Universiteit Utrecht

Measuring the alignment of perspectives of organizations in a socio-technical system

The case of the introduction of the electric vehicle in the Netherlands

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Abstract

System innovations occur through the interplay of a large number of organizations. Because different organizations may have different perspectives and goals, a misalignment of perspectives could occur which may hold back the development process. In this explorative study a method has been developed for measuring the alignment of perspectives on a specific technology. In this study the introduction and development of the electric vehicle has been chosen as the object of study, because previous studies have suggested that there are a number of different perspectives on electric vehicles among the participating organizations. The results of this study show, based on the data that has been gathered using questionnaires, that there are three methods of measuring alignment in a socio technical system. The first method is using the standard deviation of the scores from all of the respondents in the dataset as an indicator for alignment on each topic. The second method uses a Kruskall-Wallis test to test if categories of organizations have a different perspective on a topic. The third method is testing if categories of organizations have a significantly high level of no-response on a specific topic, which could suggest that there is some form of knowledge-base misalignment. When looking at the case of the electric vehicle in the Netherlands, the study shows that efforts should focus on the artifact (the electric vehicle), the fuel infrastructure, the production system/industry development, the market development/user practices and the regulations/policies. The study also suggests which categories of organizations represent perspectives that are the furthest apart on a specific area of interest.

Samenvatting

Systeeminnovaties komen tot stand door een samenwerking van een groot aantal organisaties. Verschillende organisaties kunnen echter verschillende perspectieven en doelen hebben, waardoor "misalignment" aanwezig kan zijn, wat de ontwikkeling van het systeem tegen kan houden. In deze exploratieve studie wordt een methode ontwikkeld om "alignment" te meten voor een specifiek technologisch systeem. In deze studie is de introductie van de elektrische auto als casus genomen, omdat voorgaande studies suggereren verschillen in perspectieven aanwezig zijn in het systeem van organisaties rond de elektrische auto. De resultaten van deze studie laten zien dat er, op basis van kwantitatieve informatie uit ingevulde vragen lijsten, drie manieren zijn om alignment van organisaties in een socio-technisch systeem te meten. De eerste methode is het gebruik van de standaard deviatie om vast te stelen wat de hoogste en de laagste standaard deviatie is en daarmee ook de alignment tussen actoren. De tweede methode maakt gebruik van de Kruskall-Wallis test. Hierbij wordt getest of de perspectieven van verschillende groepen van organisaties, significant van elkaar verschillen op bepaalde onderwerpen. De derde methode kijkt naar de hoogte van het aantal "weet niet/geen mening" respondenten, hierbij wordt getest of er bepaalde groepen van organisaties zijn die een significant hoger aantal "weet niet/geen mening" antwoorden gegeven hebben. Dit zou er namelijk op kunnen wijzen dat er mogelijk een misalignment van beschikbare kennis is. Wanneer gekeken wordt naar de casus van de introductie en de ontwikkeling van de elektrische auto in Nederland, is te zien dat wanneer er gewerkt wordt aan "misalignment", er met name gekeken moet worden naar de volgende dimensies van het socio-technologisch systeem: het artefact (de elektrische auto), de energie infrastructuur, het productiesysteem/industrie, de marktontwikkeling/gebruikers ervaring en beleid en regulering. Deze studie laat ook zien welke groepen actoren significant andere perspectieven hebben op een bepaalde dimensie.

Contents

I. Introduction

In the last decades the issue of sustainability has been growing and is becoming increasingly important. Governments, industries and consumers are becoming more aware of the need for sustainable development to ensure sufficient resources for upcoming generations (Eppel 1999). In recent years interest has been growing for the development of electric vehicles (EV) to be used in strategies for sustainable mobility (Beerda 2009). Several countries, including the Netherlands, are starting to develop policies and are starting projects towards the use and introduction of electric vehicles (Beerda 2009). The implementation of systemic innovations like the electric vehicle, however, require to some extent the existence of shared visions and perspectives between the organizations that are involved. In other words, it is vital to ensure that the organizations that are involved are 'aligned' to provide a solid basis for the creation and development of coherent strategies, ideas and knowledge (Martin 2000, Nooteboom 2000, Nooteboom et al. 2007).

The Oxford dictionary states that 'alignment' is a position of agreement or alliance. Alignment can occur at several different levels. For example alignment can occur within an organization or between organizations (Derzsi and Gordijn 2006). Studies have shown that a large number of problems arise during the introduction and development of a technology due to a lack of alignment of ideas and scopes of the different organizations that are involved in the system (Deakin 2001). Morriss et al. (2006) also state that understanding the perspectives of (socio-technical) system participants and sources of agreement and disagreement between them is critical for innovation strategies that require collective action.

In a recent study of the Netherlands Society for Nature and Environment (Stichting Natuur en Milieu) a number of organizations were interviewed to determine the different strategies and problems when trying to reach 1 million EV's in 2020 in the Netherlands (Van den Berg et al. 2009). The results suggested that organizations did not always perceive the same set of problems. These results are in line with the fact that there is no generally accepted definition of sustainable mobility (Deakin 2001). The result is a large number of different strategies and perspectives on how to improve the sustainability of a country's mobility and transportation network and how specific technologies should be developed towards that goal.

Several approaches (e.g. scenario exercises and transition management) aim at learning and creating a shared understanding between the organizations involved in a socio-technical system, in order to enable collaborative innovation strategies. However, few studies have pursued to analyse what perspectives exactly are misaligned, or what the 'size' of the (mis-)alignment in socio-technical systems is. To be able to tackle the problems related to sustainable mobility, it is important to look at the alignment of the perspectives of the different organizations that are involved in getting the transport system of the Netherlands more sustainable. In this exploratory research, the goal is to develop a method to measure and analyse the alignment of perspectives. The implementation of the electric vehicle is selected as a case. The research question for this study is therefore:

How can the alignment of perspectives of organizations involved in a socio-technical system be measured?

When this question is answered knowledge will be gained concerning the alignment of perspectives of organizations in a socio-technical system (in this case the system of the electric vehicle), for this study will contribute by developing a framework for measuring the alignment of perspectives in a socio-technical system. The developed framework can furthermore be used to track changes in alignment over time which will provide valuable insights in how systems develop and deal with alignment. For future developments it can also be an important tool for society to deal with alignment issues in systems aiming to develop and implement technologies. This study furthermore provides a new tool and valuable information to develop and evaluate strategies to overcome misalignment issues and enables a focus of attention on specific areas of misalignment between organizations or groups of organizations which may thus in turn increase the progress of the developments in sustainable mobility and electric vehicles.

II. Theoretical background

The introduction of the electric vehicle can be seen as a system innovation, for it requires a number of changes in for example other industries, infrastructure and regulations. In previous studies these types of innovations have been studied using a systemic approach using technological and social aspects, for example in the theory of technological transitions (Rotmans et al. 2001) or the technological innovation systems approach (Carlsson & Stankiewicz 1991, Carlsson 1997, Hekkert et al. 2006). These studies show the importance of the social context of technological development.

The development of technology is not a guarantee for its implementation or success, because for example the development of regulations and complementing technologies could also be important for a technology to be implemented by society (Freeman 1987, Lundvall 1992, Nelson 1993, Rotmans et al. 2001). Besides regulation and complementing technologies there are other aspects that influence the development of a technology, namely: user practices, markets, cultural meaning, infrastructure, maintenance networks and supply networks (Elzen, Geels & Green 2004) for a technology cannot fulfill a societal function by itself (Geels 2005), the technology will always be perceived as part of a certain context (Fleck 1993). All of these components together form the socio-technical system of a technology.

To allow the technology to develop and implementation to start, alignment between different organizations is needed. A system with a high level of alignment of ideas and views will result in a strong "network" of organizations (Martin 2000). The aligned organizations will be able to support collective ideas and start to develop a stable framework of ideas and expectations. This in turn results in a coherent idea of which steps should be taken to reach a certain goal (Martin 2000). It is therefore important to be able to measure alignment, which can then be used to determine the need for alignment improving actions, or for example to establish if the perceptions of organizations involved with the technology are converging or diverging over time.

Alignment, however, is not a clearly defined concept and can be measured on different levels. Von Tunzelmann and Acha (2005) and Derzsi and Gordijn (2006) describe two forms of alignment. Alignment can occur on an intra-organizational or an inter-organizational level. These two forms of alignment are often used in business IT alignment studies. Von Tunzelmann and Acha (2005) also describe alignment as being vertically orientated. Different organizations or components within an organization can be vertically related (for example suppliers, buyers and producers or production, marketing and sales). All of the organizations or components have to be aligned to be able to perform their tasks efficiently and to be able to cooperate effectively.

Alignment, however, does not only occur within an organization or between organizations. When not looking at the field of business IT but rather at alignment in a general context there are more forms of alignment possible. As Leonard-Barton (1988) suggests in her study, alignment can also occur between a technology and its users, which agrees with the study of Molina (1997) who suggests that alignment can occur between people, institutions and/or technical elements. In this study the focus will be on alignment between organizations, for inter organizational activities play an important role in systemic innovation processes.

In the study of Molina (1995) it is suggested that during the development of the socio-technical system of a technology, a number of alignment processes take place. For example alignment processes can take place between the system and other systems of competing or complementing technologies. According to Molina (1995) alignment can also occur between the technology and the targeted problem for which it would be introduced. Besides these technical aspects there are also

some social aspects of the system that could experience alignment processes. The system should develop alignment with the governance and strategies of the industry or market for which it is designed. The last form of alignment which is described by Molina (1995) is the alignment of perceptions and goals amongst the possible participants of the socio-technical system. A fundamental part of the socio-technical alignment of organizations is the alignment of perceptions, ambitions and goals (Molina 1995). The alignment of perceptions and goals is very important when there is a large number of competing technological developments, for example different ideas on how to develop the charging infrastructure for electric vehicles. When organizations communicate with each other they can gain insights in the motives and ideas of the other organization. This in turn can lead to understanding and alignment of perspectives. When the different parties not only understand each other's perspectives but also set common goals and aim to do the same thing, goal-alignment starts to develop (Molina 1995).

Everyone interprets the world differently and the way an organization perceives its surroundings determines what its behavior will be and could result in setting different goals. In the end the socio-technical system has to evolve towards one specific option, by means of discussion, interaction and developments within the system in order to be successful (Molina 1995). The alignment of perspectives can occur naturally when a network is formed and organizations interact (Vergragt 1988). However, there is also the possibility that the system will become "locked" by not being able to reach a consensus, which would lead to the complicated situation that one group would have to decide for the entire system on how to proceed (Molina 1995) which is not very likely to happen or will at least be very hard to achieve. To ensure that the participating organizations do not move towards such a complicated situation it is therefore important to be able to determine the alignment of perceptions between organizations within the socio-technical system. Therefore it would be interesting to focus on the dimension of the inter-organizational alignment, and focus on the alignment of perceptions and goals of the organizations that are involved.

In the study of Morriss et al. (2006) inter-organizational alignment is also studied using perceptions with a focus on the interplay between organizations. Morriss et al. (2006) study alignment at the level of individuals and interactions between cooperating organizations. When looking at the development of electric vehicles, the socio-technical system includes a large number of organizations that all play different roles in the development process while not always directly cooperating. Therefore this study places the concept of alignment at a systemic level. Instead of the single factor technology, as described by Morriss et al. (2006), this study looks for example at the technology in combination with infrastructures, regulations or complementing technologies that make up the socio-technical system that has to be built up around the electric vehicle.

The electric vehicle in itself cannot fulfill the role of mobility or transportation. For example there will always be the need for a supportive infrastructure to allow the vehicle to be mobile. Therefore when looking at the development and introduction of the electric vehicle, the entire socio-technical system has to be taken into account. The socio-technical system of the electric vehicle consists of a number of different components that can be distinguished. In the study of Geels (2005) a number of dimensions are distinguished for the socio-technical system of land-based road transportation. In this case the system concerning electric vehicles will be studied. Different dimensions are used to determine differences in perspectives on the electric vehicle among the organizations that are involved. The framework can be found in table 1.

Socio-technical system of the electric vehicle	*Technical*	- Automobile (artifact including the different components) - Road infrastructure and traffic systems (e.g. lights, signs) - Fuel infrastructure (battery companies, charging stations, energy distribution) - Production system and industry development (e.g. car manufacturers, suppliers) - Maintenance and distribution network (e.g. repair shops, dealerships)
	Social	- Culture and symbolic meaning (e.g. freedom, individuality, sustainability) - Markets and user practices (mobility patterns, driver preferences) - Regulations and policies (e.g. traffic rules, parking fees, emission standards, car tax)

Table 1. Framework of the inter-organizational alignment of perspectives on the socio-technical system based upon the theory of Geels (2005)

These different dimensions of the socio-technical system of the electric vehicle have to be further specified. When trying to measure the alignment of the different perspectives on (for example) the fuel infrastructure, it is important to develop a framework of topics which are related to the fuel infrastructure on which misalignment could occur. For example, when looking at the fuel infrastructure it is possible that a large number of topics can be described. To determine what topics are relevant or interesting, the main topics for each dimension were determined using a previous study from Van de Berg et al. (2009). This resulted in a first list of topics that could prove to be interesting to discuss. To ensure that the list of topics was still up to date and relevant, interviews were held with different organizations that were involved with the introduction of electric vehicles in the Netherlands.

III. Method

To be able to answer the research question of this explorative research a number of steps have been taken. The first step was to establish how the socio-technical system of the electric vehicle in the Netherlands is organized. Using the framework of the different components involved in a socio-technical system as described by Elzen, Geels & Green (2004), the different organizations and institutions were placed into different subsystems. These types of organizations included:

- Industry (e.g. production companies)
- Public authorities (e.g. government)
- Research organizations (e.g. public research, research institutes, brokers)
- Users (e.g. consumers, final demand)
- Financial organizations (e.g. banking, insurance)
- Suppliers (e.g. material suppliers, machine suppliers)
- Societal groups (e.g. NGO, lobby groups)

Gathering information on different organizations that are involved with electric vehicles was done using the internet, news reports and contacts acquired from the thesis supervisor. These contacts would be the first interview respondents and by asking these interview respondents about other organizations they have worked with or came in contact with, the set of potential respondents for the interviews were expanded. A previous study on electric vehicles in the Netherlands had shown that a large group of actors consisting of research institutes, national government agencies, car dealerships, energy companies, car manufacturers, local government, lease companies, financial institutes and many more are involved in the introduction of electric vehicles in the Netherlands (Van den Berg et al. 2009). This indicated that sufficient respondents could be addressed during this research for interviews or questionnaires. In addition, AgentschapNL had been contacted to request their support for the study by giving feedback and the possibility to access their network of contacts that are involved with electric vehicles in the Netherlands.

After having established the first part of the research population, the next step was to further develop the theory to a *conceptual framework*. The documents of a previous study conducted by Van den Berg et al. (2009) were used to develop the *conceptual framework* with the first set ideas on possible topics, which was used to describe the (future) socio-technical system (cf. Table 1).

Interviews

After having established the first draft of possible topics within the different dimensions of the (future) socio-technical system, the previously developed conceptual framework (See table 1.) was used to conduct a number of interviews (one for each type of organization, which resulted in a total of 7 interviews). The interviews were held using respondents from the different types of organizations that were involved with the socio-technical system to

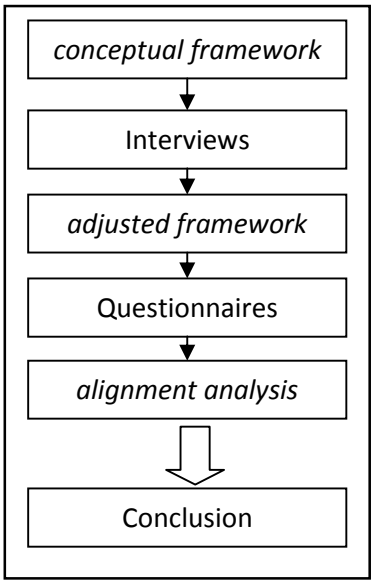

Figure 1. Research plan

ensure a broad refinement of the framework. The respondents were asked how they perceived the different dimensions of the (future) socio-technical system of the electric vehicle. The interviews were topic orientated interviews, using the *conceptual framework* as a reference for possible topics that could be discussed, which afterwards would be adjusted and refined by the new insights and perspectives gathered from the interviews. These results would lead to the development of the *adjusted framework*.

The interviews took approximately one hour each in which the respondent was questioned about different topics concerning the electric vehicle. As could be expected, some of the respondents could not provide information about all of the topics. The respondents focused their attention on the topics they came in regular contact with. When they were asked about other topics they sometimes replied that they had no idea or had no opinion on the topic. This resulted in some topics including only general ideas and other topics including more specific ideas.

When the data from the interviews was combined, each dimension had been discussed with a fair level of specificity. For each dimension “new” topics were found that were not obtained from the short literature study and previous studies. When the topics that were found in the interview part of the study are compared with the topics found in previous studies, it shows that a number of topics could be added. The respondents from the interviews added a number of topics that they found to be relevant besides the topics that could be derived from the previous study. Some of these newly added topics were based on new projects new knowledge or new technological options, while other topics were very specific and could not be found in general studies or literature.

During the interviews paraphrasing was used to ensure that the results would reflect the perspectives of the respondent. In some cases respondents were confronted with statements from other interviews to verify if the topic from the statement was relevant and to gain additional information on the topic from the respondent.

The data that was gathered from the interviews, was used to develop a questionnaire for the second part of the study. The questionnaires in turn were used to determine how respondents perceived the dimensions of the electric vehicle and the system in which it is developed. The qualitative phase of the study can be seen as a form of cognitive testing (O.N.S. 2010). The respondents from the interviews were used to develop a framework of relevant topics that could be used in the questionnaire phase of the study. The data from the interviews was analyzed using a labeling method. The data that was gathered was processed iteratively. In the first phase each statement was labeled and categorized in main topics. In the next phase the statements in each category were split up further into new categories within the main topics. This has been done until all of the statements in a certain category would discuss a similar topic. This lead to a list of topics that could be discussed in the quantitative study.

The list of topics that was made using the interview data and the data gathered from previous studies was very large. Therefore a selection had to be made to be able conduct a reasonably sized survey. In appendix A, a list of selected topics can be found that were used in the survey.

The total number of topics was 115. This would lead to a necessary reduction of topics. For a survey of approximately 15 minutes this would have to be reduced to an estimated 60 topics. This meant

that approximately 48% of the topics had to be eliminated to be able to get a survey of the required size. Topics were excluded while trying to maintain the complete spectrum of the diversity of topics where possible. The first topics were excluded based upon whether or not the topic experienced some sort of overlap with another topic. Furthermore the next topics that were to be excluded were selected based upon the expected level of “no opinion/no idea” answers. These topics would be too specific to be answered by different categories of organizations or the topics could prove to be too hard to be represented in a single simple question for the survey. After these previous steps, the list of topics would still prove to be too long, therefore an area of interest had to be excluded from this survey to reduce the number of questions to a reasonable level. The area of interest concerning the road infrastructure had to be removed. This area of interest had a smaller number of relevant questions and included topics that were bound to be resolved over time or would prove to be relevant, only once more electric vehicles would be introduced.

Questionnaires

The previously developed adjusted framework was used to develop a set of statements with which the respondents of the questionnaires could agree or disagree. In the questionnaires the respondents had first been asked to answer a number of control questions to establish what their relationship to the electric vehicle was. After the control questions the respondents were asked to score specific statements with which they could agree or disagree for the situation as they perceived it to be. Due to the limitations to the size of the questionnaires the statements were based upon a selection from the adjusted framework which was based upon the literature study and the interview results. Sometimes other types of questions were used, these questions were multiple choice question. Each question would have the option to answer “don’t know/no opinion”. For the multiple choice questions there was another option of “other, namely” in which the respondent could type their answer if it did not fit in one of the predefined categories. All of the scores were measured using a 5-point scale, in order to be able to distinguish the level of agreement or disagreement. After having established the level of agreement or disagreement to a specific question on a topic, the respondents were also asked to state if they thought additional attention and focus for this specific topic would be necessary. The complete survey can be found in appendix B.

IV. Interviews, results and analysis

In this next section the data gathered from the interviews will be discussed and analyzed. The goal of the interviews was to determine the topics that were relevant to the current situation of the electric vehicles. The data of the interviews was gathered from different types of organizations. From each of the seven previously mentioned categories of organizations, one organization was questioned. The organizations that were used were: a municipality, a lease company, a distributor/user, a service provider/distributor, an energy distributor, an environmental organization, a governmental/research supporting organization.

The respondents in general could not always formulate a perspective on a specific area of interest (e.g. regulations, technology, road infrastructure, charging infrastructure). The reason may be that a respondent is mainly exposed to issues that are related and concern their own area of expertise and working environment. In this next part, the data from the interviews will be discussed for each of the areas of interest.

The electric vehicle (artifact)

When looking at the electric vehicle as a single object the respondents mentioned a large number of topics. Some of the respondents stated that in general there was a need for technical change or improvement. Other respondents, however, stated that the electric vehicle in its current form would suffice for the first introduction in the Netherlands and that it is not the issue that would hamper the introduction of the electric vehicle. From a technical point of view the respondents discussed a number of different topics. The first set of topics was related to the battery.

Battery

The battery could, according to the respondents, be improved on many different levels. Some respondents stated that the size of the battery should be a focus of attention. The current batteries, according to the respondents, could be considered to be too large and too heavy. Besides the form factor of the batteries also other aspects like the costs of the batteries were discussed. A number of respondents discussed that the price of the current battery packs is too high which results in higher overall costs of the electric vehicle. Some ideas were presented to try to solve this problem by the idea for separating the electric vehicle and the battery pack during purchase. For example the car could be purchased and the battery leased separately.

This separate buy and lease construction could also prove to be valuable to tackle the other issues that the respondents discussed, namely the issue of the durability of the battery. The respondents perceive the current batteries to have a low durability which should be improved. Some respondents, however, stated that the development of the battery would result in an improved durability for batteries over time without specifically having to focus efforts towards the improvement of the durability. This shows an agreement on the possibility for improvement, however, it also shows that there is a difference in the sense of urgency to stimulate the rate of development towards improving the durability of the batteries. When the batteries are used, charged or discharged the batteries will experience a loss of durability. The batteries are therefore usually not covered by the standard warranty. This leads to the next issue of the lack of guarantee of the lifetime of the battery. This results in a large uncertainty for the owner of the electric vehicle. Some of the respondents stated

that it is therefore needed to monitor and study the use of the battery during its lifetime to be able to determine the durability and loss of durability and determine its remaining value.

One of the topics that were not mentioned by the respondents was the dependency on lithium producing countries. This topic was mentioned in a previous study of Van de Berg et al. (2009). This topic was added to the topic list to complete the list and because it could prove to be a valuable addition to the framework.

The last issue specifically concerning the battery is the capacity of the battery. This issue showed a number of different opinions. Some of the respondents discussed that the current capacity of the battery is sufficient for the daily traveling needs of the users. Other respondents stated that it should be increased significantly. The respondents that stated that the current capacity is sufficient, mainly used the argument of the realistic traveling needs of the user (for example 90 kilometers) while the average electric vehicle can travel significantly further and should be able to provide enough capacity for what the users need. However, the argument for an increase of capacity is often based on the idea that the user's perception of his/her need for the capacity of the battery is clouded and unrealistic. The general consensus is that there is a mismatch between what users need and what users think they need. The issue of the capacity of the battery is closely related to the volume and weight of the battery. This means that some respondents could argue that the battery should be smaller and lighter with the same capacity where other respondents could argue that the battery could stay the same but should have an increased capacity. Both would therefore agree that the energy density of the battery should be improved, while there would be difference of opinion on the total amount of energy/weight that should be implemented in an electric vehicle.

Range

This leads to the difference between the issue of battery capacity and the issue of the range of the electric vehicle. Some respondents stated that the general range of the electric vehicle should not only be increased by increasing the battery capacity but also be increased by the reduction of the general weight of the vehicle. Some of the respondents stated that the range of the electric vehicle should be increased, however, some mainly discussed increasing the battery capacity where others also discussed the general energy consumption and weight/aerodynamics of the electric vehicle. Some respondents also discussed a combination where the electric vehicle has to be light and efficient while increasing the battery capacity. The efficiency increase also has another purpose as stated by some respondents, with the increase of the general energy consumption of society there would be a need for the electric vehicle to be as efficient as possible to reduce the energy consumption that society uses for mobility. A fewer number of respondents also discussed the accuracy of the indication of remaining capacity and range. The current indicators of the remaining capacity are not always as accurately as would be desirable for users.

Vehicle weight and load capacity

Besides the range, the current electric vehicles for consumers have little available load capacity according to a number of respondents. To be able to be used as a general purpose vehicle there could be, according to the respondents, a need for more load capacity of the electric vehicle. Some respondents, however, also discussed that users should become more aware of their needs when purchasing a vehicle. It could be argued that users should buy a vehicle for their everyday needs and

hire a vehicle when an exceptional situation requires a vehicle with different attributes and specifications. Some respondents argued that a large number of vehicles on the roads today are not efficiently used, for they are larger and have more seats than needed for the general everyday traveling to work. This would also increase the energy efficiency.

Emission

The electric vehicle would be expected to be an improvement for the environment. Some of the respondents of the interviews stated that the current method of calculating the contribution to the environment should be further developed to be more transparent and be generally accepted among all the stakeholders that involved. Other respondents stated that it is fairly clear what should be taken into account when the contribution to the environment of the electric vehicle would be measured. The interview results showed that some of the respondents argued that the current energy mix (the mix of sustainable and fossil energy) that is used in the Netherlands would result in a significant improvement of emissions. However, other respondents argued that the sustainable contribution of the electric vehicle would be highly uncertain with the current energy mix and that the electric vehicle could only contribute if more sustainable energy would be generated and used to charge the electric vehicles.

Technical design

Besides the technical aspects the respondents were also asked about the design aspects of the electric vehicle. Some of the respondents stated that there was no need for a change of design of the current electric vehicle to fit the needs of the users. However, other users stated that the current form and design of the electric vehicle would not appeal to the users. The respondents that would like to see changes in the design of the electric vehicle discussed a number of different aspects of the electric vehicle. The respondents discussed that the electric vehicle should have a modern look, however, others stated that it should not be too futuristic. Some respondents stated that the electric vehicle should have a more mature look. Others also stated that the electric vehicle should have a faster and sportive look. Thus far there is no large contradiction besides the opinions on the necessity for change. Some respondents, however, did state that the electric vehicle would prove to be a nice opportunity to develop a vehicle that is completely different when compared to the current vehicles. Other respondents, however, stated that the electric vehicle should look like a conventional vehicle.

General development

The respondents also discussed the level of maturity of the electric vehicle. Some respondents stated that the electric vehicle is in a mature state, however, that mainly the batteries could be further improved. Other respondents stated that the electric vehicle should not be marketed as a finished product. As some respondents stated, the electric vehicle still has some issues and disadvantages that should be further developed before the electric vehicle is ready for the general public. Most of the respondents see a large potential for improvements that can still be developed to improve the electric vehicle.

Safety

The safety of the current electric vehicles was also discussed by a smaller number of respondents. According to some respondents, there is no clearly defined guideline for safety testing of electric vehicles at the present time. The respondents stated that there should be a focus to develop standardized safety tests for electric vehicles, however, the respondents also stated that with an introduction on a larger scale, the safety test will be further developed when large car manufacturers are involved in the production and introduction of electric vehicles. For the current situation the development of policies and certificates were discussed to be needed for companies that convert conventional cars to electric vehicles.

Ease of use

Only a small number of respondents discussed the general ease of use of electric vehicles during the interviews. These respondents stated that the electric vehicle could be improved to provide a higher ease of use. This does concern the electric vehicle in general, so it also includes the way the electric vehicle is charged and the therefore the ease of use of charging. The ease of use of the charging part of electric vehicles, however, was discussed by a larger number of respondents.

These results lead to the following topics that are related to the different aspects of the technology, which in this case is the electric vehicle itself.

- The size of the batteries
- The capacity of the batteries
- The weight of the batteries
- The guarantee and reliability of the batteries
- The durability of the batteries
- The costs of the batteries
- The level of the maturity of the technology of the batteries
- Dependency on lithium producing countries
- The range of the electric vehicle
- The accuracy of the range indication of the electric vehicle
- The emission measurement of the electric vehicle
- The emission contribution of the electric vehicle
- The load capacity of the electric vehicle
- The efficiency of the engine
- The weight of the electric vehicle
- The size of the electric vehicle
- The style of the design of the electric vehicle
    - Modern
    - Fast design
    - Futuristic
    - More mature
    - Like a conventional car
    - High-tech

- The level of maturity of the electric vehicle
- The safety level of the electric vehicle
- The level of simplicity of the electric vehicle

The road infrastructure

While discussing the effects of the electric vehicle on the road infrastructure, a number of respondents argued that there is no direct urgency for this topic to be discussed for there are no big changes needed when compared to conventional vehicles. However, some of the respondents did discuss a number of topics that were not always directly related to the physical structure of the road infrastructure but are related to the function of the road infrastructure.

Routing and information technologies

Some respondents argued that the electric vehicle does provide an opportunity to incorporate more electronics and increase interaction between the road infrastructure and the vehicle using various information technologies. For example some respondents discussed the need for intelligent routing and navigation. When planning a route the system could incorporate charging stops to ensure that the vehicle has enough power to make the entire trip. Another example is the addition of so called points of interest to the GPS system to be able to find public charging locations for electric vehicles.

Parking

Some of the respondents also discussed the issues concerning parking of electric vehicles. A number of respondents discussed the placement and construction of public charging spots as being a change to the current road infrastructure. Besides the physical change to the infrastructure there is also a financial aspect to electric vehicle parking. Some of the respondents discussed that the costs for specific parking spots for electric vehicles are very high. This is mainly the case in large cities were a large number of paid parking spots are located and parking permits are issued for parts of the city to the occupants of the city. The respondents also stated that it would be necessary to find a method to finance the parking spots or to get paid for the parking spots when electric vehicles become more common.

Traffic signs

Only a small number of respondents were discussing the topic of traffic signs. These respondents mainly discussed two types of traffic signs. The first traffic sign concerned the universal sign for charging locations. The respondent discussed that at the present time there are no signs placed to show were the charging locations are located. The other respondent discussed the need for the development of a sign that could be used to indicate a parking spot that may only be used by electric vehicles.

The position of the electric vehicle in the road infrastructure

The electric vehicle could require a change of behavior from other road users or a specific implementation of the electric vehicle in the traffic system. Some of the respondents argued that there is no need for specific attention on this topic. They argued that other road users would have to get used to silent running vehicles in city traffic. Other respondents, however, stated that some

action would be required. The first type of action would be to gather information and conduct research to gain more insight in how other road users behave when encountering an electric vehicle in an urban environment. These respondents also discussed that other road users should be informed about the possibility of encountering silent vehicles in the traffic environment. One of the respondents also argued that during the development of new district/neighborhood it might be needed to design and plan with the electric vehicles in mind to ensure the safety of inhabitants and the children of the inhabitants.

These results lead to the following topics that are related to the different aspects of the road infrastructure.

- Intelligent routing and planning
- The costs of specific parking spots
- The number of parking spots for electric vehicles
- The development of signs (for charging and parking locations for electric vehicles)
- Research of the implementation of the EV in the urban environment
- Information distribution about silent vehicles in city traffic
- New forms of urban planning to incorporate silent vehicles

The fuel infrastructure

When looking at the fuel infrastructure the topics that were discussed by the respondents could be divided into a number of categories, namely the way people charge their vehicle, the way the energy is distributed to charging locations, the way the energy is generated and the way the energy is paid for. The respondents discussed a large number of topics concerning the energy use and distribution, which could be expected, for this is a very important part for the implementation of the electric vehicle.

Charging

When looking at the way the vehicle connects to the charging station, the respondents discussed a large number of aspects concerning the way the electric vehicle would be connected. Some of the respondents argued that it would be necessary for the electric vehicle to be connected with limited visibility. Some of the options that were discussed by the respondents were, for example, the use of induction charging or a connection that rises up from the ground to connect to the bottom vehicle. Some of the respondents, however, also stated that this should be tackled in the future, so for the time being the wired connection would suffice to be able to allow a fast construction of charging points. Others, however, argued that induction charging is still in an experimental phase of development and is very inefficient. When looking at the physical connection it also became clear that some respondents argued that a universal connection was needed where other respondents argued that a universal connection is not yet needed and should be carefully considered for it could result in choosing a connection with an inferior design which might cause problems in the future.

Charging duration

When looking at the charging duration of the electric vehicle the interviews showed a large consensus on the idea that the reduction of the time needed to charge the electric vehicle was needed. Some of the respondents argued that it is vital for ensuring a high user acceptance and a higher ease of use. The charging duration in general should be faster according to the respondents. The charging duration, however, is also dependent on the method of charging. One of the respondents stated that the charging time when using fast charging should be approximately 15 minutes or less to be acceptable.

Charging method

The respondents discussed a number of different charging methods. Some argued that at the present time there should not be invested in one specific charging method for many changes are possible at the current stage of development. They also argued that the charging stations that are currently placed will probably be replaced in the future by a different method of charging. The general consensus is therefore that changes to the charging method will occur with a high probability.

When discussing the different charging methods there were a large number of statements given by the respondents. Some respondents discussed that there will be a mix of different charging methods that will be available to the user in the future. In this scenario the standard charging method might be complemented by fast charging for example in emergency situations. Some respondents argued that fast charging will not be used as standard charging method, while other respondents would argue that fast charging is an interesting option when it is further developed. The general consensus is that fast charging in its current form is not a good option for standard charging, however, investments are needed to develop it further and make it useful in the future. The respondents also argued that the use of battery swapping stations in general will be too expensive and will be very complex.

The ease of use of charging

When looking at the topics that the respondents of the interviews discussed, some of these respondents discussed the ease of use of charging the electric vehicle. The general consensus here is that everybody stated that charging the electric vehicle should be easy. Some of the respondents also stated that the reliability of the charging process could be improved. For example the user could receive a reminder to charge his/her electric vehicle to ensure a fully charged battery pack the next day.

Charging patterns

When looking at the charging patterns of the users of electric vehicles, the respondents discussed a number of topics. A few respondents stated that charging should occur when the vehicle is not in use so there would be no specific need to take the vehicle out to a station to charge it. Others stated that it should be possible to charge your electric vehicle at a specialized centralized charging station (just like the current fuel stations). Some respondents also discussed that electric vehicles should mainly be charged at work or at home. Other respondents argued that only a limited number of people could charge the electric vehicle at home due to a limitation of the power grid at their homes or due to the lack of a private parking space near their home. Therefore the respondents discussed the need

for public parking spaces with charging capabilities. The number of public charging spaces should thus be increased according to some respondents. While other respondents stated that the placement of public charging stations should only be stimulated as a short term solution.

Energy generation

One of the main topics that were discussed by the respondents when looking at energy generation was the need for sustainable energy. One respondent argued that using sustainable energy would result in an increase in costs for operating electric vehicles. However, the general consensus among the respondents was that there was a general need for an increase of the production of sustainable energy. Some of the respondents stated that the current amount of sustainable energy is enough to charge the electric vehicles at the present time, while others stated that the current sustainable energy capacity is too low. The motivation for this is that an increase of sustainable energy is needed to be able to reach the sustainability goals. For future use and the introduction of the electric vehicle on a larger scale a large number of respondents agree that an increase of the sustainable energy production is required. The majority of the respondents agreed that the use of sustainable energy should be a prerequisite for the introduction of the electric vehicle.

Location of energy generation

The sustainable energy that would be needed to charge the electric vehicle could be generated in a centralized facility, however, some respondents argued that the electric vehicle would provide a stimulating effect to increase the decentralized generation of energy at home or at work locations with solar panels or wind energy. One of the advantages as discussed by one of the respondents is that decentralized energy generation would reduce the pressure on the national energy grid. Another advantage would be that due to the electric vehicle, the energy someone generates competes with oil prices instead of standard energy prices. Some of the respondents, however, argued that decentralized generation of electricity is not necessary for the introduction of the electric vehicle.

Energy distribution

When looking at the energy distribution, the respondents discussed a number of topics. The first category of topics is related to the capacity of the energy infrastructure. Some of the respondents stated that the distribution of energy could prove to be a problem. However, after having spoken to other respondents it became clear that if capacity problems would occur, that they would probably occur on a neighborhood level. However, some respondent also argued that problems would only occur if there would be a large concentration of electric vehicle users in an area and the standard spare capacity for growth of the network would be exceeded. To increase the capacity, the current infrastructure could be replaced by a heavier version to allow for additional capacity to become available.

Intelligent energy systems

Another option to increase the capacity of the network is to implement intelligent systems according to some respondents. These intelligent systems would allow for more efficient use of the available capacity of the infrastructure. A number of respondents argued that smart grids are required to deal with the power consumption of electric vehicles. Other respondents, however, stated that it is not

required specifically for electric vehicles. They stated that smart grids are a development that also has other benefits and will therefore be implemented anyway. The electric vehicle is also argued to be able to act as a buffer for energy when connected to the grid. The electric vehicle could provide power when the energy infrastructure needs additional power. However, some respondents argued that this is not possible at the present time. This makes this topic related to the battery durability, for if the battery could be safely charged and discharged without causing too much of a loss to the durability of the battery it might become an interesting option.

Availability of suppliers

Some of the respondents stated that at the time it was still needed to have different cards to be able to charge the electric vehicle at different charging stations. However, during the interviews many of the respondents stated that eventually it should be possible to receive energy from a large number of different suppliers at a charging station. One of the respondents stated that there was an idea to develop a model, based upon the provider model used by banks and mobile telephone service providers, to allow users to switch to a provider they want to use.

The financial system of charging

During the interviews a number of topics related to financial aspects of the charging system were discussed. The first category of topics discussed the financial risks that are involved in developing the charging infrastructure for the electric vehicles. Some of the respondents stated that the energy and distribution companies should be responsible for constructing and maintaining the public charging stations. Some of the respondents stated that local governments are responsible for construction and maintenance of the infrastructure. However, in the current phase of the development process local governments could stimulate developments and the introduction of the electric vehicle by placing charging stations and thereby splitting the financial risks. One of the respondents also discussed that the Dutch government should be responsible for constructing fast charging stations due to the enormous investment costs.

Energy costs & payment

As previously mentioned some of the respondents stated that a model is being developed that could be based upon the provider model. However, as other respondents stated there currently is no working model. When looking at the payment model the respondents agree that the model should provide an easy and transparent form of payment using one universal card that allows charging at all of the public charging stations. Other respondents suggested that there would be no need for a card, due to the fact that the electric vehicle could easily be equipped with electronics to identify the car when connected to the charging stations. One of the respondents also stated that currently it is not possible to request a charging card for example for the charging locations in one city if you are not living in that specific city thereby excluding the charging locations for visitors. The current energy costs are very low. According to some of the respondents most of the card holders pay a flat-fee to use the card and the electricity that is used to charge the vehicle is free. Some of the respondents argue that the price of energy that is used to fuel electric vehicles would possibly increase to regular energy prices and might even increase further due to additional consumer taxes.

These results lead to the following topics that are related to the different aspects of the fuel infrastructure.

- The compatibility of the charging connector of the EV
- The visibility of the charging connector of the EV
- The duration of the charge cycle
- The simplicity of the charging method
- Focus on charging method:
    - Fast charging
    - Standard charging
    - Induction charging
    - Battery swapping

- The maturity of the charging methods
    - Fast charging
    - Standard charging
    - Induction charging
    - Battery swapping

- The location of charging
    - Work/companies
    - Parking garages
    - At home
    - Public parking spaces
    - Specialized central charging stations

- The number of private charging locations
- The number of public charging locations
- The quantity of sustainable energy
- The location of energy generation
- The capacity of the energy infrastructure on neighborhood level
- The general capacity of the energy infrastructure
- The need for intelligent systems to regulate energy demand
- The storage of sustainable energy
- The availability of suppliers
- The distribution of financial risks in a system of decentralized charging
- The level of financial risks in a system of decentralized charging (standard charging)
- The distribution of financial risks in a system of centralized charging
- The level of financial risks in a system of centralized charging (fast charging)
- The price of energy
- The simplicity of payment
- The compatibility of payment systems

Production system and industry development

During the interviews also topics concerning the production system and the EV industry were discussed. Two general areas of interest can be distinguished when talking to the different respondents, namely the topics concerning the development and production of the electric vehicle and the development direction of the supporting industry that is related to the electric vehicle.

Production of the electric vehicle

In the interviews a number of respondents discussed the current market and production situation of the electric vehicle. Some of the respondents agreed that the current demand for electric vehicles does not match with the supply of electric vehicles. The first mismatch that was discussed was the general production capacity of the EV producers. It was discussed that the production capacity that is available and used for electric vehicles is currently very limited, resulting in a limited supply of electric vehicles. This would suggest that production on a larger scale would be desirable. However, as discussed during the interviews, some car manufacturers are already planning to introduce electric vehicles on a larger scale which would require an increase in production capacity. The production capacity is strongly related to the demand for electric vehicles which has to be sufficient to stimulate the manufacturers of electric vehicles to invest in an increase of the production capacity.

The models of electric vehicles

The second mismatch could be found when discussing the models of electric vehicles that are available. Some of the respondents discussed that the current electric vehicle does not appeal to the potential group of first adopters. Some of the respondents stated that the first group of adopters of the electric vehicle would be organizations and companies. While a large number of electric vehicles currently focus on consumers and marketing the vehicle as being a nice second car. However, as discussed by some respondents, the current electric vehicle is too expensive to appeal to the consumer as being a second car. Besides the mismatch of the model of the electric vehicle, there could also be a mismatch between the supply and demand of the electric vehicle when looking at the different models that are available. As discussed in the interviews, the current diversity of electric vehicles is very limited. Some even discussed potential buyers that were not being able to purchase a vehicle that would fit their needs due to the electric vehicle of a specific brand or design not being available.

Industry development

When looking at the topics that were discussed, a number of topics concerned the focus of the industry and the opportunities that the Dutch industry could experience due to the introduction and development of the electric vehicle. The respondents discussed a large variety of opportunities. The Dutch industry could develop to become a specific testing-ground for the introduction of the electric vehicle. This will result in the Netherlands becoming an interesting place to study how electric vehicles would be implemented in a country. Some overlap can be found with the other opportunities that were discussed that related to the focus on knowledge creation.

The Dutch industry could focus on creating knowledge on the implementation of the electric vehicle, safety measures, but also on the technologies behind the electric vehicle and the development of the components needed to build an electric vehicle. The third opportunity was discussed in terms of not

only creating the knowledge for EV-automotive parts but also developing and producing the components for large EV manufacturers, this option was mentioned by a large number of respondents. Besides producing the parts some respondents also discussed a fourth opportunity, which was the development and production of complete EV's by the Dutch industry.

Another opportunity that was discussed by a number of respondents was the development of a large specialized recycling industry. With the introduction of the electric vehicle, the need for a high quality recycling industry could arise, where EV wrecks and batteries can be processed. The respondents discussed that there would be opportunities for the Dutch industry to use knowledge and ensure that most of the parts get recycled using a high quality recycle industry.

During its lifetime the electric vehicle has to be charged on a regular basis. Therefore a number of respondents discussed that the Dutch industry could play a major part in the industry that focuses on the development of the charging infrastructure for electric vehicles. Various projects are already in progress to gain knowledge and perform tests with a number of charging methods. The Dutch industry can therefore develop a wide knowledge base on the different charging methods. Besides the method of charging there is also the need for a method of figuring out where to place the different charging locations, what they should look like and how the system will function in densely populated areas.

Besides the development of an industry for the energy infrastructure a number of other complementary industries were mentioned by the respondents. Some of the respondents mentioned the development of lease products to support the electric vehicle while others discussed the development of additional services like alternative means of transportation, assistance with requesting access to charging infrastructure, supporting the development of charging infrastructure for customers, financing the vehicle and monitoring its use and value over time.

The main consensus amongst the respondents was that the Dutch industry could find some opportunities in providing a testing ground for the introduction of the electric vehicle, developing parts for the electric vehicle and in creating knowledge to support the development of the electric vehicle in general. The other areas of interest (recycle industry, production of EV's, charging industry, supporting services) that could provide opportunities for the Dutch industry were not mentioned or agreed upon by a large set of respondents but were mentioned by only a few respondents.

These results lead to the following topics that are related to the different aspects of the production system and industry development:

- The production capacity of producers of EV's
- The development of other models (larger models, smaller models)
- The diversification of EV models (Broader range of models)
- Industry opportunity directions
    - Testing-ground
    - Knowledge creation
    - Development and supplier of electric vehicle-automotive parts

- Development of additional service markets for electric vehicles
- Development of recycling industry for batteries
- Development of charging infrastructure industry
- Development and production of EV's

The maintenance and distribution network

The next area of interest discusses the topics that concern the maintenance and distribution of the electric vehicle. The first set of topics that were discussed during the interviews concerned the levels of expertise of the different industries that are involved with the maintenance of electric vehicles.

The need for maintenance

The general need for maintenance of an electric vehicle was discussed by a few respondents. They mainly agreed that the general need for maintenance of an electric vehicle will be lower than the maintenance requirements of a conventional car. The level of difficulty of the maintenance, however, was experiencing some levels of misalignment. In general some respondents argued that the maintenance of an electric vehicle is fairly easy. Where other respondents discussed that the maintenance of an electric vehicle can be very difficult especially the maintenance of the battery packs.

Expertise levels

Another topic was the expertise level of maintenance companies. Some misalignment issues could be seen when looking at the interview results. Where some respondents stated that there were a sufficient number of mechanics that had a fair level of expertise with regards to electric vehicles, there were also other respondents that stated that the expertise was lacking and that more expertise was necessary. Besides the expertise of maintenance companies, also the expertise of "on-road" maintenance companies was discussed by a few respondents. Only a very limited number of the respondents stated that there is a need for an increase of the expertise levels of the "on-road" maintenance companies. The expertise levels of the emergency services were also discussed. This topic was discussed fairly often and the general consensus was that there should be an increased effort to develop knowledge and gain experience among the emergency services with respect to electric vehicles.

Maintenance companies

The topics that were discussed, mainly focused on the companies that would be performing the regular maintenance of the vehicles. A few of the respondents discussed the number of maintenance companies that are available to the owners of electric vehicles. They stated that currently the maintenance infrastructure is limited and is still in its startup phase. They also stated that it is likely that the maintenance infrastructure will rapidly develop when dealerships start selling the EV on a larger scale.

Besides the number of maintenance companies, there also was a discussion of the location where the maintenance should take place. A few respondents stated that the maintenance should take place at the dealerships; also some other respondents stated that the consumer/buyer would like to buy their electric vehicle at a well known dealership of the manufacturer. A few other respondents,

however, discussed that at the moment the costs for providing maintenance services for electric vehicles is very high which makes it efficient to combine maintenance services into one specific company during the start up phase. Therefore splitting the dealership and the maintenance part of the electric vehicle becomes more and more common.

The distribution network

As discussed in the previous paragraph, it was stated that the consumer/buyer wants to buy their EV from a well known dealership. A general form of consensus could be found when looking at the need for the conventional dealer infrastructure to support the introduction of the EV. Some of the respondents also argued that large manufacturers should focus more on the introduction of the EV. Furthermore, a small number of respondents stated that the conventional dealer network would be interesting for consumers, where new dealer infrastructures would mainly be used for selling to companies or organizations. As one of the respondents stated, the use of conventional distribution network will lead to higher diffusion and acceptance of the EV technology.

The dealerships and the manufacturers also supply the public with information about their electric vehicles and potential buyers become interested. However, one of the respondents stated that the user often does not know where he/she is able to purchase an electric vehicle and that there is general need for more publicly available information about EV's and the places where they are available.

These results lead to the following topics that are related to the different aspects of the maintenance and distribution network

- The level of expertise
    - Level of expertise of maintenance companies
    - Level of expertise of road service companies
    - Level of expertise of emergency services

- The number of maintenance companies
- The location of maintenance companies
- The need for maintenance
- The level of information about EV's
- The use of the conventional car distribution networks

Societal contribution and symbolic meaning

The contribution of the development and introduction of the electric vehicle can be very diverse. In the interviews a large number of potential contributions to society of the electric vehicle were discussed. The main topics could be divided in the contributions to the environment and the contributions to the economy.

Environmental contribution

The environmental contribution is one of the most discussed topics related to the electric vehicle. The general consensus is that the electric vehicle should contribute to an improvement of the

environment. One of the topics that were discussed was the contribution to the reduction of noise. The electric vehicle produces less noise when compared to conventional vehicles. However, the main source of this potential contribution comes from a lower level of engine noise. According to the respondents this noise is only dominant at lower speeds. At higher speeds the main sources of noise would be the tires and rolling mechanism. The noise reduction therefore would only be significantly in urban environments where vehicles travel at slower speeds.

One of the other contributions to the environment, according to the respondents, is the improvement of local air quality. The electric vehicle does not produce any emissions when driving. This results in a way to improve the air quality at specific locations. During the production of the electric vehicle and the generation of the energy used to charge the electric vehicle, emissions could still occur. However, this depends on the production process and the type of energy that is being used to charge the vehicle. This leads to the third contribution to society.

As stated before the general consensus among the respondents is that the electric vehicle could and should provide a contribution to the improvement of the environment. Some respondents see the electric vehicle itself as a way to reach sustainable mobility. Other respondents stated that the electric vehicle is a way to open up a large number of new possibilities to reach sustainable mobility due to the nature of electric vehicles and its fuel being electricity which would lead to a shift of the problem from the user to the producer of the energy. Another potential contribution could be, according to some respondents, that the electric vehicle could stimulate the development of sustainable energy in the Netherlands in general. According to the respondents the electric vehicle could bridge a gap between fossil fuels and sustainable energy. Instead of competing with standard electricity prices, the price for sustainable energy could now be competing directly with fossil fuels that are used for vehicles, which would lead to a beneficial scenario for sustainable energy due to the higher taxes on fossil fuels.

Economic contribution

The respondents also discussed topics that concern the economic contribution of the electric vehicle. According to a number of respondents the electric vehicle would result in a reduction of fossil fuel consumption in general. This would lead to an increased independence of oil producing countries, which could have a positive effect on the economy by lowering the demand for fossil fuels. Besides the economic effects related to the reduction of fossil fuel consumption, a small number of respondents also discussed the potential positive effect on the dutch automotive industry that provides parts for electric vehicle to producers of electric vehicles in other countries.

Symbolic meaning

The electric vehicle also has some symbolic meaning to the user and its environment. A large number of respondents discussed that the current form of the electric vehicle does not have the right image and does not symbolize the right set of values. The respondents were asked what the electric vehicle should symbolize. A large variety of answers were found. Some answers were only given by a very small number of respondents and sometimes even only one respondent used a specific description of the symbolic function of the electric vehicle. Some of the rare answers for example were, the uniqueness, being a functional vehicle, symbolizing enjoyment and ease of use. Other answers were

more common and were discussed by multiple respondents. Some respondents discussed that the electric vehicle should symbolize speed and that the current electric vehicle is often associated with a slow method of transportation. Some discussion occurred on the topic of sustainability. Some of the respondents argued that the electric vehicle should symbolize sustainability. Other respondents argued that sustainability is important, however, that it should not be a dominant factor, for it would not be the main reason for users to buy an electric vehicle.

Status symbol

Besides the role of being a symbol for sustainability, the role of being a status symbol was also discussed. Some respondents discussed that the conventional car is a status symbol. Some of the respondents argued that people should want to be seen in an electric vehicle. Some of the respondents argued when discussing the topic of the usage of the electric vehicle that people should focus less on owning vehicles but more on the use of a vehicle. It could be argued that owning a vehicle and the vehicle increasing your status is related, for it could represent your financial and social status. This would mean that some of the respondents could argue that the electric vehicle should not necessarily increase a person´s status or that a person´s status is not related to the ownership of a specific vehicle.

Financial symbol

Strongly related to the issues concerning status, there are the issues concerning financial symbolism. A number of respondents discussed that the electric vehicle should be a financially sound decision. However, they also argue that the electric vehicle should not be strongly connected to being a cheap alternative. This would mean that when someone is considering buying an electric vehicle, it should be associated with being an attractive alternative from a financial perspective but when actually driving the vehicle it should not be associated with the owner being cheap.

Symbol of freedom

Some of the respondents also discussed the topic of freedom. The respondents argued that the electric vehicle in its current form could be perceived by the user as hampering their freedom due to the limited range. People want to be able to experience the freedom of mobility as discussed by a number of respondents. However, as one of the respondents also discussed, the experience of a user feeling limited in his/her freedom of movement can also be caused by a limited perception of the alternative ways to travel. For example the respondent discussed the awareness of users to be able to use other modalities for their mobility purposes. This also relates highly to the topics concerning user practices.

Design style

A number of respondents also discussed attributes of the style of the electric vehicle that can be related to what an electric vehicle should symbolize. Some of the respondents discussed that the electric vehicle should symbolize a modern way of transportation and being high-tech. Other attributes that were also mentioned were for example, being cool and sexy.

These results lead to the following topics that are related to the different aspects of the societal contribution and symbolic meaning.

- The contribution to air quality
    - The level of air quality
    - The distribution of emissions
- The contribution to reduced noise levels in urban environments
- The contribution to sustainability
- Economic dependency on foreign countries for oil
- Economic growth in Dutch industry
- Symbolic properties of the EV:
    - Uniqueness
    - Speed
    - Sustainability
    - Status
    - Financial
    - Easy to use
    - Freedom
    - Enjoyment

User practices and the market

During the interviews topics were discussed that related to the user practices of the users of the electric vehicles and the development and structure of the market in which the electric vehicle is developed. First the results from the interviews concerning the user practices will be discussed.

Use of mobility

The respondents discussed many topics concerning the use of mobility and the role of the electric vehicle in the need for mobility. The majority of the respondents stated that the electric vehicle should be perceived as being a part of a larger system of modalities, were users would combine different modalities to travel from point A to point B. They also stated that users should be made aware of the possibilities to travel with other means of transportation. Other respondents, however, stated that the electric vehicle for example should not be combined with public transportation, for the price of an electric vehicle is relatively high and after paying such a high price it would not be appealing to the user to be expected to travel using another modality. This directly leads to the next topic.

Flexibility of modality choice

The general consensus among the majority of the respondents was that the respondents found that the electric vehicle has to be linked to other modalities. The reason for this is to reduce the perception that an electric vehicle would reduce your freedom and flexibility. These respondents described that they thought it to be important to emphasize towards the users that people should become more flexible in choosing their mode of transportation and chose the right modality for the right mobility needs.

Ownership of the electric vehicle

Some of the respondents discussed the role of the ownership of an electric vehicle. A large number of respondents discussed that in the future users would have to focus on paying for using a vehicle instead of paying to own a vehicle. This could lead to a more flexible approach to traveling, and using other forms of mobility. As some respondents discussed, it would allow for the user to lease or hire a specific vehicle to go on vacation with his/her family and hiring a smaller vehicle for the rest of the year to go to work. The respondents also discussed the role of car-sharing to focus on buying mobility instead of a vehicle.

The demand for mobility

With the introduction of the electric vehicle some might be worried that the demand for mobility will increase and therefore the energy consumption in general would increase. In general the consensus was that the demand for mobility should be decreased as much as possible to reduce the general energy consumption. The general perception of how mobility should be used has to change according to a few respondents. A few of the respondents do not think that the electric vehicle would increase the demand for mobility substantially. However, some of the respondents do think that the electric vehicle could introduce a change of the way how mobility is used.

Perception of mobility needs

Some of the respondents discussed during the interviews the user's perception of the need for mobility. These respondents discussed that the consumers of mobility in general have a distorted image of what they really need when they look for a new vehicle. The demands are usually not matched with the real use of the vehicle. This topic shows a dilemma. The user demands are not realistic and the result is a mismatch between the user's demands and the properties of the technology (the electric vehicle). Some of the respondents suggested that the key to this mismatch is making the users aware of their unrealistic demands and making them more conscious about their true needs. Other respondents, however, stated that it might not be possible to solely depend on the ability to influence user needs and that the technology should try to develop towards the "unrealistic" user needs to increase the chances of acceptance or even a combination of increasing user awareness and trying to reach the current user demands. This topic showed a dilemma between what the ideal situation should be and what is achievable in practice.

The electric vehicle and the use of mobility

During the interviews the respondents discussed a number of topics that were related to the position of the electric vehicle in the mobility system and the total demand for mobility. The general consensus was that the electric vehicle in general should not be expected to be used for traveling to several vacation destinations or, for example, traveling with caravans. While some of the respondents stated that the electric vehicle should be able to be sufficient to deal with almost all of the mobility needs in the Netherlands. Other respondents, however, stated that the electric vehicle will probably be able to deal with only a part of the mobility needs in the Netherlands. This shows some level of misalignment. Besides the demand for mobility, another part of the position of the electric vehicle in the demand for mobility was discussed. The electric vehicle can for example be used as primary car or secondary car. Some of the respondents stated that the electric vehicle should mainly be used as primary car. In this case also a small misalignment could be discovered, because

some other respondents stated that the electric vehicle should be used as secondary car and in some situations it might even suffice as primary car.

The costs of an electric vehicle

A number of topics that concern the financial aspects of the electric vehicle were discussed. The main consensus on this area could be seen when looking at the responses on the costs for purchasing an electric vehicle. All of the respondents agreed that the electric vehicle is currently too expensive. One of the respondents, however, also stated that the costs should be lowered, though the costs are not too high for the potential first adopters of the electric vehicle. The majority of the respondents stated that the electric vehicle should be cheaper than the conventional cars. The main reason for this is that some financial slack is needed to be able to purchase additional mobility services to be able to bring the total mobility capabilities of the electric vehicle with additional mobility services on par with the conventional car. A few respondents, however, stated that the electric vehicle could be more expensive than a conventional car. This was mainly supported by claiming that the electric vehicle in the end would be cheaper due to the lower operational costs and additional benefits for the environment. These different statements on this topic result in a mismatch for the goals of cost reduction of the electric vehicle.

The costs of owning an electric vehicle

The majority of respondents agreed that the electric vehicle is cheap to operate. The financial benefit, however, is strongly related to the answers on the pricing of energy. Some of the respondents stated that the price of energy would be likely to increase. This would mean that the operational costs for the electric vehicle would increase. If the price of the electric vehicle does not drop this could lead to a significant increase of the total costs of ownership of the electric vehicle. This means that there is no direct misalignment when looking at the current operational costs of the electric vehicle. However, the answers on the energy price topic suggest that some of the respondents might favor to increase operational costs.

Uncertainty of the value of electric vehicles

Besides the costs of the electric vehicle, another important topic that was discussed was the uncertainty of the value of the electric vehicle over time. As some of the respondents stated during the interviews, the change of the value of electric vehicles is highly uncertain. Some steps have been taken to try and monitor the value of electric vehicles over time. A large number of respondents indicated that the durability of the battery is not high enough. This could indicate that the majority of the uncertainty of the value is related to the battery and the way the battery is used during its lifetime. As previously discussed in this chapter ideas have been discussed to separate the vehicle and battery in the purchase process. This would mean that the user for example could lease the battery. This would require a significant amount of data and monitoring to develop a method to accurately value a battery and determine lease prices. The development of such a system is therefore interesting to specific organizations in the system which could explain why this topic was only discussed by a small number of respondents.

User awareness

A number of topics that were discussed in the interviews were topics that concern the user awareness. The first topic that was discussed concerned the user awareness of how to use an electric vehicle. Some of the respondents discussed that the user should be made more aware of what the user should expect from an electric vehicle and what the restrictions and possibilities of an electric vehicle are. According to the respondents the user should not perceive the electric vehicle as being a restriction of his/her mobility but rather change the perspective on the use of mobility and become more flexible in choosing different modalities to fit his/her current needs for mobility.

Some respondents discussed that besides becoming aware of how to use an EV, the user might also have to become aware of the true need for mobility. The user should be able to decide what modality to use based upon the realistic need for mobility. For example often users tend to think they need to travel further than they actually need to. To be able to make a good decision it is necessary to develop an accurate view of the necessary properties of the modality. So users have to become aware of what the electric vehicle can do and become aware of what they might need. They might also need to develop an understanding for the costs of their current methods of traveling to be able to make an accurate comparison with the electric vehicle. A few of the respondents discussed this last topic and stated that users should be made more aware of the costs of their current form of mobility. In this case a slight misalignment could be found when looking at the importance of this topic. Only one of the respondents stated that these changes in user awareness would be more important than technical changes. This might indicate that there might be a misalignment when looking at the urgency levels that the respondents experience when talking about these topics. Where some respondents stated that the user will have to adapt to the electric vehicle, other respondents stated that the user at least should experience the electric vehicle as being as close to a conventional car. This implies that the result should be an experience that resembles the satisfaction the user has when using a conventional car. However, it does not state how this should be achieved. The user might have to adapt to the technology or the technology to the user or a combination.

Reliability of mobility

Some respondents discussed the reliability of electric vehicles. The vehicle itself is fairly reliable, however, a lack of charging or a lack of battery capacity can result in problems for the driver. As stated by some of the respondents, the user has a need for additional services to guarantee their mobility. This reliability and guarantee is necessary to persuade users to start using an electric vehicle, according to some of the respondents.

User experience and user feedback

To be able to develop a technology further a certain amount of user feedback can be necessary to be able to improve the product. As the different respondents state more effort has to be undertaken to gain additional insights in the user experience of the electric vehicle. As one of the respondents stated: “The user will decide if it will be successful…”. In this phase it is important to gather as much information as possible according to the different respondents. This topic has a fair amount of alignment, because all of the respondents that discussed the user experience of the electric vehicle stated that it was necessary to gather additional information about the user experiences.

In the next part the topics will be discussed that concern the market structure or market development of the industry of the electric vehicle.

New entrants to the market

To ensure new input and new ideas it might be interesting to look at the possibilities for new entrants to the market. The new entrants and their possibilities in the market are only discussed by a few of the respondents. A small number of respondents state that there are good opportunities for new entrants for developing and producing new electric vehicles. The other respondents state that the financial risks are too high for starting businesses. This shows two forms of misalignment. The first form is that the topic is only discussed by a limited number of respondents which could mean that the other respondents do not perceive this topic to be important. The other form of misalignment is the perception of the level of financial risks and opportunities in the market.

Market structure

Some topics were discussed that concern market strategies and the market structure. The first topic that was discussed was the role of lease companies. Some respondents stated that it will be possible that lease companies will become increasingly important for the introduction of electric vehicles. Lease companies can develop additional services to complement the electric vehicle. The lease companies can also be used to mitigate the financial risks on the battery packs for the users of electric vehicles. There is a fair level of alignment on possible new roles for lease companies.

The market can be demand driven or supply driven. Some respondents stated in the interviews that the focus is too much on supply driven strategies. These respondents argued that a lot of investments are being done too soon while there is no clear demand for it. Other respondents argued that these investments are necessary to stimulate the demand. This shows that there is some form of misalignment that occurs on this topic.

Related to the previous topic is the topic of governmental influence. Some respondents argued that by stimulating development in a specific direction, it could occur that an inferior solution will be used due to the time pressure. For example by stimulating the development of public charging stations in a specific format, the industry could conform to that as it being the dominant design which could result in the hampering of the development of other technologies or designs. Other respondents, however, stated that some influence from the government is needed to direct and align different efforts of all the different organizations that are involved. This shows that there is a fair level of misalignment that can be observed.

Market strategies and focus

Besides the market structure there is also the market strategy and focus of the activities in the market. A number of topics that were discussed in the interviews are related to this area of interest. The first topic that was discussed was the geographical focus of the introduction of the electric vehicle. The main consensus is that the electric vehicle will be very interesting for usage in urban areas and large cities. One of the respondents explained that the electric vehicle can be seen as a modality for use inside cities and other technologies (hydrogen/hybrid or diesel) for mobility outside the cities. Besides the geographical focus also the mobility motive was discussed which was highly

related to the geographical focus. Some respondents argued that the electric vehicle would be suited to be used as primary car for home-to-work mobility or even work related mobility. Other respondents, however, argued that the electric vehicle could also be used as secondary car.

At the present time one of the main questions is: Who should be targeted first? Some of the respondents discussed that there are a number of interesting users for electric vehicles, namely consumers, lease drivers and work related mobility (for example maintenance crews). Some respondents argued that consumers are an important group of users. Other respondents, however, argued that consumers should not yet be targeted for the focus should be with large fleet owners that can deal with the monetary and operational risks of electric vehicles.

Market activities

There is also the issue of what the market should do and which activities should be undertaken. A large number of respondents argued that the market should focus on a specific activity. However, the activities that should be undertaken varied somewhat. The different respondents discussed a number of possible activities ranging from focusing on testing and starting pilot projects to commercialization and final implementation of the electric vehicle. The main differences could be seen as differences in the perception of the development phase. Where some respondents mainly want to focus on gathering more information and testing, other respondents argued that the focus should be on informing consumers and implementing the electric vehicle in society.

Other technologies

The respondents also discussed other technologies. The respondents formed a general consensus on the idea that other technologies should be further developed to complement the electric vehicle. The main mismatch that could be found on this topic was the motives for investing in other technologies and the technology that should be invested in. Some of the respondents argued that hydrogen technologies should be developed, while others stated that the prospects for hydrogen technologies are not perceived to be very promising. Another technology that was discussed was bio-fuels. Some respondents argued that the use of electric vehicles for mobility and transportation purposes are limited and that bio-fuels should be used to fuel the remaining vehicles. Also the technology for (plug-in) hybrid vehicles was discussed. This technology was perceived by some respondents as being the solution to bridge the gap between conventional vehicles and electric vehicles and increase acceptance rates. Some of the respondents also discussed the final situation being a mix of different technologies that would provide a sustainable mobility system.

When looking at the motives for the development of other technologies, a number of different motives were discussed. As discussed in the previous paragraph some technologies are perceived as being useful to complement the electric vehicle by developing a sustainable mobility solution for the parts of the demand for mobility where the electric vehicle could not provide this. Another reason for developing other technologies could be to develop a successor for the electric vehicle (for example the hydrogen vehicles). The third category of motives found for development of other technologies, were motives related to the development of technologies that could facilitate and assist the acceptance and development of electric vehicles. In this case the use of plug-in hybrids was suggested. The last motive for developing other technologies was related to keep developing the

technologies that are used in conventional vehicles to also reduce the impact on the environment of the vehicles that are still in use.

The standardization process

In the interviews the respondents discussed topics related to the standardization process of the electric vehicle and the charging infrastructure. Two categories of topics could be distinguished, namely the speed of the standardization process and the level of standardization. These topics, however, are highly related for the level of standardization is the result of the speed of the standardization process and time. A small number of respondents argued that the standardization process was moving too fast. The respondents stated that by moving at a fast pace it could be likely that technological options were selected that could prove to be inferior. It was argued that the need for standardization was not very high while some categories of organizations were pushing for even higher levels of standardization. Other respondents, however, argued that standardization was very important and that it is needed for a successful use of the charging infrastructure. This shows a mismatch that is mainly based on the level of urgency of the standardization process to take place.

These results lead to the following topics that are related to the different aspects of the user practices and the market.

- Combination of modalities in the use of mobility
- The flexibility of choosing different forms of mobility
- The role of ownership in the use and need for mobility
- The level of use of mobility
- The level of awareness of mobility needs
- The position of the EV in the total demand for mobility (replacing part of mobility)
- The position of the EV in the users demand for mobility (primary car, secondary car)
- The costs of buying an EV
- The costs of owning an EV
- The uncertainty of the value of the EV over time
- The user awareness of how to use an EV
- The user awareness of the costs of current forms of mobility
- The user awareness of the need for mobility
- The need for guarantee and reliability of mobility when using an EV
- The need for change of user needs
- The need for user-feedback of EV usage
- The need for more user experience with EV's
- The risk level for new entrants to the market
- The possibilities for new entrants to the market
- New roles for lease companies with regards to EV's
- The market strategy (demand driven, supply driven)
- The influence of the government (facilitating, controlling)
- The geographical focus of the EV market (urban areas, big cities)
- The mobility motive focus of the EV market (home-to-work, work related mobility)

- The user focus of the market (companies, consumers, fleet owners)
- The activity focus of the EV market
    - Pilot projects monitoring and testing of the EV
    - Standardization of charging infrastructure
    - Commercialization of EV's
    - Implementation of EV's
- The use and investment in other technologies for mobility
- The speed of the standardization process
- The level of standardization

Regulations and policies

In the interviews a number of topics were discussed that were related to regulations and policies. The topics that were discussed in the interviews can be sorted into two categories of topics. The first category that will be discussed includes the topics concerning the stimulating measures. The second group that will be discussed, concerns the topics that are related to regulations and policy creation.

Stimulating measures

The respondents discussed a number of topics that are related to the efforts of the government to stimulate actions and developments in society. The first topic that was discussed was the general need for stimulating measures. The general consensus among the respondents was that stimulating measures are necessary for a successful start of the introduction of electric vehicles in the Netherlands. A large number of respondents also added that stimulating measures should not be used indefinitely. The use of stimulating measures should be reduced over time as the system develops. Some respondents argued that stimulating measures will create new market opportunities. The general need for stimulating measures was shared across the majority of the respondents, however, in the interviews it also became clear that there are still a number of potential problems when looking at the stimulating measures that are currently in use.

Complexity and efficiency of stimulating measures

One of the issues that were discussed by a significant number of respondents was the complexity of the stimulating measures. These respondents argued that there are too many different measures which results in a complicated situation. According to the respondents this, for example, often results in long and complicated procedures to acquire subsidies. Another topic that was discussed often was the efficiency of the different stimulating measures. A large number of respondents argued that the stimulating measures often do not have the desired effect or do not focus on the right actor groups or activities. One of the respondents for example discussed that stimulating measures do not focus on consumers while they should. Another respondent discussed that stimulating measures should focus on developing infrastructure, implementation and the commercialization of the electric vehicle instead of solely focusing on research and development and the production of knowledge. A number of respondents discussed that the stimulating measures often do not have the desired effect. Due to the large set of different stimulating measures the efficiency of the stimulating measures can decrease which is further discussed in the next paragraph.

Integration of stimulating measures

A fair number of respondents discussed the integration of stimulating measures. These respondents discussed that there is a need for a more integrated set of stimulating measures. The current policies and regulations only distinguish a limited number of vehicle types. The limited categories of vehicles and the large complexity and number of stimulating measures could result in a diesel car acquiring more stimulation from the government than an electric vehicle which is not as it was intended according to the respondents. This could be addressed by adding additional categories in the stimulating measures for different vehicle types and integrating the different stimulating measures to ensure that the correct amount of stimulation is given to areas in which it is intended.

Focus of stimulating measures on specific users

As previously discussed the respondents discussed that stimulating measures are needed, however, they do not always focus on the correct target group of users. The respondents were asked to state which group of users should be targeted by the stimulating measures. A diverse set of answers were given. The respondents discussed three different groups of potential users that could be targeted by stimulating measures. Some respondents discussed focusing on companies that own a large number of vehicles for these companies are, according to the respondents, the first potential group of users of electric vehicles for testing and development and consumers should not be the main focus at the present stage of development of the electric vehicle. Other respondents discussed that the stimulating measures should focus on consumers, for this group of users could require assistance due to the more limited financial resources of consumers. The first consumers are argued to provide valuable information that is needed to ensure higher rates of acceptance of the electric vehicle in the future. The last potential group on which stimulating measures could focus was argued to be the users of lease cars. Lease companies can be valuable partners to reduce the financial risks and monitor the development of the value of electric vehicles. Some respondents also discussed that the current stimulating efforts are focusing too much on the drivers of lease cars. This shows that there are a number of different groups that could be the focus of stimulating measures and that there is some misalignment on this topic when looking at the answers from the different respondents.

Focus of stimulating measures on activities

Besides the focus of stimulating measures on specific users, the stimulating measures can also focus on specific activities in the market. When looking at the answers given by the respondents a number of activities can be distinguished. In total four categories of activities could be distinguished from the answers given in the interviews. The first category contains activities related to the development and distribution of knowledge. Some respondents argued that more R&D is needed to develop battery technologies further. Other respondents, however, discussed that stimulating efforts should focus less on research and development efforts and focus on the other activities that concern the second category of activities. The second category of activities concern activities related to the commercialization and distribution of electric vehicles. Some respondents argued that while a number of people want to drive an EV, the market for EV's is still limited and the brand or model that the user wants can often not be delivered without having to buy a standard model that was converted to become an electric vehicle. The other side of the market is related to the third category of activities. The third category of activities contains the activities related to the ownership and use of electric vehicles. Some respondents argued that stimulating measures should focus on persuading

companies and consumers to buy an electric vehicle and focus on gathering user feedback from users. The last category of activities, concern the activities that are related to the development of the charging infrastructure. Some respondents argued that the stimulating measures should focus on further developing the charging infrastructure and to reduce the financial risks of investing in the development of charging infrastructure. For example some respondents discussed the role of the government in a scenario of fast charging stations. Due to the high costs of these stations it might be needed for the government to play an important role in the development of fast charging stations. Other respondents, however, argued that the government should not get too involved in developing charging infrastructure, which is related to the topic about the influence of the government on the market, for the government might stimulate developments that are inferior. This shows that there are some levels of misalignment that can be detected when looking at the answers given in the interviews. The development of charging infrastructure can be stimulated in a number of different ways which do not always include the government having to place charging stations. On this topic the stimulating measures can include a large diversity of stimulating measures that are directed at developing the charging infrastructure that can range from facilitating processes to allow for a faster development of charging infrastructure to financing the construction of charging locations. In the next paragraph the role of the local government in the placement of public charging stations is discussed separately.

Local government and the development of charging stations

In the interviews some respondents specifically discussed the role of the local government in the construction of public charging stations as being a stimulating measure. A significant number of respondents discussed this topic, however, the opinions did not always align with each other. The majority of respondents argued that the local government should not focus on constructing charging infrastructure themselves but should facilitate and stimulate the process of developing charging infrastructure by organizations in the market. Some argued that at the moment there is no need for the government to get involved in the placement of public charging stations due to the limited number of electric vehicles, for the primary focus should be on companies and organizations that use electric vehicles. These organizations do not need public charging locations and it would therefore not be needed to start developing public charging locations at the moment. As discussed in the previous paragraph the government could also disturb the technological development by constructing charging locations which could be experienced as a set standard that the rest of the market will have to follow in further developments of the charging infrastructure. Other respondents, however, argued that local governments could develop charging stations to ensure that the development of the charging infrastructure progresses at a steady pace.

Incorporation of electric vehicles in local government

The next set of topics that are discussed concern the second group of topics which concern regulations and policy creation. A number of respondents discussed topics that are related to the incorporation of electric vehicles in local policy. Some respondents stated that there are significant differences between the different local governments in how they deal with electric vehicles. Other respondents stated that it sometimes is hard to find the person that is responsible for electric vehicle related issues at local governments, when for example trying to request the placement of charging infrastructure or trying to request permission for the placement of charging infrastructure. According

to the respondents it is often hard to come into contact with the right person to discuss how and where charging infrastructure can be placed. It often takes a long time before a charging station is placed and lobby efforts are necessary to prevent the process from slowing down even further. A number of respondents discussed the need for the development of policies to facilitate the electric vehicle by a larger number of local governments.

Policy development

Besides the need for local governments to develop policies to incorporate electric vehicles in their areas, there are also policy developments that could be needed to take place on a national level. The respondents in the interviews discussed three different sets of topics that are related to the creation of policy and regulations. The first set of topics concern the development of safety standards for electric vehicles. The majority of respondents argued that the safety of the electric vehicle is important. However, a smaller number of respondents discussed that there is a need for the government to start developing specific safety regulations for electric vehicles, for the current regulations are not sufficient. In the interviews it was also discussed that safety regulations will probably be further developed when large corporations are introducing larger numbers of electric vehicles in the market. The small number of respondents that discussed the safety regulations agreed that there is a need for further development of the safety regulations concerning the electric vehicle.

Besides the regulations concerning the safety standards for the electric vehicle, a small number of respondents also discussed a second set of topics that related to the development of policies and parking permits for electric vehicles. It was discussed that the current policies for parking permits are not sufficient to allow electric vehicles to park in large cities on specific parking locations. Electric vehicles need to park in specific charging spots to allow them to be recharged. However, the current parking permits in large cities do not give access to specific parking locations. To allow the electric vehicle to be parked on a specific location where other vehicle may not be parked would require new regulations to be created. Currently the law does not specify what an electric vehicle is so it is impossible to prevent other vehicles from parking on a location that is reserved for electric vehicles only.

Some respondents also discussed policy developments that do not concern the electric vehicle specifically. The third set of topics concern the payment for mobility in general. Some respondents discussed that the taxes for users of mobility should only be related to the use of mobility instead of owning a vehicle paying a fixed tax to contribute to maintaining the road infrastructure, which is currently the case. This policy, however, is not directly related to the electric vehicle but concerns all the vehicles that use the road. The policy can include special tax rates for cleaner vehicles, which indirectly concerns the electric vehicle and can result in being able to stimulate the use of clean vehicles. A number of respondents discussed this topic and showed a fair level of agreement. The other respondents, however, might not have discussed it because it is not specifically related to the use of the electric vehicle.

Regulations on the European level

Besides regulations that are developed on national level, there might also be a need for developments of regulations on a European level. Some respondents specifically discussed that the uniformity of the charging infrastructure should be discussed on a European level. This is even a step further, where other respondents stated that the uniformity does not even have to be taken care of at the present time on national level. It could , however, be suggested that a respondents do not think that the uniformity should be addressed at the present time, while stating that if it would be addressed that it should be addressed on a European level. This means that there is no clear alignment or misalignment that could be found on this topic.

Some respondents also discussed other regulations and standards on a European level that could influence the electric vehicle indirectly. These respondents discussed that by further developing the emission standards for vehicles, the acceptation of electric vehicles could benefit from stricter emission standards. Other respondents also discussed the general need for stricter emission standards, for the electric vehicle will take some time to be accepted throughout society, it might be still necessary to reduce the emissions that are generated by conventional vehicles. The majority of the respondents think that developing stricter emission standard on a European level will contribute to the development and acceptation of the electric vehicle in the Netherlands.

These results lead to the following topics that are related to the different aspects of the regulations and policies.

- The need for stimulating measures
- The complexity of stimulating measures
- The effect of stimulating measures
- The need for a more integrated set of stimulating measures
- The user focus of stimulating measures
    - Focus on company fleets
    - Focus on private consumer cars
    - Focus on lease cars
- The activity focus of stimulating measures
    - Knowledge development
    - Commercialization and distribution of EV's
    - Ownership and use of EV's
    - Charging infrastructure development
- The need for local governments to place public charging stations
- Incorporation of e-mobility in local governance structure and policy
- Policy creation
    - Safety standards
    - Parking permits for EV's only
    - Different payment for mobility
- Regulating uniformity of charging infrastructure on a European level
- Increasing strictness of European emission standards

V. Questionnaires, results and analysis

The quantitative dataset has been gathered using an internet survey. With the assistance of AgentschapNL a contact list was assembled to gather information on organizations that might want to take part in the survey. The total number of people that were contacted was 273. Approximately 126 people responded of which 104 finished the questionnaire. The complete dataset that had been gathered was used, so the incomplete questionnaires were used up to the point that they were left blank. This resulted in additional data points that could be used for analysis. Additional testing was done to check if this affects the outcome of the analysis and there was no significant difference between the analysis done with only the questionnaires that were fully completed and the unfinished questionnaires. The following table (table 3) shows the number of respondents for each of the categories of organizations.

	Organization categories						
	Prod.	***R&D***	***Gov.***	***Users***	***Financ.***	***Energy***	***NGO***
Number of respondents	27	29	33	8	6	11	12
Percentage of total	21.4%	23.0%	26.2%	6.3%	4.8%	8.7%	9.5%

Table 3. Frequency table of respondents

The number of respondents for each category varies. However, a low number of respondents can be expected for a category that in general consists of large organizations that are smaller in number. This does not mean that categories with a smaller number of organizations are less important. For example there might be only a handful of financial institutes that are actively involved with electric vehicles, which might be relative large companies.

The dataset consists of three sets of questions. The first set consists of the data gathered from the interval questions that used a scale of 1 to 5 (from disagree to agree). The second set consists of the data gathered using the multiple choice type of questions using a value 0 or 1 to determine if someone selected an option or not. The last set consists of data about the level of "no opinion/don't know" answers on a specific question where 0 means that they answered the question and 1 if they responded that they did not know or had no opinion.

Analysis interval questions

The first step is to look at the standard deviation of the different topics that were discussed using interval questions. The first analysis shows the following list of topics with the lowest standard deviation:

Question number	***Statement on the topic as stated in the questionnaire (1 = completely disagree, 5 = completely agree)***	***Mean***	***Std. Deviation***
7.27	The uniformity of the charging method should be dealt with on an European level	4.70	0.557
4.1	The level of expertise of maintenance companies of the electric vehicle is sufficient	1.66	0.676
7.10	It is important to spend additional attention on coordinating local policy initiatives	4.26	0.758
7.1	Stimulating policy is necessary for the introduction of the electric vehicle	4.50	0.770
2.16	It is important to spend additional attention on constructing charging infrastructure at the correct locations	4.34	0.783

Table 4. The low-standard deviation results of the analysis of the interval questions

Table 4 shows the topics from the questionnaire that experienced the lowest standard deviations of the topics when looking at all of the respondents in the dataset combined. This means that the answers given by each of the respondents on these topics were very similar. What is interesting is the fact that the mean values are not converging at a center value (value of 3.00) but are actually converging near the maximum and minimum values (values of 1.00 and 5.00).

The following results are the results for the topics with the highest standard deviation:

Question number	***Statement on the topic as stated in the questionnaire (1 = completely disagree, 5 = completely agree)***	***Mean***	***Std. Deviation***
2.25	Using the electric vehicle as an energy buffer to store sustainable electricity is a good idea	3.67	1.451
6.15	The user needs have to change for a better fit with the properties of the electric vehicle	2.79	1.423
2.1	Sufficient efforts have been under taken to ensure the uniformity of the charging connector of the electric vehicle	2.53	1.423
4.3	The use of the dealer infrastructure of conventional cars is necessary for the introduction of the electric vehicle	3.39	1.418
2.19	The capacity of the electricity infrastructure at the neighborhood level is sufficient for the upcoming years	3.37	1.403

Table 5. The high-standard deviation results of the analysis of the interval questions

The values in table 5 show the topics from the questionnaire that experience a relatively high standard deviation. This means that for these topics the different answers given by the respondents in the dataset are spread out and are not converging on a specific value.

The values from tables 4 and 5 show the level of deviation of the answers that were given by the entire population. The system can, however, experience a large population of organizations that support a specific perspective while a smaller population of organizations from a different category supports another perspective. When looking at the innovation from a systems perspective it is interesting to compare the alignment of perspectives corrected for the different categories of organizations, for collective action is required which means that if one category of organizations has a perspective that significantly differs from other actors it might hamper the total development of the system. The next analysis therefore compares the distribution of answers between the different categories of organizations. The data that was gathered was non-parametric data due to a non Gaussian distribution of the population; therefore non-parametric tests have to be used to determine if there is a significant difference between the answers given by one category of organizations and another category of organizations. The non-parametric version of an ANOVA was used, namely the Kruskal-Wallis test (Wonnacott T.H. and Wonnacott R.J. 1990). A confidence interval of 95% was used. The results of the Kruskal-Wallis test will provide a higher robustness when compared to the results from an ANOVA, because the Kruskal-Wallis test has no prior assumptions that the dataset has to meet.

The Kruskal-Wallis test showed that there were a number of topics of which the distribution of answers experienced a significant difference between the different categories of organizations that took part in the survey.

The topics that experienced a significant difference between the categories were:

Question number	***Statement on the topic as stated in the questionnaire***	***Sig.***
1.1	The current range of the electric vehicle is sufficient	0.000
1.7	The durability of the battery of the current electric vehicle is sufficient	0.031
2.1	Sufficient efforts have been under taken to ensure the uniformity of the charging connector of the electric vehicle	0.018
2.5	The time needed to charge an electric vehicle is too high	0.000
6.1	The electric vehicle should be able to fulfill the majority of the mobility needs	0.037
6.7	The electric vehicle should be combined with other modalities	0.011
6.10	It is important to spend additional attention on the effect of the electric vehicle on the total demand for mobility	0.043
6.28	It is important to spend additional attention on the influence and control of the government on the market of the electric vehicle	0.023
7.14	The focus of the current stimulating efforts are directed at the right activities	0.018
7.19	The local governments need to build charging infrastructure	0.033
7.22	It is important to spend additional attention on the development of safety regulations for electric vehicles	0.029

Table 6. Results Kruskal-Wallis test of distribution differences between groups

The values in table 6 show the topics that experience a significant difference in the distribution of perspectives between groups. This does include the center value of the distribution of the groups, but also the spread of the values within the groups is compared to other groups. This means that the analysis states that the categories of organizations experience a significant difference in perspectives on a certain topic or that the categories of organizations experience a significant difference in convergence of the perspectives within a group of organizations.

After having established that these topics experience a significant difference between the different categories of organizations, the next step is to determine which groups are at either side of the spectrum of answers. The following results show the mean values for each of the different categories of organizations and the standard deviation to show the internal spread of answers for each category of organizations.

		Organization categories						
Question number	Mean (Std. Dev) **Question from the questionnaire**	***Prod.***	***R&D***	***Gov.***	***Users***	***Financ.***	***Energy***	***NGO***
1.1	The current range of the electric vehicle is sufficient	3.38 *(1.308)*	2.70 *(0.912)*	2.16 *(0.808)*	**1.50** *(0.756)*	3.50 *(1.378)*	**3.56** *(1.333)*	2.33 *(1.118)*
1.7	The durability of the battery of the current electric vehicle is sufficient	2.88 *(1.166)*	2.59 *(1.098)*	2.33 *(0.856)*	**1.83** *(1.169)*	3.20 *(1.643)*	**3.78** *(0.972)*	2.57 *(1.272)*
2.1	Sufficient efforts have been under taken to ensure the uniformity of the charging connector of the electric vehicle	1.95 *(1.359)*	2.32 *(1.359)*	2.81 *(1.272)*	**1.67** *(1.211)*	3.33 *(1.366)*	**3.67** *(1.803)*	2.43 *(0.976)*
2.5	The time needed to charge an electric vehicle is too high	2.86 *(1.320)*	3.58 *(1.283)*	4.27 *(0.944)*	**4.43** *(0.787)*	3.17 *(1.472)*	**2.33** *(1.658)*	4.38 *(0.744)*
6.1	The electric vehicle should be able to fulfill the majority of the mobility needs	4.04 *(1.107)*	4.12 *(1.191)*	3.58 *(1.232)*	**3.17** *(1.169)*	**3.17** *(1.169)*	**4.56** *(0.726)*	3.29 *(1.380)*
6.7	The electric vehicle should be combined with other modalities	3.62 *(1.465)*	3.48 *(1.344)*	**2.97** *(1.295)*	3.83 *(0.753)*	**4.67** *(0.516)*	3.25 *(1.035)*	4.57 *(0.535)*
6.10	It is important to spend additional attention on the effect of the electric vehicle on the total demand for mobility	3.11 *(1.100)*	2.63 *(1.209)*	3.07 *(1.252)*	**2.40** *(1.140)*	**4.33** *(0.816)*	2.89 *(1.537)*	3.86 *(1.215)*
6.28	It is important to spend additional attention on the influence and control of the government on the market of the electric vehicle	3.95 *(0.785)*	3.64 *(1.049)*	**3.48** *(0.975)*	3.50 *(0.837)*	3.83 *(1.169)*	**4.78** *(0.667)*	4.00 *(0.816)*
7.14	The focus of the current stimulating efforts are directed at the right activities	2.59 *(0.959)*	2.91 *(0.921)*	3.09 *(0.848)*	2.75 *(0.500)*	2.50 *(1.049)*	**2.22** *(0.667)*	**3.71** *(0.488)*
7.19	The local governments need to build charging infrastructure	4.14 *(1.082)*	3.00 *(1.414)*	3.68 *(1.249)*	**4.40** *(0.894)*	3.33 *(1.211)*	**2.89** *(1.269)*	3.29 *(0.951)*
7.22	It is important to spend additional attention on the development of safety regulations for electric vehicles	**4.67** *(0.483)*	4.21 *(0.631)*	4.13 *(0.968)*	3.67 *(0.816)*	4.00 *(1.000)*	**3.56** *(1.014)*	4.40 *(1.342)*

Table 7. Overview descriptive data of significant topics by category of organizations

The values in table 7 show, for each topic, the categories of organizations with the mean values that are the furthest apart. The categories of organizations that were the furthest apart were underlined. The values vary between completely agree (value 5.00) to completely disagree (value 1.00).

Analysis of multiple choice questions

Due to the nature of multiple choice questions, a separate analysis had to be done. The answers given in the questionnaire were recoded to contain the value 0 or 1, where 0 means it was not checked and 1 means that it was. For each of the different answers the descriptive statistics show the means value between 0 and 1 (which is also directly related to the standard deviation). In the case that an answer that used the “other, namely” option, the data was excluded in this analysis and will be discussed separately.

These questions are analyzed using a similar setup as used in the previous analysis of the interval level questions.

The results show that the following 5 topics have a low standard deviation:

Question number	*Statement on the topic as stated in the questionnaire*	*Agree (%)*
1.15b	The design of the electric vehicle has to be futuristic	3%
2.14a	Charging stations should be located at work and near companies	94%
1.15a	The electric vehicle should be large	6%
5.5c	The electric vehicle should symbolize speed	8%
1.15e	The design of the electric vehicle should be fast	11%

Table 8. Results of multiple choices answer option with a relatively low standard deviation

Table 8 shows the level of agreement of respondents with a specific statement. This represents a similar table as table 3. However, in this case percentages are used because the respondents could only answer the question with the value 0 or 1, which means that the standard deviation of a topic is directly related to the level of agreement (If 100% of the respondents would agree or 0% of the respondents would agree, the standard deviation would be 0. While if 50% of the respondents would agree, it would mean that the standard deviation would reach its maximum of 0.5 for a range of values from 0 to 1). Table 8 therefore shows the multiple choice selections that experienced the lowest standard deviation.

Another list can be made about the topics that had a relatively high standard deviation, namely:

Question number	*Statement on the topic as stated in the questionnaire (0 = disagree, 1 = agree)*	*Agree (%)*
2.14d	The electric vehicle should be charged at specialized charging stations (comparable to current fuel stations)	50%
5.5h	The electric vehicle should symbolize pleasure and enjoyment	50%
3.3c	The chances for the Dutch industry are to develop and produce parts for the electric vehicle	52%
6.31a	The primary group of users for the electric vehicle are companies that own a fleet of vehicles	55%
3.3e	The chances for the Dutch industry are to develop a recycle industry for batteries	45%

Table 9. Results of multiple choice answer option with a relatively high standard deviation

The values in table 9 show the level of agreement with the specific statements from the multiple choice questions. This table shows the topics that experience relatively the highest levels of standard deviation (misalignment) of the multiple choice options.

This list of topics is based upon the entire collection of data. However, it is also interesting to compare the answers given by each of the different categories of organizations. When comparing the distribution of the answers given by each of the different categories of organizations using a Kruskal-Wallis test, a number of topics can be determined that show a significant difference between the groups, namely:

Question number	*Statement on the topic as stated in the questionnaire*	*Sig.*
1.15a	The electric vehicle should be large	0.034
1.15f	The electric vehicle should be high-tech	0.048
2.14b	The electric vehicle should be charged at home	0.039
6.31a	The primary group of users for the electric vehicle are companies that own a fleet of vehicles	0.037
6.31b	The primary group of users for the electric vehicle are consumers	0.028
3.3a	The chances for the Dutch industry are to be a test case for the implementation of the electric vehicle on a national scale	0.022

Table 10. Results of the Kruskal-Wallis test of distribution differences between groups

Table 10 shows the different multiple choice options that experience a significant difference in the distribution of values between groups. In this case due to only having two outcome values (namely 0 and 1) the standard deviation is directly related to the level of agreement. Therefore in this case the groups can only experience differences in the level of agreement between the different groups of organizations.

After having established that a number of topics experience misalignment between different groups of organizations. The next step is to describe which groups are at each end of the spectrum of answers.

		Organization categories						
Question number	*Percentage of agreement* ***Question from the questionnaire***	***Prod.***	***R&D***	***Gov.***	***Users***	***Financ.***	***Energy***	***NGO***
1.15a	The electric vehicle should be large	**0%**	8%	4%	**40%**	**0%**	13%	**0%**
1.15f	The electric vehicle should be high-tech	26%	21%	17%	40%	33%	**13%**	**75%**
2.14b	The electric vehicle should be charged at home	87%	96%	94%	**57%**	67%	78%	**100%**
6.31a	The primary group of users for the electric vehicle are companies that own a fleet of vehicles	48%	**83%**	52%	33%	**17%**	56%	43%
6.31b	The primary group of users for the electric vehicle are consumers	**4%**	**4%**	10%	**50%**	33%	11%	14%
3.3a	The chances for the Dutch industry are to be a test case for the implementation of the electric vehicle on a national scale	65%	65%	67%	50%	**100%**	**22%**	**100%**

Table 11. Overview of descriptive data of significant topics by category of organizations

The values in table 11 show the highest and lowest levels of agreement on a specific multiple choice option for each of the different categories of organizations. The highest and lowest are underlined. In this table the analysis shows how the values are distributed among the different organization categories so they can be compared.

When looking at the results from table 7 and 11, it becomes clear that users and energy related companies are often the categories of organizations that are the furthest apart. This means that in the majority of topics the users and energy related organizations play an important role in the general misalignment of perspectives on the topic.

Analysis of "don't know/no opinion" answers

The last set of questions focused on the respondents that stated to not know an answer or have no opinion on a specific topic. The first step is to determine which topics experience the highest/lowest level of "don't know/no opinion" answers.

The 5 topics that experienced the lowest level of “don’t know/no opinion” answers were:

Question number	*Statement on the topic as stated in the questionnaire (0 = filled in opinion, 1 = didn’t know or had no opinion)*	*No opinion (%)*
6.1	The electric vehicle should be able to fulfill the majority of the mobility needs	0%
5.5	The values that the electric vehicle should symbolize	0%
1.4	It is important to spend additional attention on the costs of the battery for the electric vehicle	1%
1.2	It is important to spend additional attention on the range of the electric vehicle	1%
1.1	The range of the electric vehicle is adequate	1%

Table 12. Results of topics with a low level of “don’t know/no opinion” answers

Table 12 shows the topics that experience the lowest level of “don’t know/no opinion” answers given in the questionnaire. This indicates that all of the respondents or nearly all of the respondents had formed an opinion on the topic of the question. The topics that did experience a high level of “don’t know/no opinion” answers, were:

Question number	*Statement on the topic as stated in the questionnaire*	*No opinion (%)*
2.31	The ease of use of the payment system used for charging the electric vehicle in public is sufficient	33%
2.15	The charging infrastructure is being constructed at the right locations	27%
7.23	The regulations with regards to parking permits exclusively for electric vehicles is sufficient	25%
7.21	The regulations with regards to the safety of the electric vehicle is sufficient	25%
2.19	The capacity of the electricity infrastructure on the neighborhood level is sufficient for the upcoming years	24%

Table 13. Results of topics with a high level of “don’t know/no opinion” answers

The values in table 13 show the topics that experienced the highest level of “don’t know/no opinion” answers from the questionnaires. These values indicate that these topics are unknown or are experienced as not being important by a large part of the system.

The next step is to look at the values for each of the categories of organizations. Using a similar type of analysis as used for the previous sets of data, the situation for each category of organizations can be determined. The use of a Kruskal-Wallis test resulted in a number of topics that showed a significant level of difference between the “don’t know/no opinion” values of different categories, namely:

Question number	*Statement on the topic as stated in the questionnaire*	*Sig.*
1.16	The current design of the electric vehicle supports a successful introduction of the electric vehicle in the Netherlands	0.032
5.7	It is important to spend additional attention on the values that the electric vehicle should symbolize	0.024
2.23	The electric vehicle should be charged using renewable energy	0.024
2.24	It is important to spend additional attention on the need for renewable energy to charge the electric vehicle	0.024
4.1	The level of expertise of maintenance companies of electric vehicles is sufficient	0.014
4.2	It is important to spend additional attention on the level of expertise of maintenance companies of electric vehicles	0.026
7.14	The current stimulating measures have the correct focus on activities	0.046
7.25	The EU regulations on the emission levels of conventional vehicles should be further tightened and developed to reduce emissions	0.035
7.21	It is important to spend additional attention on the need to further develop EU regulations on the emission levels of conventional vehicles	0.017

Table 14. Results Kruskal-Wallis test of distribution differences between groups

The values in table 14 show the significance level of the differences among groups of the level of “don’t know/no opinion” answers given in the questionnaire. These topics show that there are a

number of topics that experience a significant difference in the level of "don't know/no opinion" answers given by the different groups.

Having established the topics that experience significant differences among the different groups concerning the levels of "don't know/no opinion" answers. The next step is to determine which groups have a high level of "don't know/no opinion" of answers so possible knowledge gaps can be discovered.

		Organization categories						
Question number	*Percentage of no opinion/don't know answers* ***Question from the questionnaire***	***Prod.***	***R&D***	***Gov.***	***Users***	***Financ.***	***Energy***	***NGO***
1.16	The current design of the electric vehicle supports a successful introduction of the electric vehicle in the Netherlands	0%	4%	13%	**43%**	0%	11%	13%
5.7	It is important to spend additional attention on the values that the electric vehicle should symbolize	0%	0%	0%	**14%**	0%	0%	0%
2.23	The electric vehicle should be charged using renewable energy	0%	0%	0%	**14%**	0%	0%	0%
2.24	It is important to spend additional attention on the need for renewable energy to charge the electric vehicle	0%	0%	0%	**14%**	0%	0%	0%
4.1	The level of expertise of maintenance companies of electric vehicles is sufficient	4%	9%	**37%**	17%	0%	0%	14%
4.2	It is important to spend additional attention on the level of expertise of maintenance companies of electric vehicles	4%	4%	**27%**	0%	0%	0%	0%
7.14	The current stimulating measures have the correct focus on activities	4%	4%	23%	**33%**	0%	0%	0%
7.25	The EU regulations on the emission levels of conventional vehicles should be further tightened and developed to reduce emissions	4%	0%	23%	**33%**	0%	11%	0%
7.21	It is important to spend additional attention on the need to further develop EU regulations on the emission levels of conventional vehicles	9%	0%	20%	**50%**	0%	11%	0%

Table 15. Overview descriptive data of significant topics by category of organizations

The values in table 15 show that the levels of "don't know/no opinion" answers for each of the different categories of organizations. The highest values are underlined. These values show which group experienced the highest level of "don't know/no opinion" answers for a specific topic.

In appendix C an overview can be found of the answers that were given in the optional "else, namely" field of the different multiple choice questions.

The results in table 15 show that on the majority of the topics, the users stated to have no opinion on the topic or could not answer the question. This indicates that a large knowledge gap can be found in the category of the users when looking at the topics that were mentioned in table 15.

VI. Conclusions & recommendations

The first part of the conclusion will focus on answering the research question, after which the second part of the conclusion will focus on the recommendations for the case of the introduction of the electric vehicle in the Netherlands. The main research question of this master thesis is:

How can the alignment of perspectives of organizations involved in a socio-technical system be measured?

In this study the first step that was undertaken was a literature study to investigate the different perspectives that exist regarding the introduction of the electric vehicle. The different perspectives found in the literature were arranged in a conceptual framework that was used to conduct a number of interviews. These interviews resulted in the development of an adjusted framework that contained a broad overview of different topics for which the perspectives could be measured with a questionnaire.

After the literature research a list of topics could be formulated. However, this list was limited and was expanded by a limited set of semi-structured interviews. The interviews allowed for a relative fast method to gather the different topics that are important to the subject area of the research. Besides getting fast results it also allowed for gaining additional insights into the motivation and nuances behind different answers of the respondents. These nuances sometimes made it hard to determine what the perspective of the respondent entailed. Using the data from the interviews it was not possible to quantify the differences in perspectives of the various respondents.

The questionnaires contributed by giving the possibility to quantify and analyze more accurately the perspectives of the different types of organizations. Due to the larger number of respondents and a strict categorization of organizations, it became possible to look at the different categories of organizations and compare the distributions of values between these categories.

To answer the research question, the alignment of perspectives of organizations involved in a socio-technical system can be measured using a combination of qualitative and quantitative research. The results can be analyzed using three forms of analysis.

The first method focused on measuring the alignment of perspectives when looking at the entire population of respondents. This was done using the standard deviation of the answers in the dataset. This analysis resulted in a list of standard deviations for each topic. The downside to this analysis, however, is the fact that the values can only be compared to each other giving a relative measure of alignment. So the list itself only contained information on the most and least aligned topics. However, there is no measure for absolute misalignment (or alignment) because a frame of reference is missing. Another problem with this method is the number of respondents for each category. Some categories of respondents could be overrepresented in the final dataset. The comparison of standard deviations for the different topics from the questionnaire will measure the relative levels of alignment and misalignment of perspectives in a socio-technical system only accurately if the progress of the socio-technical system is depending on each respondent equally, without being influenced by the category to which the respondent belongs.

In this study innovation was studied using a systems perspective. This suggests that all of the different categories of organizations have to experience some level of alignment to allow the system to successfully develop further. Another analysis is therefore needed to study the alignment between the different categories of organizations. The second method for measuring alignment is therefore not only looking at the standard deviation but comparing the different distributions of answers for each category of organizations using statistical tests like the Kruskall-Wallis test. This analysis resulted in a list of topics that experienced a significant difference in distributions of values across the different categories of organizations. Afterwards the different distributions of values (means and standard deviations) for each category can be explored to find the differences in perspectives between the different categories of organizations.

In the third analysis another form of misalignment was measured, namely the misalignment of the knowledge base of the different categories of organizations. The different levels of "don't know/no opinion" answers given in the questionnaires can be used as a measurement of the gaps in the knowledge base of organizations. This analysis can therefore be seen as an addition to the previously mentioned methods. By analyzing the distributions of the different levels of "don't know/no opinion" answers across the various categories of organizations, a list of topics was found on which a significant difference in distributions exists of "don't know/no opinion" answers. The differences in knowledge base may provide a misalignment by itself but it can also lead to differences in perspectives or influence the ability to change perspectives, for knowledge and experiences from the past can influence the general perspective of organizations. The third analysis can therefore also be seen as a way to measure the potential for alignment and misalignment of perspectives of organizations.

Recommendations

In this next section recommendations will be made for the case of the introduction of the electric vehicle in the Netherlands. When looking at the dimensions of the socio-technical system that the various topics from the questionnaire represent and the topics themselves, a list can be made of the topics that would require additional discussion and additional efforts to reduce misalignment. When looking at the results from the questionnaires, five dimensions include topics that experienced a significant amount of misalignment across different categories of organizations, namely:

- The artifact (the electric vehicle)
    - There is no overall agreement whether the battery and range of the electric vehicle are sufficiently developed or not
    - There is no overall agreement whether the design of the electric vehicle is suitable for implementation or not
- The fuel infrastructure
    - There is no overall agreement whether the uniformity of the charging connectors is sufficient or not
    - There is no overall agreement whether the time that is needed to charge an electric vehicle is too high or not
    - There is no overall agreement on the location(s) where the electric vehicle should be charged
- The production system and industry development
    - There is no overall agreement on the opportunities and chances for the Dutch industry to profit from the introduction of the electric vehicle in the Netherlands
- The market development and user practices
    - There is no overall agreement on what role the electric vehicle will play in fulfilling the mobility needs of users and whether additional attention should be given to the changes in the total demand for mobility by society or not
    - There is no overall agreement on whether additional attention should be given to the level of influence the government has on the market or not
    - There is no overall agreement on which group of users will be the primary group of users for the introduction of electric vehicles
- The regulations and policies
    - There is no overall agreement on whether the local government should participate in the development of charging infrastructure or not
    - There is no overall agreement on whether there should be additional attention given to the development of safety regulations for the electric vehicle or not
    - There is no overall agreement on which activities should be focussed on by stimulating efforts (e.g. research, developing charging infrastructure, commercialization)

When looking at the results for each of these general topics from the five dimensions, a list can be made of the categories of organizations that represented an outer limit of the values of a general topic in that dimension. This results in the following overview of general topics that should be discussed and the categories of organizations (marked with an X) that represent the organizations

with the highest levels of misalignment on the topic area. The overview can be used to focus attention on topics and categories of organizations in discussions to assist in reducing the misalignment of the system.

	Organization categories						
The need for additional attention to reduce misalignment ***Topic dimensions***	***Prod.***	***R&D***	***Gov.***	***Users***	***Financ.***	***Energy***	***NGO***
1. Artifact (the electric vehicle)							
- The battery and range of the electric vehicle	-	-	-	**X**	-	**X**	-
- The design of the electric vehicle	**X**	-	-	**X**	**X**	**X**	**X**
2. Fuel infrastructure							
- The uniformity of the charging connections	-	-	-	**X**	-	**X**	-
- The time needed to charge	-	-	-	**X**	-	**X**	-
- The charging locations for the electric vehicle	-	-	-	**X**	-	-	**X**
3. Production system and industry development							
- The opportunities for industry development	-	-	-	-	**X**	**X**	**X**
6. Market development and user practices							
- The usage of mobility and the usage of electric vehicles	-	-	**X**	**X**	**X**	**X**	-
- The influence of the government on the market	-	-	**X**	-	-	**X**	-
- The primary group of users of electric vehicles	**X**	**X**	-	**X**	**X**	-	-
7. Regulations and policies							
- The role of local government in the development of charging infrastructure	-	-	-	**X**	-	**X**	-
- The safety regulations for the electric vehicle	**X**	-	-	-	-	**X**	-
- The focus of stimulating efforts	-	-	-	-	-	**X**	**X**

Table 16. Overview of focus areas to reduce misalignment

The two categories of organizations that often have the highest level of misalignment are the users and the energy related companies. Besides focusing on misalignment of perspectives, it might also prove useful to focus on reducing potential knowledge gaps that could result in a misalignment of perspectives. By analyzing the differences of the distribution of "don't know/no opinion" answers across groups, the dimensions that experienced a significant difference between groups could be identified. The differences in distributions of knowledge gaps mainly occurred on the following general topics distributed across five dimensions:

- The artifact (the electric vehicle)
    - Whether the design of the electric vehicle is suitable for implementation or not
- The fuel infrastructure
    - Whether the electric vehicle should be charged using renewable energy or not
    - Whether additional attention should be given to charge electric vehicles using renewable energy or not
- The maintenance and distribution network
    - Whether the level of expertise of the maintenance companies for electric vehicles is sufficient or not

    - Whether additional attention should be given to the level of expertise of the maintenance companies for electric vehicles or not
- The cultural and symbolic meaning
    - Whether additional attention should be given to the image and symbolism of electric vehicles or not
- The regulations and policies
    - Whether the current stimulating efforts have the correct focus on activities or not
    - Whether the EU regulations on emission levels of conventional vehicles should be developed further to reduce emissions or not
    - Whether additional attention should be given to the further development of EU regulations on emission levels of conventional vehicles with the focus to reduce emissions or not

When looking at the distributions for each category of organizations, an overview of general topics can be made that should be discussed and additional information is provided of the categories of organizations (marked with an X) that represent the organizations with the largest gap of knowledge on the specific topic area. This overview can be used to determine on what topics additional attention on potential knowledge gaps is necessary and which categories of organizations can be expected to have the highest chance of experiencing a knowledge gap.

	Organization categories						
Possible knowledge gaps ***Topic dimensions***	***Prod.***	***R&D***	***Gov.***	***Users***	***Financ.***	***Energy***	***NGO***
1. Artifact (the electric vehicle)							
- The design of the electric vehicle	-	-	-	**X**	-	-	-
2. Fuel infrastructure							
- The usage of renewable energy for charging	-	-	-	**X**	-	-	-
4. Maintenance and distribution network							
- The expertise of EV maintenance companies	-	-	**X**	-	-	-	-
5. Culture and symbolic meaning							
- The image and symbolism of electric vehicles	-	-	-	**X**	-	-	-
7. Regulations and policies							
- The focus of stimulating efforts	-	-	-	**X**	-	-	-
- The EU regulations on emission levels of conventional vehicles	-	-	-	**X**	-	-	-

Table 17. Overview of possible knowledge gaps

These results show that the users often experienced misalignment of their knowledge base which can also affect their perspectives and may result in misalignment of their perspectives. These results can be used to coordinate future efforts to reduce knowledge gaps and reduce misalignment among organizations involved in the socio-technical system of the electric vehicle in the Netherlands.

VII. Discussion

Issues and limitations that occurred while performing this study are discussed in the following sections.

After having completed the interviews a number of limitations arose. It became clear that topics that were discussed in the literature and interviews change over time. Therefore the misalignment of the perspectives of the organizations in a socio-technical system cannot be related to a static set of topics. The set of topics might change over time and to measure the alignment of the system as a whole, additional steps are needed to ensure that the topics are (still) relevant at the present time. Measuring the same set of topics over time will therefore not represent a proper measure of alignment of the socio-technical system.

The list of topics gathered from the interviews was very long. The resulting questionnaire therefore had to be a selection of the potential set of topics that could be used. Due to practical limits it is very hard to develop a questionnaire that is limited in size, while capturing the complete scope and depth of the topics and issues that are relevant to the system. The issues were carefully selected to reduce overlap and maintain the integrity of the topic list. By removing the dimension of road infrastructure from the topic list, a reduction could be made while maintaining the integrity of the other dimensions. The other topics that were removed experienced either a large overlap with another question or the topic was too specific to be answered by all of the respondents. The result was a questionnaire with a broad scope of general questions concerning 7 of the “original” set of 8 dimensions of the socio-technical system. The respondents also had the opportunity to specify their comments at the end of the questionnaire. By removing the questions that would prove to be too specific to be answered, the resulting questionnaire was experienced by some respondents as being very general which was stated in some comments at the end of the questionnaire.

The number of respondents per category of organizations can be a topic of discussion. For some categories the number of respondents was significantly lower than for other categories. However, the nature of the categories does limit the number of respondents. For example, the total number of financial institutions that are involved with electric vehicles is limited when compared to the number of governmental organizations that are involved with electric vehicles. By comparing the data across the different categories of organizations, this problem was resolved because the test value of the analysis also corrects for a lower number of respondents within each category.

To be able to gather data that would show differences among respondents, the questions in the questionnaire were formulated as rather extreme statements. Some respondents, however, experienced this as being biased. The questions in the questionnaire sometimes represented the positive perspective on a topic, while sometimes representing a negative perspective on another topic. The result is therefore a well balanced set of questions that does not favor a specific perspective on electric vehicles, which was also tested by allowing internal test respondents to fill in the questionnaire beforehand and provide feedback for improvements.

Future research

The results of this study are a first step towards further research concerning relationships of alignment of an innovation system and other variables. Further research could focus on a number of different aspects of alignment.

Using this method of measuring alignment, a longitudinal study can be undertaken to study the relationship of alignment of a socio-technical system with other variables over time. This will lead to new insights in the relationship between alignment and the development of such a system. This method can also be used to evaluate efforts that focus on reducing misalignment among a variety of organizations.

Alignment will evolve over time. In some stages of development a systemic innovation might even require some level of misalignment among participants to allow for new insights and stimulate innovation efforts. This can be compared to the optimal cognitive distance theory as described by Nooteboom et al. (2007). This theory describes that participants of an alliance should be different enough to provide the other participants with new knowledge. However, they should also be similar enough to allow for successful communication and transactions of knowledge and ideas. It could therefore be suggested that different phases in the development of an innovation are related to different “optimal” levels of alignment among the participants of the socio-technical system that is related to that innovation. It might therefore be interesting for future research to focus on measuring alignment throughout the different phases of development of a socio-technical system.

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Appendix A. List of topics included in the survey

Topic	*Selected for the survey*
Artifact (the electric vehicle)	
The size of the batteries	-
The capacity of the batteries	-
The weight of the batteries	-
The guarantee and reliability of the batteries	-
The durability of the batteries	***Yes***
The costs of the batteries	***Yes***
The level of the maturity of the technology of the batteries	-
Dependency on lithium producing countries (added from additional source: study of Stichting natuur en milieu)	***Yes***
The range of the electric vehicle	***Yes***
The accuracy of the range indication of the electric vehicle	-
The emission measurement of the electric vehicle	***Yes***
The emission contribution of the electric vehicle	-
The load capacity of the electric vehicle	-
The efficiency of the engine	-
The weight of the electric vehicle	-
The size of the electric vehicle	-
The style of the design of the electric vehicle	***Yes***
The level of maturity of the electric vehicle	-
The level of safetyness of the electric vehicle	***Yes***
The level of simplicity of the electric vehicle	***Yes***
Road infrastructure	
Intelligent routing and planning	-
The costs of specific parking spots	-
The number of parking spots for electric vehicles	-
The development of signs (for charging and parking locations for ev's)	-
Research of the implementation of the EV in the urban environment	-
Information distribution about silent vehicles in city trafic	-
New forms of urban planning to incorporate silent vehicles	-
Fuel infrastructure	
The compatibility of the charging connector of the EV	***Yes***
The visibility of the charging connector of the EV	***Yes***
The duration of the charge cycle	***Yes***
The simplicity of the charging method	***Yes***
Focus on specific charging method	***Yes***
The maturity of the different charging methods	-
The accessibilty and availability of charging stations	***Yes***
The quantity of sustainable energy	-
The need for usage of sustainable energy for charging EV's	***Yes***
The location of energy generation	-
The storage of sustainable energy in EV as buffer	***Yes***
The capacity of the energy infrastructure on neighborhood level	***Yes***
The location of charging infrastructure	***Yes***
The general capacity of the energy infrastructure	-
The need for intelligent systems to regulate energy demand	***Yes***
The availability of energy suppliers	-
The availability of private charging locations	***Yes***
The number of public charging locations	-
The level of financial risks in a system of decentralized charging (standard charging)	***Yes (combined)***
The level of financial risks in a system of centralized charging (fast charging)	***Yes (combined)***
The distribution of financial risks in a system of centralized charging	-

The distribution of financial risks in a system of decentralized charging	-
The price of energy	***Yes***
The simplicity of payment	***Yes***
The compatibility of payment systems	-
Production system and industry development	-
The production capacity of producers of EV's	***Yes***
The diversification of EV models (Broader range of models)	-
Production focus on other models (larger models, smaller models)	***Yes***
Industry opportunity directions and chances	
Maintenance and distribution network	-
The need for maintenance in general	***Yes***
The level of expertise of maintenance companies	-
The level of expertise of road service companies	-
The level of expertise of emergency services	-
The number of maintenance companies	-
The location of maintenance companies (spread)	***Yes***
The use of the standard car distribution networks	
Cultural/societal contribution and symbolic meaning	
The contribution to air quality	-
The contribution to reduced noise levels in urban environments	
The contribution to sustainability	***Yes***
Economic dependency on foreign countries for oil	-
Economic growth in Dutch industry	***Yes***
Symbolic properties of the EV	***Yes***
Market and user practices	***Yes***
The combination of modalities in the use of mobility	***Yes***
The role of ownership in the use and the need for mobility	-
The flexibility of chosing different forms of mobility	***Yes***
The level of use of mobility	-
The level of awareness of mobility needs	***Yes***
The position of the EV in the total demand for mobility (replacing part of mobility)	***Yes***
The position of the EV in the users demand for mobility (primary car, secondary car)	***Yes (combined)***
The costs of buying an EV	***Yes (combined)***
The costs of owning an EV	***Yes***
The uncertainty of the value of the EV over time	-
The user awareness of how to use an EV	-
The user awareness of the costs of current forms of mobility	-
The user awareness of the need for mobility	***Yes***
The need for guarantee and reliability of mobility when using an EV	***Yes***
The need for change of user needs	***Yes***
The level of information distribution to consumers about EV's	***Yes***
The need for more user experience with EV's	***Yes***
The risk level for new entrants to the market	-
The possibilities for new entrants to the market	-
New roles for lease companies regarding to EV's	***Yes***
The market strategy (demand driven, supply driven)	***Yes***
The influence of the government (facilitating, controlling)	***Yes***
The geographical focus of the EV market (urban areas, big cities)	***Yes (combined)***
The mobility motive focus of the EV market (home-to-work, work related mobility)	***Yes (combined)***
The user focus of the market (companies, consumers, fleet owners)	***Yes***
The focus of activities of the EV market	-
The development of a solid business case for the EV	***Yes***
The use and investment in other technologies for mobility	-
The speed of the standardization process	-

The level of standardization	
Policies and regulations	***Yes***
The need for stimulating measures	***Yes***
The effect of stimulating measures	***Yes***
The focus of stimulating measures on specific activties	***Yes***
The focus of stimulating measures on specific users	***Yes***
The need for local government to place public charging stations	***Yes***
The need for a more integrated set of stimulating measures	***Yes***
The complexity of stimulating measures	-
Incorporation of e-mobility in local governance structure	***Yes***
The development of policies concerning safety standards	***Yes***
The development of local policies for electric mobility	***Yes***
The level of coordination between different local initiatives	***Yes***
The development of policies for exclusive parking permits for EV's	-
The development of policies concerning the payment for mobility in general	***Yes***
The level of standardization of charging on an european level	***Yes***
The further development of european emission standards	

Appendix B. Overview of questions from the survey

	Question
	Artifact (the electric vehicle)
1.1	De actieradius van de huidige elektrische auto is voldoende
1.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.3	De kosten van de huidige batterijen voor een elektrische auto zijn te hoog
1.4	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.5	Door batterijen voor elektrische auto's worden we steeds afhankelijker van lithium producerende landen
1.6	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.7	De levensduur van de huidige batterijen in elektrische auto's is voldoende
1.8	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.9	De wijze waarop de emissiereductie van de elektrische auto momenteel wordt gemeten is goed
1.10	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.11	De veiligheid van de huidige elektrische auto is voldoende
1.12	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.13	Het gebruiksgemak van de huidige elektrische auto is voldoende
1.14	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.15a	De elektrische auto moet groot zijn
1.15b	De elektrische auto moet futuristisch zijn
1.15c	De elektrische auto moet modern zijn
1.15d	De elektrische auto moet volwassen zijn
1.15e	De elektrische auto moet snel zijn
1.15f	De elektrische auto moet high-tech zijn
1.16	Huidige ontwerpen van elektrische auto's zijn geschik voor een succesvolle introductie
1.17	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
1.18	Het ontwerp van de elektrische auto moet overeenkomen met het ontwerp van een conventionele auto
1.19	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
	Fuel infrastructure
2.1	Er is voldoende geregeld op het gebied van de uniformiteit van de oplaadstekkers van de huidige elektrische auto
2.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.3	De huidige oplaadpalen vormen een te grote inbreuk op het straatbeeld
2.4	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.5	De tijd die het kost om een elektrische auto op te laden is te veel
2.6	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.7	Het gemak waarmee een elektrische auto kan worden opgeladen is voldoende
2.8	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.9	Het is gemakkelijk om toegang te krijgen tot de publieke oplaadsystemen voor elektrische auto's
2.10	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.11a	De elektrische auto moet worden opgeladen met door gebruik te maken van langzaam laden
2.11b	De elektrische auto moet worden opgeladen met door gebruik te maken van snel laden
2.11c	De elektrische auto moet worden opgeladen met door gebruik te maken van inductie laden
2.11d	De elektrische auto moet worden opgeladen met door gebruik te maken van batterij wisselen
2.12	Op dit moment wordt aandacht besteed aan de juiste oplaadmethode(n) voor elektrische auto's
2.13	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.14a	De elektrische auto moet worden opgeladen bij bedrijven en op het werk
2.14b	De elektrische auto moet worden opgeladen bij particulieren thuis
2.14c	De elektrische auto moet worden opgeladen op publieke parkeerplaatsen
2.14d	De elektrische auto moet worden opgeladen bij gespecialiseerde oplaadstations (vergelijkbaar met huidige tankstations)
2.15	De oplaadpunten zijn/worden op de juiste locaties beschikbaar gesteld
2.16	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.17	De mogelijkheden voor het thuis opladen van een elektrische auto zijn voldoende
2.18	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.19	De capaciteit van het energienetwerk op wijkniveau is de komende jaren voldoende voor het opladen van elektrische auto's
2.20	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.21	Het is noodzakelijk dat er een "slim" energienetwerk ontstaat om beter aan de energievraag (voor elektrisch rijden) te kunnen

	voldoen
2.22	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.23	De elektrische auto dient te worden opgeladen met duurzame energie
2.24	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.25	Het gebruik van de elektrische auto als energie opslag/buffer (vehicle-to-grid) voor duurzame energie is een goed idee
2.26	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.27	De financiële risico's voor het aanleggen van de oplaad infrastructuur voor elektrische auto's zijn te hoog
2.28	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.29	De huidige prijs van elektriciteit voor het opladen van de elektrische auto is te laag
2.30	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
2.31	Het betaalgemak van de betaalsystemen voor het opladen van de elektrische auto is voldoende
2.32	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
	Production system and industry development
3.1	Er is een grotere diversiteit in modellen van elektrische auto's nodig
3.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
3.3a	De kansen voor de Nederlandse industrie liggen bij het vervullen van de proeftuin functie voor elektrisch rijden
3.3b	De kansen voor de Nederlandse industrie liggen bij het ontwikkelen van kennis over elektrisch rijden
3.3c	De kansen voor de Nederlandse industrie liggen bij de ontwikkeling en productie van onderdelen voor elektrische auto's
3.3d	De kansen voor de Nederlandse industrie liggen bij de ontwikkeling en productie van elektrische auto's
3.3e	De kansen voor de Nederlandse industrie liggen bij het ontwikkelen van een recycle industrie voor batterijen van elektrische auto's
3.3f	De kansen voor de Nederlandse industrie liggen bij het ontwikkelen van een industrie voor het opladen van elektrische auto's
3.3g	De kansen voor de Nederlandse industrie liggen bij het ontwikkelen van ondersteunende diensten voor elektrische rijders
3.4	De kansen voor de Nederlandse industrie worden voldoende benut
3.5	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
	Maintenance and distribution network
4.1	Er is voldoende expertise over elektrische auto's aanwezig bij onderhoudsbedrijven
4.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
4.3	Het gebruik van de dealer infrastructuur van conventionele auto's is noodzakelijk voor de introductie van de elektrische auto
4.4	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
	Cultural/societal contribution and symbolic meaning
5.1	De bijdrage van de elektrische auto aan een verduurzaming van de maatschappij is hoog
5.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
5.3	De elektrische auto zal voor economische kansen in de Nederlandse industrie zorgen
5.4	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
5.5a	De elektrische auto moet een unieke uitstraling hebben
5.5b	De elektrische auto moet status uitstralen
5.5c	De elektrische auto moet snelheid uitstralen
5.5d	De elektrische auto moet een goede financiële afweging uitstralen
5.5e	De elektrische auto moet duurzaamheid uitstralen
5.5f	De elektrische auto moet eenvoud uitstralen
5.5g	De elektrische auto moet vrijheid uitstralen
5.5h	De elektrische auto moet plezier uitstralen
5.6	De elektrische auto heeft momenteel al de juiste uitstraling
5.7	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
	Market and user practices
6.1	De elektrische auto moet een groot deel van de mobiliteitsbehoefte in Nederland kunnen vervullen
6.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.3	De elektrische auto moet de primaire auto van een gezin gaan vervangen
6.4	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.5	De elektrische auto past vooral in een systeem waarin niet het bezit, maar het gebruik van de auto centraal staat
6.6	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.7	De elektrische auto komt vooral tot zijn recht in combinatie met andere vervoersmiddelen

6.8	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.9	De komst van de elektrische auto zal leiden tot een toename in het gebruik van mobiliteit
6.10	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.11	De totale kosten van aanschaf en gebruik van de elektrische auto zijn te hoog
6.12	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.13	Er is te veel onzekerheid over de restwaarde van de elektrische auto (op de tweedehands markt)
6.14	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.15	De behoeften van de gebruiker moeten veranderen om aan te sluiten bij de elektrische auto
6.16	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.17	De consument is voldoende geïnformeerd over de elektrische auto
6.18	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.19	Er is meer informatie nodig over de ervaringen van de gebruikers van elektrische auto's
6.20	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.21	De consument heeft momenteel voldoende vertrouwen in de elektrische auto
6.22	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.23	De risico's voor nieuwe ondernemers in de markt voor elektrische auto's zijn te hoog
6.24	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.25	De marktpartijen rond de elektrische auto moeten wachten met het uitvoeren van activiteiten tot er een duidelijke behoefte van de consument en een markt voor is
6.26	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.27	De overheid moet de markt rond elektrische auto's vrij laten
6.28	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.29	De elektrische auto is vooral interessant voor gebruikers in grote steden
6.30	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.31a	De primaire doelgroep van de elektrische auto's zullen bedrijfswagens zijn
6.31b	De primaire doelgroep van de elektrische auto's zullen consumenten zijn
6.31c	De primaire doelgroep van de elektrische auto's zullen lease auto's zijn
6.32	De elektrische auto past voldoende bij deze eerste doelgroep
6.33	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.34a	De markt moet zich richten op het testen van elektrische auto's
6.34b	De markt moet zich richten op het uitvoeren van pilot projecten
6.34c	De markt moet zich richten op het ontwikkelen en aanleggen van oplaadinfrastructuur
6.34d	De markt moet zich richten op het ontwikkelen van de elektrische auto en onderdelen
6.34e	De markt moet zich richten op het verkopen en commercialiseren van elektrische auto's
6.34f	De markt moet zich richten op het informeren van consumenten over elektrische auto's
6.35	De huidige marktpartijen richten zich op de juiste activiteiten
6.36	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
6.37	Het is noodzakelijk dat er ook geïnvesteerd wordt in andere technologieën voor duurzame mobiliteit
6.38	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
	Policies and regulations
7.1	Stimulerende maatregelen zijn noodzakelijk voor de introductie van de elektrische auto
7.2	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.3	De effectiviteit van de huidige stimulerende maatregelen is voldoende
7.4	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.5	De complexiteit van de huidige stimulerende maatregelen is te hoog
7.6	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.7	De samenhang tussen de huidige stimulerende maatregelen is goed
7.8	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.9	Er is voldoende coördinatie tussen lokale beleidsinitiatieven met betrekking tot elektrisch rijden
7.10	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.11	Er is voldoende aandacht bij lokale overheden voor elektrisch rijden
7.12	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.13a	Stimulerende maatregelen moeten zich richten op de kennisontwikkeling en het testen van elektrische auto's
7.13b	Stimulerende maatregelen moeten zich richten op de verkoop en distributie van elektrische auto's
7.13c	Stimulerende maatregelen moeten zich richten op het bezit en gebruik van elektrische auto's
7.13d	Stimulerende maatregelen moet zich vooral richten op het ontwikkelen van laadinfrastructuur
7.14	De huidige stimulerende maatregelen zijn gericht op de juiste activiteiten

7.15	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.16a	De stimulerende maatregelen moeten zich richten op bedrijfswagens
7.16b	De stimulerende maatregelen moeten zich richten op consumenten
7.16c	De stimulerende maatregelen moeten zich richten op lease rijders
7.17	De huidige stimulerende maatregelen richten zich op de juiste doelgroep
7.18	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.19	Lokale overheden moeten publieke laadpunten aanleggen
7.20	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.21	De regelgeving met betrekking tot de veiligheid van elektrische auto's voldoet
7.22	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.23	De regelgeving met betrekking tot parkeervergunningen voor uitsluitend elektrische auto's voldoet
7.24	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.25	De EU emissie standaard voor conventionele auto's moet aangescherpt worden
7.26	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed
7.27	De uniformiteit van het opladen van de elektrische auto moet op Europees niveau geregeld worden
7.28	Het is belangrijk dat er extra aandacht aan dit onderwerp wordt besteed

Appendix C. Overview of "other, namely" responses

"Other, namely" answers

All of the multiple choice questions included the option to answer "other" and then be able to freely discuss what the respondent wanted to answer in an open question. These answers, however, could not be included in the analysis. This is mainly due to the fact that the option was added by the respondent, the other respondents therefore were not able to answer the question. If we were to assume that respondents not adding the option to the questionaire him/herself is the same as the respondents not selecting it, if it would have been included in the questionaire, the results in all of the cases would be that there would be a highly significant amount of alignment due to the fact that almost all of the respondents would not have selected the option (because they didn't add it to the questionnaire). Only the one or two respondents that actualy added the option would have a different score. These results are therefore highly unreliable and are mentioned here seperately. The following options were added by the respondents but could not be analyzed properly:

- The design of the electric vehicle should be functional and practical

- The electric vehicle should symbolize functionality
- The electric vehicle should symbolize the future
- The electric vehicle should symbolize cleanness
- The electric vehicle should symbolize safety

- The electric vehicle should be charged/fueled using a hydrogen cell
- The electric vehicle should be charged/fueled using a range extender
- The electric vehicle should be charged while driving via induction charging in the road

- The market should focus on developing recycle infrastructure and industry
- The market should focus on lobby activities

- Stimulating measures should focus on stimulating the development of sustainable energy
- Stimulating measures should focus on stimulating the development of a multimodal transportation system
- Stimulating measures should focus on stimulating the development of a recycle system

All of the options that were added, were added by only a few respondents.