Elmonet, who allowed themselves to make profit on EV's by cutting marketing costs on showrooms and advertising, by bringing the car to interested parties and events themselves, failed after it was bought by Autobinck, who returned to the old fashioned way of selling cars (Elmonet, 2017). The same applies for MisterGreen, who are able to lease

Tesla's, despite Tesla not giving any commission, because of their low overhead costs in respect to for example Athlon, who are commission focused (MisterGreen, 2017). Renault experienced difficulties to sell their BEV's and therefore trained their entire sales force in the Netherlands specifically for the selling of BEV's (Renault, 2017).

Energy

For the energy companies, the electrification of automobility promises an enormous potential market expansion. However, the integration of their services within the automobility infrastructure requires overcoming a lot of barriers. Parties within the energy domain tend to cooperate to reach successful integration of automobility and the energy net. However this does apply for the some of the automotive parties (E-Laad, 2017; Greenflux, 2017; Movenience, 2017; We Drive Solar, 2017).

TecforRec was a provider of recreational energy systems, such as energy columns for camping sites, who entered the EV charging station market and started the cooperation with PIA Mechanical to make their charging station latent. From this cooperation Streetplug was founded (Streetplug, 2017). And it was energy provider Delta, who started the cooperation with Movenience, to handle the payment system of their charging stations (Movenience, 2017).

IT

Another important development is the increasing digitalization and importance of connectivity within the daily lives of people. More and more products are connected to the internet continuously or handled by a smartphone (Wortmann & Flüchter, 2015; Tojib, Tsarenko, & Sembada, 2015). These developments are also visible in the automotive industry. Mobility offerings can often be accessed or controlled through a layer of digitalization (Hanelt, Piccinini, Gregory Hildebrant & Kolbe; EC-Rent, 2017; Greenflux, 2017; Jedlix, 2017; Streetplug, 2017).

Cars connected to the internet allow businesses to expand their use cases. It allows cars to show real-time information on for example availability and pricing of charging points (Eco-Movement, 2017; Jedlix, 2017). The integration of smartphone services in daily life allowed Streetplug to make use of smartphones for the handling of their charging points, which have no buttons whatsoever, because of their latency (Streetplug, 2017). Also for making bookings and payments of cars the smartphone has become the standard instrument (EC-Rent, 2017; We Drive Solar, 2017).

4.6.2 Analysis

Three industries are converging in the transition of the automotive regime: the automotive industry, the energy industry and the IT industry. In the automotive industry two trends can be identified. The first trend is the German industry protecting its own market. Th German industry is not open to cooperation with grid operators and try to exclude them from the automotive regime. Renault, and its partners of EV ready, envision the future of the car to be integrated in a smart grid. Actors from the energy industry are open to these collaborations, as they foresee a large market to gain as a result of this integration, but also need to collaborate mutually to smoothen the integration they can all profit of. We Drive Solar is an example of a use case for the smart grid. To reach such a smart grid value network innovations from both automotive and grid operators are necessary. The digitalization of both cars and charging infrastructure enables the actors from the IT industry to exploit their capabilities in this new regime.

5.Conclusion

The aim of the research was to explore how business model innovation was influences by the changes in the six regime dimensions during the transition of the Dutch automotive regime towards electric auto mobility. The findings showed that destabilization of the regime dimensions resulted in barriers and opportunities for businesses. Business models were innovated to seize these opportunities and take away these barriers. By taking away the barriers business model innovation contributed to further destabilization of the regime dimensions.

Below, the influences are described per regime dimensions and it is specified which concept of the business model was influenced. Furthermore the expectations discussed in the theory section are reflected with the case study findings. Table 4 gives an overview of the influences per regime dimension.

For the policy dimension the expectations were in line with the theory. The demand side economic instruments meant for stimulation, mainly stimulate conventional business models and are therefore no direct trigger for business model innovation. The supply side economic instruments support innovations, but are mainly found in European funding programs. Regulatory instruments are often configurated around conventional business models and may need change to enable business model innovations, therefore the only direct effect regulatory instruments have on business model innovation is an inhibiting, until regulation is adjusted. The expectation that soft instruments would be of no influence was supported by the data. The main influence of the policy instruments used, is the stimulation of market growth. This has brought the Dutch EV market in a frontrunner position, which forms opportunities for business model innovations.

The expectation for the complementary technology dimension was that the lack of a dominant business model would trigger a variety of business model innovations in all three the business model concepts. The results are partly in line with this. The predominant innovative distinction between complementary technologies lies in the value propositions, which entail destination charging and on-the-go charging. The first triggers innovations in the value capture and value network, but not as was expected, to distinguish the business model through these innovations, but rather to overcome barriers such as grid congestion, in case of the continuation of the transition. The business model of on-the-go charging is ready for this continuation without further business model innovations. It can be concluded that the complementary technology triggers innovations in the value propositions, and in the case of destination charging consequential value network and capture innovations

The expected innovations in value propositions due to intensified R&D were not confirmed by the result. Amongst the entrepreneurs active in the BEV market, consensus exists this will be the dominant pathway and therefore they do not adjust their business models on the competition of alternative technologies. The R&D results within the pathway of BEV are influencing business model innovations. Especially in the period between the very first adopters, the innovators, who are less discouraged by the technical deficiencies and high price, and the period of competitive prices and technological performances. In this period the high prices compared to the conventional technology form the trigger to innovation of the value capture.

Conflicts caused by the technology with existing norms and values in the regime, such as range anxiety infringing the feeling of freedom, form cultural barriers. The expectation that these will barriers would be overcome with innovations in the value propositions was confirmed by the data. An unforeseen other cultural source for business model innovation is the status that comes with the adoption of a new technology. For a product as visible as a car, the enhancement of this status forms the influence to configure value propositions around this.

In the market dimension it can be seen that the expectation that value proposition would be innovated to highlight innovativeness in the first stages was not confirmed. The group of innovators will form a niche market in which new technologies will be adopted without innovation in the value proposition. It is the value capture that needs innovation, to make low margin products for small niche markets profitable. The later groups form the cause of innovation in the value proposition, due to group specific demands. The Dutch EV market is compared to other countries a frontrunner, which attracts international parties and provides opportunities for value network innovations for domestic actors.

That the influence of the industry dimension was mainly on the value network, which was confirmed by the data. However these value network innovations can only occur with industry actors open to cooperation. In the industry dimension a clear distinction can be made between actors open for cooperation and actors protecting their market, excluding other parties where possible. It can be seen that the cooperation leads to new business models. Smart charging, and the future possibilities of a smart grid, offer new values to capture and use cases to propose, but for these to be commercialized successfully, cooperation between converging industries is necessary.

Table 4 Results ordered per dimension

Dimension	Indicator	Effect on BMI
Policy	Regulatory instruments	
	Approval	Without regulatory approval, the *value proposition* or *capture* may form barriers
	Economic instruments	
	Market stimulation	Causing market growth and stimulating conventional *value capture*
	R&D stimulation	Stimulating the development of new capabilities, which are part of *value network*
	Soft instruments	
	Public/Private partnerships	No substantial influence
Complementary technology	Availability	
	Numbers	No substantial influence
	Differentiation	
	Destination charging	Opportunities for *value capture* in the avoidance of grid congestion
	On-the-Go charging	*Value proposition* similar to current refuelling rhythm
Science	Pathways	
	ICEV	Slowing down market transition, allowing some BM's to keep their *value network* (internal competencies) on top of the wave
	Fuel Cell technology	No substantial
	BEV	Consensus amongst the respondents that it will be the dominant technology.
	R&D Results	
	Increasing results	Cause faith, making it easier to find investments, which helps the *value capture*

		In the beginning performance and price not important for business model
		High prices, due to the battery price cause innovation in the *value capture*
Culture	Norms and Values	
	Freedom	Innovative *value propositions used to overcome barrier of range anxiety*
	Status	'*Coolness'* and *'Greenness'* increase the *value* of *propositions* including these concepts.
Market	Customer Groups	
	Innovators	*Value captured* through beneficial side effects of being the first BEV importer.
	Early adopters	Business car owners demand smarter *value proposition*
	Majority	The expected mass adoption of EV's are a reason for differentiated *value propositions.*
	International market position	
	Leading market	The frontrunners market offers the opportunity to expand the *value proposition* internationally and offers opportunities for *value network* innovation through international cooperation.
Industry	Response strategy	
	Automotive	Protectionist behaviour impedes business model innovations in the *value network.*
		Entrants from other industries often place their existing competencies within the value chain of the BEV; low risk innovation of the *value network.*
	Energy	Openness to cooperation increases innovation in the *value network.*
	IT	Increased connectivity of cars creates opportunities for innovations in *value propositions.*

The findings also showed that the business model innovation had a destabilizing influence on the regime dimensions. The regime dimensions were often structured around the characteristics of ICEV's, which formed barriers for BEV commercialization. For example in the Dutch policy framework, the regulatory instruments formed barriers for BEV's and charging infrastructure. Business partnered with influential organisations (e.g. Elmonet-Urgenda and Streetplug-NKL) to pressure them for regulation change, which can be seen as further regime stabilization.

Another example is range anxiety, a barrier towards adoption of BEV's from the culture dimension, which inhibits the growth of the market and thus the market dimension. Business models expanded their value proposition with extra services, such as route-planning and free ICEV's for use on holidays, to overcome these barriers. On-the-go charging aims to take away this range anxiety through their value proposition. In

this way business model innovation takes away a cultural barrier, which caused the inhibition of market growth. These business model innovations resulted in further destabilization of the market and culture dimension.

A third example follows from the market growth. Increase in BEV numbers can cause grid congestion. This is a barrier, because it would take huge investments in the power grid to charge the prospected numbers BEV's without causing grid congestion. Businesses recognized these future problems and configurated their business model around it. The value proposition of smart charging, which can help to avoid grid congestion, allows businesses to capture the value that lies in the avoidance of grid congestion. The Dutch market being a frontrunner in the BEV sector, attracts international parties to develop and test their BEV goods and services in the Netherlands. This helps domestic parties to form partnerships with these international parties. Since the Netherlands does not have a domestic automotive industry, the opportunity to collaborate with international automotive parties offers unique opportunities. In these partnerships unique capabilities are developed to overcome grid congestion and develop a smart grid. These innovative value networks further destabilize the regime, as barriers are overcome, and strengthen the international position of Dutch businesses.

6.Discussion

6.1 Implications for theory

Multi-level Perspective

The results showed that destabilization of regime dimensions had direct and indirect effects on business model innovation. Furthermore they showed that these business model innovations contributed in their turn to the further destabilization of the regime dimensions and may contribute to the stability of the regime if the regime dimensions re-align with the breakthrough innovation. One might argue these business model innovations are part of the socio-technical niche and can be seen as niche experimentation, however this research showed business models were not only newly formed around emerging technological innovations, but also actors in the destabilizing regime innovated their business model in reaction to the emerging technologies. Sarasini, Linder, Langeland & Julsrud (2017) claim business model innovations should be placed in between the niche-level and regime level. However this research showed that the business activities, such as business model innovation, were influenced by and contributed to the destabilization of the regime. Because business activity on actor level interacts with other regime dimensions and can both contribute to the stability or destabilization of the regime, this thesis argues that regarding 'business activity' as a seventh regime dimension would be of added value to the multi-level perspective.

Geels (2004) proposed the use of socio-technical regimes in the MLP, but did not specify the demarcation of these ST-regimes. Geels (2012) argues the demarcation of the object of analysis is up to the researcher and different level of analysis are possible. This research showed that many of the developments in the regime dimensions where highly dependent of their geographical context. Various country specific factors demonstrated to be of great influence on the regime destabilization. Without geographical demarcation, important interactions between regime dimensions would have been overlooked and the understanding of the transition would have had less depth. Therefore this thesis argues geographical demarcation of the socio-technical regime is key to the correct operationalization of the multi-level perspective.

During the desktop study, various actors in the destabilized regime turned out to have entered the regime from other, adjacent regimes, such as the energy and IT sectors. As the research aimed to have a sample representing the actor activity they were included in the research. Not only were they triggered to enter the regime by its destabilization, their business activities demonstrated to be of significant influence on the destabilization of the regime themselves. This intersection with developments in other regimes is not represented in the socio-technical regime as described by Geels (2004). These developments cannot be connotated to the developments on landscape level, as this landscape level is defined as beyond the influence of actors (Geels, 2004). To include these developments in the research, they were gathered under the industry dimension. However this is theoretically incorrect, as this dimension should only entail the response strategy of the established firms of the destabilizing regime. Therefore this thesis argues the multi-level perspective should include the influence of adjacent regimes.

Business model innovation

This research showed that the external business environment can have significant influences on the occurrence of business model innovation. Within the perspective of a socio-technical regime transition business models are both influenced by, as well as influencers of the destabilization of regime dimensions.

When a new technology emerges from the niche level this often creates the need for complementary goods and services to create a working technological configuration around the emerging technology. Within this complete technological configuration businesses innovate their business model or new business models arise. Although only explored in a single case study, this thesis proposes the following relationships between the external business environment and business model innovation, in times of transition.

Innovative sustainable technologies tend to be higher priced than the conventional technological alternatives (Johnson & Suskewicz, 2009; Siegel, 2009). This research showed entrepreneurs tend to search for innovative forms of value capturing to lower the initial purchasing of price the new technology for customers. In case of indispensable complementary goods and services business opportunities will arise in the fulfilment of this need. This research disregarded the generic complementary goods and services, the ones that are not distinctive for the emerging technology, as this need could be fulfilled by existing businesses. For the specific complementary goods and services, mainly business model innovations in the value network and value proposition were identified. Businesses from other sectors with core competencies that matched the need for complementary goods or services innovated in their value network, placing themselves in the value network of the emerging technological configuration. As no dominant design existed for the complementary goods, differentiation could be identified in the value proposition of these complementary goods. This thesis therefore argues that innovation of the value capturing mainly occurs to make the core emerging technology more competitive, while value proposition and value network innovations occur in the configuration around the emerging core technology.

During a regime transition a lot of barriers may arise (Farla, Alkemade & Suurs, 2010). This research shows that barriers arise from developments in single, or combinations of regime dimensions and that these barriers form triggers for business model innovation in all three the concepts of a business model. Therefore this thesis argues that barriers towards further adoption of the emerging technology form triggers for business model innovation

6.2 Policy implications

As CROW functions as knowledge institute and advises mainly (decentral) governments, the policy implications given in this paragraph function as advice to the host organisation of the internship performed for this Master's thesis as well.

The conclusions of this research point out the Dutch market finds itself in a frontrunner position, which provides the possibilities to develop unique capabilities with international partners from the automotive industry. The current Dutch policy is very demand side orientated, which has resulted in the frontrunner position. To maintain this position, the focus should shift from creating a market and infrastructure, which are now readily available, to developing capabilities to overcome barriers and seize opportunities that lie in the further transition towards electric automobility. However R&D stimulations are mainly found in European funds. To further exploit the frontrunner position and further develop its leadership status, Dutch policy makers would be wise to invest more in the supply side of BEV's. With the absence of a domestic automotive industry, these R&D stimulations should focus on the complementary goods and services. International automotive parties are attracted to the Dutch market for R&D projects due to the current frontrunner status, which allows domestic parties with the possibility to cooperatively develop and test use cases for the integration of the car with the power grid. Such smart grid projects have demonstrated to find itself under international scrutiny. Investments in further development of smart grids, could help domestic

actors in this field to successfully develop businesses in this field and provide the Netherlands with a leadership position.

6.3 Limitations to research

To ensure the feasibility of conducting this research in 6 months by a single researcher, the research focus was demarcated. A single case was studied, in order to explore the relations between the developments in regime dimensions and business model innovations. In this particular case the regime dimensions were in a state of destabilization. This impedes the possibility of generalization of the findings.

6.4 Further research

Further research on the influence of regime dimensions on business model innovation can provide further insights in transition management. Contradictions or similarities found in case studies on other regimes, in a less far state or further state of destabilizations or with different paths of development in regime dimensions can help to form generalizable theories.

This research included business models with mobility goods, mobility services, complementary goods and complementary services in their value proposition. As this was an exploratory case study this inclusion provided insights to a limited level of detail and deepness. Sarasini et al. (2017) recently published a research deepening the insights in the mobility services business model innovations. Such narrower focus provides the potential for more detail and deeper insights. This study showed the convergence of the energy sector and automotive industry caused a variety of business model innovations for complementary services of the automotive industry. On the interface of these converging industries lies the potential to collaboratively develop a smart grid. Conducting research on the relationship between the system-level and actor-level on the junction of two regimes could provide insights in inter-regime relationships and provide deeper understanding of the transition towards a smart grid and the integration of EV's on this smart grid.

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Appendix A – Interview structure

Om het interview zo soepel mogelijk te laten verlopen zal ik eerst een korte uitleg geven over het onderzoek en de verdere structuur van het interview. Onderbreek me gerust als ik te snel ga of er iets onduidelijk is.

Het onderzoek richt zich op hoe *business model innovatie* wordt beïnvloed door bepaalde '*systeemdimensies*' tijdens de transitie naar elektrisch vervoer.

Business model innovatie houdt in dat een bedrijf zich onderscheidt door vernieuwend te zijn in het business model. Hierin maken we voor het onderzoek onderscheid tussen 3 delen van het business model. De **waarde propositie**, dit omschrijft wát je aanbiedt en hóe je het aanbiedt. Het **waarde netwerk**, dit houdt zowel het interne als externe netwerk in en omschrijft dus de unieke kwaliteiten van een bedrijf en de plek binnen de value chain. En de **waarde verzameling**, dit omschrijft de omzetstromen en het verdienmodel van het bedrijf.

We gaan dus kijken hoe deze drie onderdelen van het business model worden beïnvloed door veranderingen op een breder systeemniveau. Hiervoor gebruiken we een onderverdeling in zes systeemdimensies. We bespreken voor iedere systeemdimensie wat we voor veranderingen hebben gevonden en wat deze veranderingen voor invloed hebben gehad op jullie business model en daarna bespreken we of er veranderingen die wij misschien over het hoofd hebben gezien die ook van invloed zijn geweest. De zes dimensies zijn:

Markt: dit omschrijft hoe de markt de elektrische auto ontvangt, wat de grootste barrières zijn voor een aankoop en wat de grootste relatieve voordelen zijn. Ook proberen we klantgroepen te onderscheiden voor wie wellicht andere aspecten belangrijk zijn.

Cultuur: dit omschrijft de normen en waarden rondom auto mobiliteit. Denk bijvoorbeeld aan de steeds sterkere behoefte van mensen om duurzamer te leven of de opkomst van de deeleconomie die de traditionele normen rondom bezit wegnemen.

Wetenschap: dit omschrijft de ontwikkeling van de resultaten van R&D. Wat hierin vooral belangrijk is, is de ontwikkeling van de batterij, op welk punt was deze goed genoeg, heeft de beperkte batterijduur het business model beïnvloed, etc. Wat hierin ook meegenomen wordt is de ontwikkeling van de verbrandingsmotor, die door de opkomst van duurzaamheid en de concurrentie van elektrische auto's ook een boost heeft gekregen.

Technologie: dit omschrijft de aanvullende technologie om een innovatie werkend te maken. In het geval van de elektrische auto kijken we hiervoor vooral naar de laadinfrastructuur, maar ook naar andere technische ontwikkelingen die bijdragen aan de functionaliteit van EV's.

Industrie: dit omschrijft de strategieën van de grote autobedrijven rondom elektrisch vervoer. Zijn ze radicaal omgeslagen naar elektrisch vervoer, hebben ze gekozen voor een stapsgewijze overgang of zijn ze helemaal niet bereid te veranderen.

Beleid: dit omschrijft welke beleidsmaatregelen er afgelopen jaren zijn geweest. Denk aan fiscale voordelen, subsidies en andere maatregelen om elektrisch rijden te stimuleren.

Het doel van het onderzoek is om te bespreken hoe de ontwikkelingen in deze zes 'dimensies' hebben geleid tot de keuzes die gemaakt zijn voor de drie delen van het business model.

Beleid:

Er is sinds 2011 beleid waarin de overheid actief de transitie naar elektrisch vervoer stimuleert. Er zijn hiervoor verschillende beleidsmaatregelen getroffen. Zelf schrijven ze de grote toename in aantal elektrische auto's en laadpunten toe aan de fiscale voordelen en de subsidies vanuit de verschillende GreenDeals. Ook zouden internationale samenwerkingen en het formule E-team geleid hebben tot grote groei van de markt en meer innovatie, vooral op het gebied van Smart Charging.[1]

1.a Herkent u deze ontwikkelingen en welke waren het belangrijkst voor jullie organisatie?

1.b Hoe hebben deze ontwikkelingen jullie keuze om -vul specifieke business model innovatie in- beïnvloed?

1.c Hebben deze ontwikkelingen invloed gehad op andere onderdelen van jullie business model?

1.d Zijn er op het gebied van beleid nog andere ontwikkelingen geweest die jullie organisatie hebben beïnvloed?

1.e Hebben deze ontwikkelingen specifiek bijgedragen aan jullie keuze om -vul specifieke business model innovatie in- te implementeren?

Aanvullende Technologie:

Het aantal (semi)publieke laadpunten is de laatste jaren snel gestegen, echter lijkt deze stijging achter te blijven bij de stijging van het aantal stekkerauto's, desondanks lijkt dit vooralsnog geen problemen op te leveren.[2] *Ook zijn er zorgen over het rondkrijgen van een business case rondom laadpalen zonder subsidie. Een derde belangrijke ontwikkeling is de ontwikkeling van een landelijk dekkend laadnetwerk van snelladers langs de snelweg. Daarnaast zijn er zorgen over het gebrek aan één standaard stekker voor alle auto's.*

2.a Herkent u deze ontwikkeling en welke waren het belangrijkst voor uw organisatie?

2.b Hoe hebben deze ontwikkelingen jullie keuze om -vul specifieke business model innovatie in- beïnvloed?

2.c Hebben deze ontwikkelingen invloed gehad op andere onderdelen van jullie business model?

2.d Zijn er nog andere technologische ontwikkelingen, zoals bijvoorbeeld de ontwikkeling van software voor EV's, geweest die jullie organisatie hebben beïnvloed?

2.e Hebben deze ontwikkelingen specifiek bijgedragen aan jullie keuze om -vul specifieke business model innovatie in- te implementeren?

[1] Terugblik en vooruitblik op het beleid voor elektrisch vervoer
[2] Electric mobility charged to maturity

Wetenschap:

Waar tien jaar geleden de wetenschappelijke interesse in EV bijna te verwaarlozen was ten opzichte van de interesse in de waterstofauto, lijkt EV de slag gewonnen te hebben en de toekomst van autorijden te zijn. De range en prijs van de elektrische auto worden in het algemeen gezien als de twee grootste struikelblokken. Hierin is een belangrijk aandeel weggelegd voor de batterij. Er is een sterke ontwikkeling te zien op dit gebied, in de periode van 2008 tot 2015 is de energiedichtheid van de batterijen bijna vervijfvoudigd en de prijs per energie-eenheid lag in 2015 op een kwart van die van de prijs in 2008. Beide ontwikkelingen lijken wel langzaam te stagneren.[3] Ook zit er natuurlijk een vertraging tussen de uitkomsten in R&D en de invoer hiervan op de markt. Om echt op prijs competitief te zijn met de verbrandingsmotor zullen deze ontwikkelingen zich nog door moeten zetten tot 2020-2022 is de verwachting.

3.a Herkent u deze ontwikkeling en welke waren het belangrijkst voor uw organisatie?

3.b Hoe hebben deze ontwikkelingen jullie keuze om -vul specifieke business model innovatie in- beïnvloed?

3.c Hebben deze ontwikkelingen invloed gehad op andere onderdelen van jullie business model?

3.d Zijn er op het gebied van wetenschappelijk onderzoek nog andere ontwikkelingen geweest die jullie organisatie hebben beïnvloed?

3.e Hebben deze ontwikkelingen specifiek bijgedragen aan jullie keuze om -vul specifieke business model innovatie in- te implementeren?

Cultuur:

Normen en waarden zijn over het algemeen langzaam veranderende dingen, toch lijken er een aantal ontwikkelingen gaande. Zo lijkt duurzaamheid een steeds grotere rol te gaan spelen in keuzes die mensen maken. Ook lijkt, vooral onder jongeren, eigendom van een product minder belangrijk te worden en wordt vooral de functionaliteit van een product belangrijk. Wat nog wel een issue lijkt, is het idee van vrijheid dat een auto moet bieden, mensen zijn niet gewend hun trip te plannen, maar overal te kunnen tanken wanneer nodig. Voor sommige mensen is een auto ook een statussymbool, de EV was tien jaar geleden nog alleen weggelegd voor 'nerds', terwijl er nu misschien zelfs wel wordt opgekeken tegen EV rijders

4.a Herkent u deze ontwikkelingen en welke waren het belangrijkst voor uw organisatie?

4.b Hoe hebben deze ontwikkelingen jullie keuze om -vul specifieke business model innovatie in- beïnvloed?

4.c Hebben deze ontwikkelingen invloed gehad op andere onderdelen van jullie business model?

4.d Zijn er op het gebied van cultuur of normen & waarden rondom (elektrisch) vervoer nog andere ontwikkelingen geweest die jullie organisatie hebben beïnvloed? Hebben jullie bijvoorbeeld bepaalde keuzes gemaakt om ook sceptische groepen te overtuigen?

4.e Hebben deze ontwikkelingen specifiek bijgedragen aan jullie keuze om -vul specifieke business model innovatie in- te implementeren?

Markt:

De markt voor elektrische auto's groeit. Echter lijkt deze groei voornamelijk te danken te zijn aan de zakelijke rijder. De voornaamste groep elektrische rijders is de hoogopgeleide man van middelbare leeftijd die zijn

[3] Global EV Outlook

auto voornamelijk voor woon- werk verkeer gebruikt[4]*. De markt is echter, zeker voor particulieren, nog relatief klein. Voor een definitieve doorbraak lijken er nog wel een aantal ontwikkelingen nodig.*

5.a Herkent u deze ontwikkeling en welke waren het belangrijkst voor uw organisatie?

5.b Hoe hebben deze ontwikkelingen jullie keuze om -vul specifieke business model innovatie in- beïnvloed?

5.c Hebben deze ontwikkelingen invloed gehad op andere onderdelen van jullie business model?

5.d Zijn er op het gebied van de markt nog andere ontwikkelingen geweest die jullie organisatie hebben beïnvloed?

5.e Hebben deze ontwikkelingen specifiek bijgedragen aan jullie keuze om -vul specifieke business model innovatie in- te implementeren?

Industrie

Waar in 2005 de interesse in elektrisch vervoer volledig leek verdampt, is in de afgelopen 10 jaar ontzettend toegenomen. De introductie van de Prius wordt gezien als aanstichter hiervan. De ontwikkeling die volgde leek zich met name te richten op het reduceren van de uitstoot van verbrandingsmotoren, met name door de Europese autofabrikanten. De industrie lijkt langzaam maar zeker het potentieel te herkennen in EV, nu er steeds meer fabrikanten met een EV komen. Echter blijft de verandering langzaam gaan en blijven verbrandingsmotoren de core business.

6.a Herkent u deze ontwikkelingen en welke waren het belangrijkst voor uw organisatie?

6.b Hoe hebben deze ontwikkelingen jullie keuze om -vul specifieke business model innovatie in- beïnvloed?

6.c Hebben deze ontwikkelingen invloed gehad op andere onderdelen van jullie business model?

6.d Zijn er op het gebied van industrie nog andere ontwikkelingen geweest die jullie organisatie hebben beïnvloed?

6.e Hebben deze ontwikkelingen specifiek bijgedragen aan jullie keuze om -vul specifieke business model innovatie in- te implementeren?

[4] Maak elektrisch rijden groot