

Lecture Notes in Mobility

Dirk Fornahl  
Michael Hülsmann *Editors*

# Markets and Policy Measures in the Evolution of Electric Mobility

 Springer

# **Lecture Notes in Mobility**

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Editors

# Markets and Policy Measures in the Evolution of Electric Mobility

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This book is, in a sense, the successor of the edited volumes “Evolutionary Paths Towards the Mobility Patterns of the Future” (Hülsmann and Fornahl 2014) which was based on the conference held in the same context in the year 2011 and “Future mobility. Theoretical, empirical and political aspects of the first stage of electric mobility evolution” (Hülsmann and Fornahl, forthcoming) which was based on the conference held in the same context in the year 2012.

Therefore, we are indebted to the Ministry of Transport and Digital Infrastructure (BMVI) that provided us with the opportunity to organize the conference and brought scientists working on electric mobility together to discuss ideas and to set up this book. Furthermore, we want to thank all presenters and participants of the conference for their interesting presentations and fruitful discussions.

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Noreen E. Werner



# Introduction

Antje Campen, Dirk Fornahl, Nikolai Iliew and Michael Hülsmann

**Abstract** For many years electric mobility is discussed as a possible option to cope with problems related to urbanization, greenhouse gas emissions, especially carbon dioxide and as a possible solution to reduce the dependencies on fuels from fossil sources. The generation of electricity from renewable resources reduces greenhouse gas emissions considerably, which means that driving an electric vehicle on renewable energy might bring down emissions close to zero. This chapter introduces electric mobility issues and provides an overview of the contributions of this book.

## 1 Introduction

For decades electric mobility is discussed as a solution for future mobility. Many hopes are pinned on new technologies that are supposed to provide more sustainable forms of transportation.

The dependence on fossil fuels and the climate change led not only in Germany to a debate on how the future of mobility might be designed. In terms of an increasing world population, further worldwide urbanization, economic growth as well as climate change on the whole it is common sense that in a few decades the oil era comes to an end. Combustion engines, based on fossil fuels can no longer

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satisfy all the future mobility needs. As one option Electric mobility emerges as a solution approach for individual transportation that might meet environmental and resource requirements as well as economic and social aspects.

The usage of electric vehicles—in combination with the use of renewable energies—can help to reduce emissions and the dependency on fossil fuels. Electric mobility is also a driver of innovation and the establishment of new technologies, which in turn help to create and maintain jobs and generate prosperity (Pehnt et al. 2007; Schindler et al. 2009; Whitmarsh and Koehler 2010).

Therefore, electromobility does not only constitute a field of scientific interest, but is strongly promoted by policy makers (Bundesregierung 2011). The changed conditions lead the automobile manufacturers, customers and legislature to realize that in the future there are more options as only Internal Combustion Engines (ICE). The emerging path is still in the beginning, meaning there are lots of alternatives.

One of the potential solutions, full or hybrid electric vehicles, have to take into account the technical, economic and organizational requirements of customers, as well as how monetary and non-monetary support schemes could or should be designed to facilitate market introduction and diffusion. In this regard the issue of how strategies, structures and systems need to change in order to bring electric mobility to the market and how customer demand for a payable and sustainable mobility can be satisfied have to be taken into account, too.

## 2 Background and Structure

The contributions in this book are essentially based on presentations held at the workshop “Future mobility. Markets and policy measures in the evolution of electric mobility” in December 2013 which was arranged by the Centre for Regional and Innovation Economics (University of Bremen) at OFFIS e.V. in Oldenburg in cooperation with Jacobs University.<sup>1</sup> At that time, a large part of field trials had been completed and assessments about the direction of future developments of e-mobility could be made.

The focus of this volume is to give an overview on new insights and highlight trends and challenges for markets and policies in the field of electric mobility. The intention is to gather theoretical, empirical and political contributions from different fields, explicitly focussing on the market introduction phase of electric mobility in order to shed some more light on the complex demand, supply and policy side topics.

This book is subdivided into three parts. Part 1 discusses threats and opportunities of electric mobility from a client’s perspective. Part 2 deals with policy

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<sup>1</sup>This book is, in a sense, the successor of the edited volumes “Evolutionary Paths Towards the Mobility Patterns of the Future” (Hülsmann and Fornahl 2014) which was based on the conference held in the same context in the year 2011 and “Future mobility. Theoretical, empirical and political aspects of the first stage of electric mobility evolution” (Hülsmann and Fornahl, forthcoming) which was based on the conference held in the same context in the year 2012.

perspectives and how these facilitate market entry and diffusion. Finally part 3 shows the management and market perspectives and how strategies, structures and systems must change in order to bring electric mobility to the market.

### 3 Client's Perspectives: Threats and Opportunities

Part 1 of the book deals with the client's perspectives. The authors present the technical, economic and organizational requirements of customers and their acceptance and experiences regarding electric mobility. They want to shed light to the question if there is a strong willingness-to-pay for electric mobility.

**Ensslen et al.** direct their attention towards different field trials and corresponding acceptance studies with new technologies which have been carried out between 2010 and 2013 at the Chair of Energy Economics at the Karlsruhe Institute of Technology (KIT). Additionally, regression methods have been applied in order to characterize early involved Electric Vehicle (EV) adopters based on a subsample of EV company car users in the French-German context. A binary logit model explaining private EV purchase intention has been developed.

**Nehls** explores ways to increase the attractiveness of electric cars. The paper first analyzes promising applications of electric cars within company fleets, which are then aggregated to five key purchase motives. It then elaborates service concepts tackling image and Total Cost of Ownership (TCO) issues of the electric car. Discussion of added value reveals potential for the successful integration of electric cars into corporate fleets and includes several best practice examples.

**Wappelhorst et al.** present a study which was carried out in the city of Berlin comprising several surveys dealing with carsharing. Expectations and experiences of users with a flexible carsharing offer including exclusively electric vehicles were evaluated and analyzed over a period of 1 year.

**Colmorn and Hülsmann** deal with a realistic estimation of threats and opportunities regarding the usage of electric mobility. These issues can be identified with the help of the hype cycle. Here the authors rise the question about the steps which lead towards the "slope of enlightenment". As a result, the paper contributes to the research on future concepts of mobility by providing an overview of different strategic perspectives.

### 4 Policy Perspectives

Part 2 shows how policy measures can or shall support market introduction. The articles discuss how the efficiency of the funding can be increased and how monetary and non-monetary support schemes shall be designed to facilitate market entry and diffusion. In the following the contents of the articles are illustrated.

**Reinecke** deals with public e-mobility funding and its influence on cooperation and innovation. In a qualitative survey with different organizations involved in the innovation system of e-mobility, impediments as well as proposals for improvement were identified. The study focused on cooperative behavior, and it could be shown that political measures have a great impact on that.

**In der Heiden** analyzes a leapfrogging strategy from the Chinese government to jump-start technological upgrading in the country's automobile industry. The paper identifies this leapfrogging attempt as a strategic project initiated by the central government and organized in a top down manner. It sheds light on the supporting public policy framework and conducts a preliminary review of the strategy's accomplishments until mid-2012. By way of an indepth examination of guidance policies and incentive structures, the paper highlights the challenge of coordinating promotion plans across the country.

## 5 Management Perspectives

Part 3 of the book deals with the questions of whether electric mobility can really gain a considerable market share in the upcoming years and how strategies, structures and systems must change in order to bring electric mobility to the market. The customer demands for a payable and sustainable mobility must be satisfied. The following papers provide insights into research focussing on the role of the markets in the evolution of electric mobility.

**Dalichau and Blättel-Mink** concentrate on electric cars, on carsharing, and on intermodal services as possible ways of reducing emissions, decreasing the number of cars and overcoming the problem of insufficient space without at the same time increasing social inequality and threatening economic competitiveness. In an ongoing research project, the role of organizations as change agents towards sustainable mobility is being explored. The preliminary findings allow for a deeper understanding of how organizations understand their roles in a transformation process towards new modes of (sustainable) mobility, but they also indicate some of the problems that still exist.

**Fojcik et al.** investigate the process and the effectiveness of various organizational measures to balance opportunistic behavior in cooperative situations, i.e. the simultaneity of cooperation and competition between at least two companies, in the context of the automotive supply industry. In a first step, various organizational measures of transaction cost, principal-agent and social exchange theory were extracted. In a second step, ten German automotive suppliers have been examined during cooperative situations by means of a case study analysis in order to test the process, the efficiency and the effectiveness of the theoretically derived measures.

**Hildebrandt et al.** examine the degradation in lithium-ion batteries from a lessor's perspective. They suppose that battery life can be influenced directly by the user. In the case of a lease contract, the battery always remains the property of the lessor. In this respect, there are no direct incentives for the user to increase battery

life by expending additional effort. Therefore, the idea of a dynamic leasing concept as an opportunity for car manufacturers to encourage consumers to adopt a gentle treatment of the battery in order to extend battery lifetime and thus the residual value is discussed.

**Trümper et al.** analyze commercial fleets in the City of Hamburg to investigate the influence of organizational parameters, such as vehicle use, as well as structural parameters, such as vehicle types and fleet size, on the potential of battery electric vehicles to substitute conventional ones.

**Werner** examines the conditions of global dominant innovation design considering e-mobility and the emergence of the lead market in different countries. With the help of a principal component analysis, different country-specific indicators were applied in the model of five lead market factors. But lead markets change quickly and the given theoretical concept is only estimating opportunities and not forecasting technology developments.

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**Part I**  
**Client's Perspectives: Threats**  
**and Opportunities**

# Strategic Perspectives of Electric Mobility—Steps Towards the Slope of Enlightenment

Richard Colmorn and Michael Hülsmann

**Abstract** In the idea contest for technological solutions, cost-efficient processes and customer-oriented mobility services for the usage of electric mobility the phase of a realistic estimation concerning the threats and opportunities can be identified with the help of the hype cycle. Therefore, the research question arises about the steps which lead towards the slope of enlightenment. In this regard, the paper intends to discuss the questions in the following categories for getting an extensive overview: How did the market structures change? How did the business models change? How will the service strategies change? As a result, the paper contributes to the research about future concepts of mobility by providing an overview of different strategic perspectives.

**Keywords** Electric mobility · Market structures · Business models

## 1 The Slope of Enlightenment

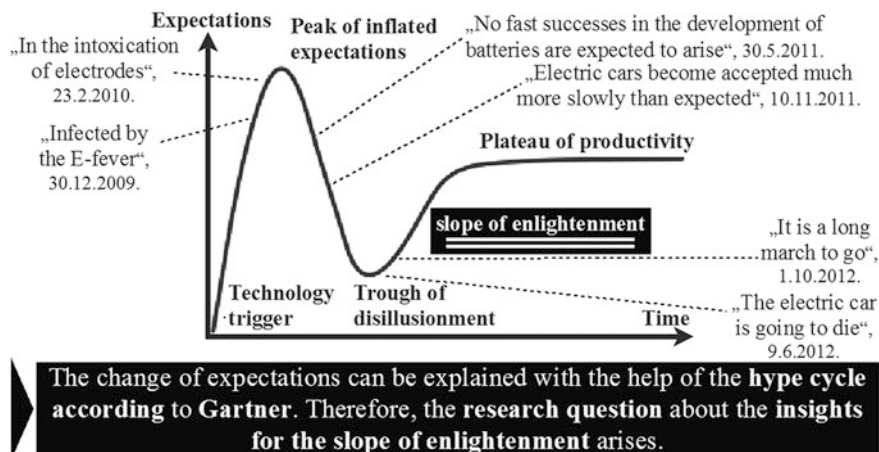
In the headings of German online newspapers a change in the expectations about the success of electric mobility can be observed in the course of time. For example, optimistic headlines in 2009 and 2010 such as “Infected by the electric fever” (Pander 2009) and “In the intoxication of electrodes” (Rother 2010) can be distinguished from sceptical ones in 2011 such as “No fast successes in the development of batteries are expected to arise” (Handelsblatt Online 2011) and “Electric cars become accepted more slowly than expected” (Eckl-Dorna 2011) and pessimistic ones, e.g. “The electric car is going to die” (Höltmann 2012) and “It is a long march” (Süddeutsche 2012). This development of expectations or opinions about the success

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**Fig. 1** Illustration of the change of expectations over time with the help of the hype cycle according to Gartner (cf. N.N. 2014)

of electric mobility can be approached in a first step with the help of the hype cycle according to Gartner (cf. N.N. 2014). The hype cycle according to Gartner is a graphical tool from the advisory firm Gartner Inc. for illustrating the typical phase of the expectations and acceptances of new technologies. According to that, a technology trigger such as the development of electric mobility appears, when no usable concepts are available at the market. A peak of inflated expectations follows because the media jumps on the topic with stories about the potential outcomes. Due to the fact that the efforts in research and development and first applications fail to deliver, negative headlines come more to the front. This is followed by the phase of the slope of enlightenment in which the opportunities and threats as well as the strengths and weaknesses of the new technology have been understood so that a more realistic estimation becomes possible towards the plateau of productivity in which a market penetration due to the fulfilment of the customer needs arises. By assigning the above-mentioned exemplary headlines to the typical curve of a hype cycle, the development of the change of opinions and expectations about electric mobility can be explained. Therefore, the **research question** can be derived about the insights for the slope of enlightenment so that the preconditions for the market penetration can be acknowledged (Fig. 1).

The research question refers to the scientific discipline of Strategic Management because it deals with the question—inter alia—about how to be successful on the market in the long run (Reisinger et al. 2013). For doing so, it is important to identify the opportunities and threats in the business environment that is becoming more and more complex and dynamic. For this, the paper shall help to get the “big picture” when talking about electric mobility so that the following considerations orientate themselves to the typical proceeding of a strategic analysis. For example, Reisinger et al. (2013) distinguish between an internal (comprising the structure,

culture and strategies) and an external strategic triangular (comprising the positioning and the distribution and strategies) so that they are connected through the sets of strategies for doing a strategic analysis. By considering the constrains of this paper, Sect. 2 will consider the question about the changes in the market structures for the external triangular because this allows to identify findings in the company's environment, while Sect. 3 will focus on changes of the business models for the internal triangular because of their focus on the configurations of the value creation of a company. Section 4 will consider the question about changes in the service strategies for combining the external and internal perspective before Sect. 5 can conclude with a summary towards the main findings for the slope of enlightenment.

## 2 How Did the Market Structures Change?

Starting point for the investigation of the strategic perspectives was the question about the relevant external influences for the development of electric mobility because insights about these influential factors allow to derive conclusions of so-called enabling or disabling interrelations from the environment. For this purpose, a database that had been started in a previous project was continued. In this context, online-articles were identified, systematically saved and analysed with regard to the keyword of "Elektromobilität" (German for electric mobility). The systematic approach for saving the articles from Spiegel-Online (including Manager Magazin), Wirtschaftswoche, Süddeutsche and the Zeit was the result of the date in the type of "yyyy-mm-tt-" plus the automatically suggested name for the pdf by saving the article. For the analysis of these articles, different categories were used. The first category examined, if a positive, neutral or negative impression could be identified, of course, from a subjective point of view. For indicating these trends, the first category was indicated through "+1", "0" or "-1". Thus, it became possible to graphically and statistically investigate the opinions about the electric mobility over time because the dates could be transformed to a time scale, while the values could be scaled in a mathematically cumulative way. The following four categories corresponded to political-legal, economic, socio-cultural and technological factors of a so-called PEST-analysis. In general, it is aim of a PEST-analysis to identify influential factors in the four above-mentioned categories that can directly or indirectly affect the organisation so the potentials of success are supported or weakened (cf. e.g. Kerth et al. 2009). With the help of this database and the statistical analysis of the cumulative values in the "trend-category", the hypothesis about a hype cycle of the expectation about electric mobility could be further supported. Doing so, the advantages and disadvantages of this technology are more realistically integrated. Additionally, the identified influential factors could also be clustered with regard to their statement of being an opportunity or a threat for the development of Electric Mobility. While a more detailed publication of this extensive analysis is in preparation, at this stage the general conclusion can be drawn that opportunities and threats can be identified in equal measure. Therefore, a

final conclusion cannot be drawn so that the environment becomes more complex and dynamic but the dominating trends are hard to determine.

As another important aspect for figuring out the changes in the market structures, the question—inter alia—about the competing forces can be addressed. The reason for this is that changes in the industry-wide competition are generally connected with changes in the market shares and companies successes (Kerth et al. 2009). Porter's Five Forces are a well-established approach for analysing the external competing situation of an industry (Porter and Brandt 2009). It is based on the idea that the market attractiveness is the result of the intensity of the competitive rivalry, i.e. the barriers to market entry. This intensity of competitive rivalry is the result of the bargaining power of suppliers and customers as well as the threats of potential customers and of substitute products.

The **threat of substitute products** expresses the idea that the customer needs or requirements can generally be fulfilled by another product or service, too, so that the product or service is substituted. In the context of electric mobility a threat of substitution exists because different driving technologies exist respectively are being developed such as traditional cars on the basis of fossil fuels, fuel cell vehicles or hybrid vehicles such as Plug-In-Hybrids or Range Extenders (cf. Bundesregierung 2009). Therefore, an increasing competition can be assumed but considering the amount of e.g. hybrid vehicles that are currently available on the German market it can be seen that the German car manufacturers as one major player for the development of electric mobility are well positioned (Fig. 2).

These considerations are quite similar to the ones about the **threat of new competitors** dealing with the market entry of new companies. In this regard it can be observed that most of the car manufacturers extend their product portfolio by developing electric vehicles. Hence, only an increase of the competition is expected to arise in the short run because new companies such as Stromos E Cars, Think or Move About have already gone bankrupt so that only Tesla Motors and BYD promise to have a successful market position in the long run (Table 1).

With regard to the bargaining powers it can be argued that the **bargaining power of customers** will further increase because the customer preferences and their expectations will further increase such as e.g. with respect to the greenness or IT-based functionalities of the car. At the same time, the willingness to pay decreases while only certain customer segments concentrate on the brand image. The **bargaining power of the suppliers** has increased, too, because the trend of a shift of the value creation towards the supplier will further continue due to increasing requirements of research and development of high-technology products. In addition to these competencies, the availability of resources plays an essential part. For example, for the production of e-motors the materials of iron, neodymium, chopper and noble earths are essential that are only produced in certain—often politically instable—regions. Besides a price increase of these raw materials due to an increase of demand a stronger dependence on few suppliers arises. Finally, the removal of existing and the adding of new components will support this trend.

In consequence, it can be summarized that the competing forces within the industry have increased and it is expected that they will continue to increase in the

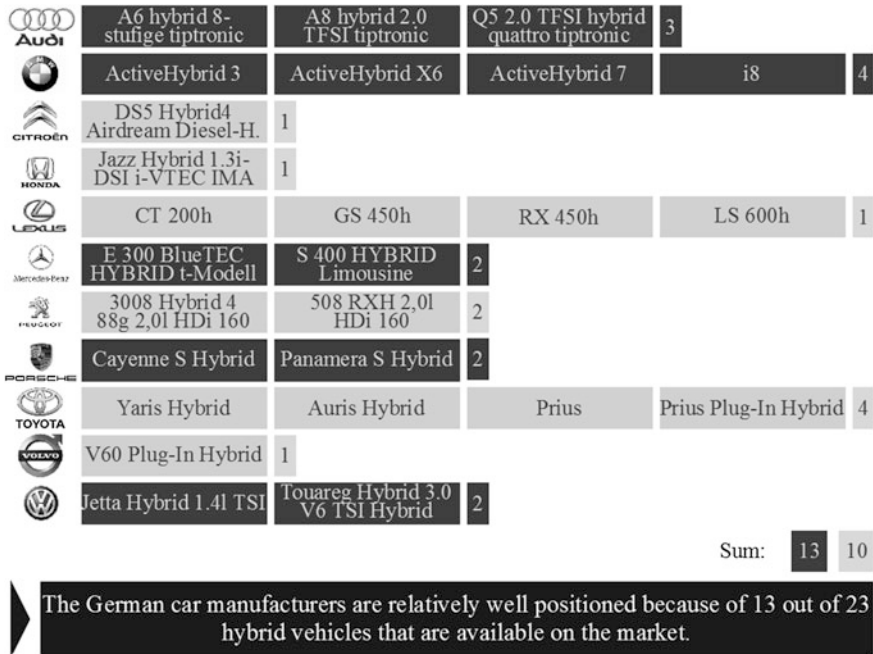


Fig. 2 Illustration of the threat of potential substitutes through e.g. hybrid vehicles

Table 1 Battery electric vehicles available on the German market (as per April 2014)

Brand and model	List price (€)	Range (km)
BMW i3	34.950	171
Chevrolet Volt	42.950	95
Citroen C-Zero	29.393	119
Ford Focus Electric	39.990	149
German E-Cars Stromos	25.950	101
Mercedes-Benz SLS	416.500	250
Mia Electric	25.504	64
Mitsubishi iMiEV	23.790	119
Nissan Leaf	29.690	160
Peugeot iOn	23.393	119
Renault ZOE	21.700	151
Smart Fortwo	23.680	132
Tesla Model S	76.740	500
Volkswagen e-Golf	34.900	147
Volkswagen eUp	26.900	160
15 models including six German ones	Ø 32.824 <sup>a</sup>	Ø 156 <sup>a</sup>

<sup>a</sup>Without Mercedes-Benz because of its high deviation

mid- and long-term (cf. Colmorn and Hülsmann 2013). Nevertheless, it could also be shown that the competitiveness of the German automotive industry is quite promising, which also has positive implications for the development of electric mobility.

### 3 What Are the Changes of the Business Models?

In order to answer the overarching question about the changes of the business models, the terminology of a business model should be clarified first. The terminology of a business model can be assigned to the field of business informatics because it was developed in the time of the New Economy to show how a business functions in an abstract way. In this regard, different definitions can be defined e.g. by highlighting customers, offerings, activities and organisations, resources, supply of factors, production inputs or the scope of management, while for example Wallentowitz et al. (2009, 2010) mention the three core areas of the customer proposition, the architecture of the value creation and the revenue generation models. Nevertheless, it can be assumed that independent of the exact definition a business model generally tries to determine how a company can configure its resources and competencies for addressing the value of the end customer so that the questions about their changes seem important because of internal changes in a company.

In the scientific literature and the daily news, new forms of business models are discussed. Therefore, it becomes possible to categorize business models, considering whether they constitute archetypes of business models or new forms. While traditional forms can generally be distinguished from each other with regard to their scope of costs (total costs vs. product costs) and their scales of usage (fixed vs. usage-dependent), new forms of business models cannot clearly be identified (Fig. 3).

To what extent these business models are competitive for electric mobility has been investigated in Colmorn and Hülsmann (2014). In that paper, a Total Cost of Ownership-approach (cf. e.g. Carr and Ittner 1992) was used for determining the customer value with regard to the Total Costs in dependence on the price development and the yearly driving performance. An empirical database was collected containing information about prices as well as usage-dependent and usage-independent costs e.g. for the Volkswagen Golf VII 1.4 TSI and the eGolf so that the two driving technologies could be compared with each other. As a result, it could be shown that independent of the different price developments for electric energy and fossil fuels it is assumed that battery electric vehicles will not be competitive in the middle term due to the high purchase costs for the battery. Therefore, it can be derived that business models for the IT-based services might be a more promising approach in the context of future mobility concepts because they can be used independently of the driving technologies that will be successful on the market in the long run.

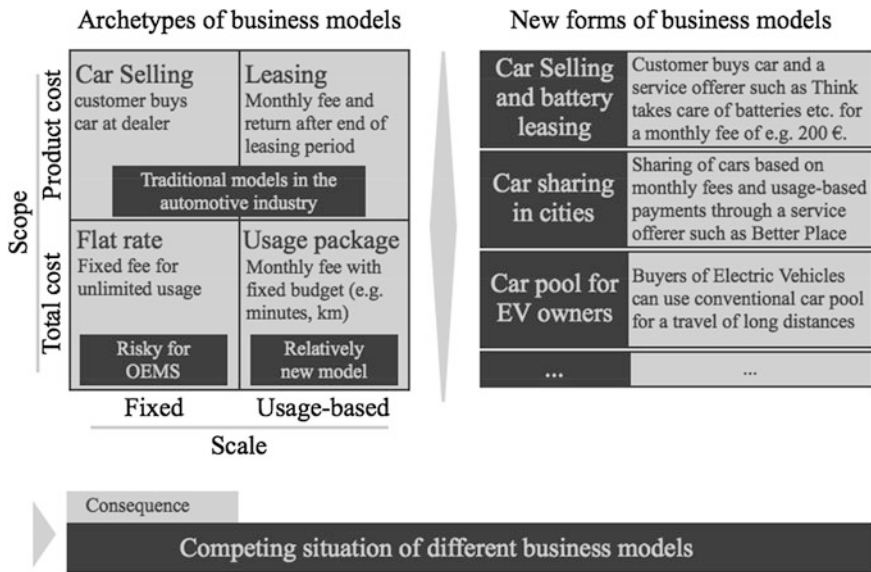


Fig. 3 Traditional and new forms of business models (from Colmorn 2014 with reference to McKinsey 2010)

#### 4 How Will the Service Strategies Change?

Service strategies help to realize the value proposition for the end-customer so that the diffusion of electric mobility is supported and the risk of market failure can be reduced. Thus, service strategies can be understood as a goal-oriented end-means-combination to be successful on the market by integrating the results of the internal and external perspective. In order to do so, this section intends to investigate the market positioning and the respective observable customer benefit as one option for answering the question about the service strategies.

This approach is based on the assumption that the technology of electric mobility does not focus on the ownership of a special product any longer; instead of this the offering of a mobility service becomes more and more important. In consequence, it seems prudent to specify the potential markets for electric mobility because of this change to a more service-oriented character for mobility. Thus, this problem can be directly traced back to the result of the PEST-analysis because the functionalities for the usage as well as the increased customer requirements were identified as a significant change in the market structures. In combination with the results of the economic as well as technological factors, the following markets and their corresponding market segments can be identified:

- The market for the electric cars is the result of the three segments of the chassis, the electric motor/powertrain and the battery/storage system.