User involvement in Dutch niche experiments in the transition towards electric mobility

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Abstract

Transitions are long, complex and gradual processes that often start with niche experiments with a new technology. Battery powered vehicles are one of the promising technologies at the start of such a transition. With the ambition of the Netherlands to be a leading player in the transition towards electric mobility, several niche experiments are taking place. Literature emphasizes the important role of experiments in a protected space at the start of a transition. In order to build successful niche experiments, the shaping of expectations and multiple learning processes are seen as important steps. Both first- and second-order learning by providers is necessary to learn both from the technology and about preferences and the social embedding of the technology in society. Users play an important role in these processes. The goal of this research is therefore to shed light on the way interactions with users are shaped in niche experiments with electric vehicles in the Netherlands. This research is conducted as a multiple case study. Interviews with both providers of experiments and users in these experiments provided in-depth insight in the interactions between them in the four cases under investigation. Most important outcomes are that providers of niche experiments have difficulties in selecting the right users for their experiments and tend to have too little focus on the interaction with the users. Providers should therefore think about the users they want to incorporate in their experiment and the way they will setup a close interaction with these users before the experiment starts. This research showed that users do have a lot of knowledge about the technology and the experiment they are being a part of, but also showed the difficulties of project teams to extract these learnings from the users. In conclusion, literature warns for a too strong focus on technological learning and highlights the role users can play in societal learning processes. Most experiments however proved to have this strong focus on technological learning, despite the role users can play in societal learning processes.

Keywords: Niche, Experiment, Electric vehicle, Transition, Users

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P. Tuinenburg BSc

Introduction

Climate related and human habitat problems are getting more and more attention as serious problems in our modern society (Liu et al., 2011). Overcoming these problems is difficult. Vested interests, economies of scale and years of experience with fossil fuel technologies together, stimulate a lock-in position, the carbon lock-in (Unruh, 2000). To escape this lock-in, a transition towards sustainable technologies is needed.

One of the problems in our society that is getting more attention is urban air pollution. A big contributor to air pollution in the Netherlands is the transport sector (CBS, 2011). Next to its polluting character, the transport sector, and more specific personal mobility, can also largely be blamed for noise and congestion (van den Bosch et al., 2005). The transition towards a sustainable transport sector is hard due to the complexity from social, technical and economic perspective (Goldman & Gorham, 2006; Button, 2010). Sustainable mobility has received increased attention in research, especially from an innovation system perspective (Cohen, 2010). According to Banister (2005; 2008) the transport sector did however, not take real actions in order to change.

There are several technologies available in niches that can help to convert the transport sector to be more sustainable. Since niches have an important role in the transition towards a new technology (Kemp et al., 1998; Geels, 2002) this can be seen as a positive development. However, such a transition is generally a complex and gradual process that at least takes 25 years (Rotmans et al., 2001; Alkemade et al., 2011). Niche experiments clearly play a role at the first stages of such a transition, when technological possibilities and user preferences are still uncertain (Schot and Geels, 2008).

Electric mobility is widely recognized as a promising technology that can play an important role in the transition towards sustainable mobility (Leurent and Windisch, 2011). The Netherlands started to give subsidy to nine electric mobility projects within their 'electric testing grounds' (Proeftuin hybride en elektrisch rijden), because of the aspiration to be a leading player in the transition towards electric mobility (EL&I, 2011). Goals of these niche projects are to learn how the technology works in practice and which aspects can contribute to make electric driving a success (Rijksoverheid, 2010).

Van den Bergh et al. (2007) showed that in such experiments success often depends more on social aspects than on technical aspects. Others say that the focus on technologies in the transition towards sustainable mobility is too strong (Kemp and Rotmans, 2004; Hekkert, 2010), while literature on experiments plea for societal learning processes in experiments (Vergragt and Brown, 2007; Kemp et al., 2011). This emphasizes the importance of learning about user preferences, the social desirability of the technology and legal frameworks in an early stage of the transition (Truffer et al., 2002; Geels and Schot, 2007; Nill and Kemp, 2009).

Now, at the beginning of the transition towards sustainable mobility, the technology of electric vehicles proved itself to be promising. After such an initial trigger the focus should be on niche management processes like expectation management, social learning and social network dynamics (Raven and Geels, 2010). Users can play a role in these processes and will thereby help to enlarge the market for electric vehicles. Especially in transitions, like that of the electric car, a close relationship with users is important to complete the transition successfully (Lundvall,

1988). Interaction with users offers them the opportunity to articulate their social needs effectively and thereby improve the acceptance of the technology (Smits and den Hertog, 2007). Not all users are suited to give sufficient feedback in complex transitions (Letll, 2007; Von Hippel, 1986), it is therefore important to carefully select the users involved in the experiment and to think about the way of interaction with them. Especially because they play a big role in the adoption of successful transport innovations (van der Straten et al., 2007). This raises the question in what way this interaction currently is shaped in Dutch experiments:

"In what way is interaction with users shaped in niche experiments with electric mobility in the Netherlands?"

In order to be aware of the role users can play in theory in innovation processes, a literature review is needed. Because it is important to be aware of the kind of users involved in the experiment as mentioned above and to be aware of what is learned in the experiment, this leads to the following two sub questions:

- What kinds of users are involved in the niche experiments?
- What kind of learning takes place within the experiments?

As described above, it is important to know which users are involved because not all users are capable of contributing to radical innovations or innovations in early phases in a transition process (Lettl, 2007). Interaction with users is however crucial in experiments in this phase of a transition (Geels and Schot, 2007). Niche experiments are also appropriate to learn, both for first- and second-order learning. First-order learning concerns the options in a given case in a given context (van de Kerkhof and Wieczorek, 2005; Hegger et al., 2007). Second-order learning concerns new insights in the problem itself, the decisions and the context in which this takes place (van de Kerkhof and Wieczorek, 2005; Hegger et al., 2007) and thus about the assumptions and values that drive stakeholders in the experiment. It is important to make a distinction between these two kinds of learning and thus to know which kind of learning takes place in the experiments under investigation in this research.

Current literature often focuses on the success or failure of experiments and tries to explain the differences (Van der Laak et al., 2007). Outcomes are for instance the importance of niche experiments in early stages of a transition and the understanding of the incumbent regime (Truffer et al., 2002; Raven, 2006), or the statement that users play an important role (Hoogma et al., 2002). This research will shed light on the way users in experiments can play this important role. Because users in experiments can be helpful in the early stages of a transition, this research will ask both providers of experiments and users from different projects in a qualitative way about their interaction. In the method section this will be further elaborated. This research focuses on the Netherlands because the Dutch government would like to be a leading player in the transition towards electric mobility (Ministerie IM, 2011). The focus on users will lead to both academic and societal contributions. Academic contributions will lie in the way interactions in experimental niches are shaped. From a societal perspective, this research can gain new insights for stakeholders and policymakers and will shed light on possible improvements in user interactions in niche experiments. Goal of the research is to provide insight in the practical application of user involvement in experiments. It will shed light on the difficulties with user involvement in practice in comparison to what is known in theory.

Theoretical framework

This chapter will elaborate on the theories used in this research. It starts with a demarcation and ends with a conceptual framework, derived from the theories used.

Demarcation

This study is conducted in the discipline of Innovation Studies. From an evolutionary economics perspective, the concepts of technological regimes and search heuristics are important in innovation research (Nelson and Winter, 1977), as well as the notion of technological paradigms (Dosi, 1982). These notions are foundations for two streams in literature that relate to each other; the one of transition management (Kemp et al., 1998; Rotmans et al., 2001; Kemp and Rotmans, 2004) and the one of strategic niche management (Truffer et al., 2002; Schot and Geels, 2008; Raven and Geels, 2010). Where transition management focuses on the coordination and enabling of processes at different levels in such a systemic way that there is space for variation, selection and innovation (Kemp and Loorbach, 2006), strategic niche management (SNM) focuses on the way protected spaces can be created for technology and market experience in such a way that the derived knowledge may enhance diffusion into the current socio-technical regime. Within SNM, social desirability of the technology and learning from the experiments are important goals (Nill and Kemp, 2009).

Transition Management

The transformation processes in which existing structures, institutions, culture and practices are broken down and new ones are established is called a transition (Loorbach, 2007). Transitions are complex and slow processes that at least take 25 years (Rotmans et al., 2001). When trying to manage transitions, governments have three levels to be active in; strategic, tactic and operational (Rotmans et al., 2001; Loorbach, 2007). At the strategic level the setting of long term goals is important like the creation of a vision, discussions on norms and values and a lot of other activities and developments that relate to the societal system (Loorbach, 2007). The tactical level is about steering activities that relate to the current regime. The time horizon here is about 10 to 15 years and actors try to achieve their specific goals in a context that can change parts of the existing regime, but not the regime as a whole (Loorbach, 2007). At the operational level, all short term activities and experiments of individuals with innovative potential play a role (Loorbach, 2007). Often these activities are performed in a protected niche in which they can develop into a mainstream option (Kemp et al., 1998).

Strategic Niche Management

Radical change often comes from outside technological regimes. These regimes create stability by guiding the innovative activity towards incremental improvements (Geels, 2002). Technologies from outside the regime therefore often need a niche to develop. Strategic niche management (SNM) focuses on the way niches can be created for technology and market experience in such a way that the derived knowledge is adequate for diffusion into the current socio-technical regime. After (1) the choice for a technology, (2) the selection and (3) set-up of the experiment, it can be (4) scaled up and if the potential is high, (5) the protection of the niche can slowly be broken down (Kemp et al., 1998). A balance should be found between protection and selection pressure in order to reach the goals of the experiment; "learning about the desirability of the new technology and enhancing the further development and the rate of application of the new technology" (Kemp et al., 1998, p. 186). Good experiments contain

several niche processes; the shaping of expectations, the building of social networks and multiple learning processes (Raven, 2005).

The first process, the shaping of expectations is based on the expectations of most stakeholders that will participate in the niche experiment. Especially in the early development of a technology, the articulation of the expectations must be properly done since it can attract resources and new actors (van der Laak et al, 2007). Well formulated expectations are shared by multiple actors, specific and substantiated by ongoing projects (Elzen et al., 1996; Hoogma et al., 2002). The second process is the building of social networks. Again, this is important in the early stages of a technology. A social network around a technology should be built by a broad range of actors that interact with each other on a regular basis (Raven, 2005; van der Laak et al., 2007). The third process is about multiple learning processes, and of the utmost importance in experiments. Learning should be broad and not only focused on technological and economic factors. Social factors like user preferences should be a focus of a good learning process in niche experiments. For this reason there should be attention for underlying assumptions of participants in the experiment (Raven, 2005; van der Laak et al., 2007). Interaction with these participants and learning processes are the main goals, not the protection of a technology itself (Geels and Schot, 2007). Therefore, users in an experiment should not only be seen as consumers with preferences. Such a view on the users has the threat of no depth and breadth in the learning processes because of the low involvement of stakeholders (Schot and Geels, 2008). This means that the way of interacting with users and the way of monitoring, partly influences the learning processes and is thus of the utmost importance.

As mentioned before, the ultimate goal of niche experiments is not the protection of the technology but are always different learning processes like social desirability of the technology and user interaction (Geels and Schot, 2007; Nill and Kemp, 2009; Coenen et al., 2010). Especially, because the ultimate goal for the technology is to grow out of the niche and to become part of the socio-technical regime or maybe even shapes this new regime, as a part of a transition process. Transitions eventually always demand the acceptance of constraints of a technology by people and the willingness to change their behavior (which requires the willingness to learn), because a transition cannot take place without changing entrenched values (Kemp and van Lente, 2011).

User involvement

By interacting with users in an experiment, the users can more effectively articulate their social needs, but at the same time, the provider of the experiment can improve the acceptance and social embedding of the technology (Smits and den Hertog, 2007). Especially when the innovation has a more radical character, a transition process can benefit from close user interaction (Lundvall, 1988). Interactions should be intensive in the case of such big changes because regular communication with the user can give insight in the tacit knowledge the user has; this knowledge is hard to transfer without intensive interaction because this information is often 'sticky' (von Hippel, 1994). A stable and intensive relationship with the user is necessary to transfer this sticky information and is required for more radical innovations (Madhavan and Grover, 1998; Mascitelli, 2000).

In the light of strategic niche management, where user interaction and learning are important goals, there should be some kind of selection mechanism for the selection of users in the experiment that can provide feedback. This is needed because not all users are suitable to provide sufficient feedback that will contribute to radical innovations and the transition towards

such a technology (Lettl, 2007). Regular market research is therefore not suited in niche experiments in the beginning of a transition. Users that are suited for providing feedback in complex, radical innovations are often referred to as 'lead users' (Von Hippel, 1986). These leading users are on the forefront of a trend, new technology or transition, and their preferences are seen as future preferences of regular consumers. According to Lettl (2007), these creative users are unsatisfied with current technology and are open to new technologies. Preferably they also like to use a product in some kind of extreme context that really tests the new product. In order to have several learning processes, it is important that the providers of the experiment carefully select these users.

Learning

As mentioned before the reasons to involve users in an innovation process is the chance of learning. Both the providers of an experiment and the users should learn from the technology and the experiment. This embodies both first-order and second-order learning. First-order learning for the users has characteristics of learning by using, which grows out of experience by using products characterized by a high degree of system complexity (Rosenberg, 1982). This is about the experiences with electric vehicles, compared to ordinary gasoline cars. It also refers to the diminishing of problems in the usage of electric vehicles. For the users the second-order learning process is about the change of their own assumptions and values. This is important because a transition cannot take place without changing entrenched values (Kemp and van Lente, 2011).

Providers of an experiment also have first- and second-order learning processes. First-order learning for providers is about the possibilities of a technology. It also consist of new policy options in a given policy problem in a given context (Brown et al., 2003; van de Kerkhof and Wieczorek, 2005; Hegger et al., 2007). The providers learn from the monitoring of the cars and the users. Second-order learning concerns new insights in the problem itself, the decisions and the context in which these problems with the technology take place (van de Kerkhof and Wieczorek, 2005; Hegger et al., 2007) and thus about the assumptions and values that drive stakeholders in the experiment. Second-order learning in experiments eventually helps the providers to implement the new technology into society. In experiments it has to be clear which kind of learning is enabled and whether this is in line with the intended learning outcomes.

Niche experiments and the role of users in literature

Since Kemp et al. (1998) introduced Strategic Niche Management it is often used in research. SNM research emerged from the observation that many sustainable innovations never leave the laboratory and are thus not applied in the marketplace (Kemp et al., 1998; van der Laak et al., 2007). According to van der Laak et al. (2007) the level of analysis in SNM research is often (a series of) projects like a small scale experiment or pilot plants. The scholars then ask the question whether an innovation trajectory was a success or a failure. This is analyzed through the interaction between the before mentioned niche processes of 'shaping expectation, building social networks and multiple learning processes'. For instance Hoogma et al. (2002) analyzed several cases involving electric vehicles. General learnings are that new distribution channels and active lead users are essential. These cases did give insight in success or failure factors and showed the importance of users, but it did not shed light on the way these users should be involved in experiments. Truffer et al. (2002) mainly argues the importance of both long term visions and short term experimentation. It has less focus on the role of the users within these

experiments. The research of Raven (2006) focuses on the impact of experimentation in stable or instable regimes. It has no attention for the setup of the experiment and the possible role users can play in an experiment. His main conclusion is that both niche processes and changes in the incumbent regime are necessary for understanding new innovations (Raven, 2006). The same goes for several other SNM research in all kinds of sustainable topics like wind turbines (Kemp et al., 2001), biogas plants (Geels and Raven, 2006) and renewable energy technologies (Tsoutsos and Stamboulis, 2005). All of these researches proved to give useful insights in the role niches can play in technological transitions and the role of niche processes. Nevertheless, there is a lack of attention for the role users' play in experiments in technological or market niches. Users are however seen as important in SNM literature (Geels and Schot, 2007; Nill and Kemp, 2009; Coenen et al., 2010). Also related literature on experiments in protected spaces that do not make use of the SNM framework have no focus on the role of users in experiment. Van den Bergh et al. (2007) analyzed seven sustainable transport innovations and concluded that technical and economic factors are not the success factors for these projects. Often socio-cultural, political, process-related and psychological factors determine a projects' success or failure (van den Bergh et al., 2007). In what way these factors are shaped and what the role of users in the projects was is however not under investigation.

Towards a conceptual model

Wrapping this all up, one can say that niche experiments play an important role in the early stage of a transition. Several studies show what role these experiments exactly play and what the pitfalls are in those experiments. With the help of abovementioned theories a conceptual model can be created.

Setup of the experiment

First of all, the setup and surroundings of the niche experiment should be carefully selected in conformity with intended learning outcomes. The setup of the experiment should be in line with the learning goals and should make sure what mechanisms of the new technology are tested in the experiment (Kemp et al., 1998). This typically is an activity performed by providers of an experiment. They are the initiators of an experiment and should think of goals and selection criteria for their experiment. A clear focus and a vision for the experiment is crucial when articulating goals and selection criteria for the experiment, but it is important to keep the vision open because there are always other options too (Raven, 2006). Therefore the vision should not be rigid; it should be open for change and learned lessons within the experiment (Raven, 2005; van der Laak et al., 2007). Next to this, the providers have to think about the actors involved in the experiment. Competent actors that are established in the current way of thinking should be involved because of their resources, experience in the field and knowledge (Flynn, 2002; Raven, 2005). However, firms with no special interest in the current regime are necessary for the innovative character of the experiment (Hoogma, 2000; Geels and Raven, 2006).

Selection of users

Not only a careful selection of the environment of the experiment is needed, the right users in an experiment also influence an experiment. It is clear that user involvement contributes to successful niche experiments and that therefore users play a big role in these experiments (Caniëls and Romijn, 2008; Schot and Geels, 2008). Not only can users articulate their needs, but providers of an experiment increase the social embedding of a technology and might improve the acceptance of a technology (Smits and den Hertog, 2007). This is especially important because societal protest can be a serious problem in an experiment without a focus on social

embedding of the technology (Verbong et al., 2008). One would say that providers should focus on enthusiastic users that have feeling with the new technology. These 'lead users' as Von Hippel names them (von Hippel, 1986), are on the forefront of a trend and should be open towards new technology and using it in some kind of an extreme context (Lettl, 2007). A stable and intensive relationship with these users is needed to transfer the specific knowledge of these users towards the providers of the experiment (Madhavan and Grover, 1998; Mascitelli, 2000).

Expectations of the experiment

As mentioned before, the vision within an experiment should not be rigid, but open for change and lessons learned within the experiment. But there should be a vision and expectations beforehand about the experiment. Visions and expectations can differ between stakeholders but overall the expectations should be shared (Hoogma et al., 2002; Raven et al., 2010). Differences in expectations and visions should be made clear, but it should not become a problem (Kemp and Loorbach, 2006; van der Laak et al., 2007). Not only should differences be accepted, expectations should also not be too high. Often, the failure to meet very high expectations, leads to disappointments and shifts in attention (Verbong et al., 2006; Verbong and Geels, 2007). The difficulty is to make specific expectations clear amongst the providers of an experiment, without setting these expectations too high. Thereby, different expectations should be accepted and the providers should be open minded to change these during the experiment.

Monitoring

When expectations are formulated, the goals are set and the users are selected for an experiment, the experiment can start. An experiment should be monitored in order to be able to learn (Raven et al., 2010). Here it should be clear in what way users will be monitored, but also in what way technical attributes are monitored and how these two different data streams will be compared to each other. In the monitoring process there should be room for unexpected problems. Good experiments differ from bad experiments with their anticipation on these kind of problems. Without a good anticipation, there is the danger of low quality of learning in the experiment (Verbong et al., 2008).

Learning from and in the experiment

In experiments there is often the danger of a technology push where the focus is on technological learning (Truffer et al., 2002; Verbong et al., 2008). Especially in experiments there is the possibility of learning at different dimensions like learning with users about the technology in practice and the societal 'fit' of the technology (Hoogma et al., 2002). Learning about the values and assumptions of stakeholders in the experiment is regarded as second order learning. Insight in these values and assumptions will have a contribution in the transition towards a new technology (van de Kerkhof and Wiczorek, 2005). It should be known if the learning goals are reached with the current interaction pattern and if these goals are of first order or second order learning (Schot and Geels, 2008). More learning can be achieved when visits between experiments are arranged (van der Laak et al., 2007).

For the users in the experiment the first order learning process is about how they have to deal with the new technology. Their second order learning process is about their own values and assumptions and the way they look at their own transportation movements.

Commitment and involvement of the user

As argued before, interaction with the user plays a role in niche experiments in order to let them formulate their social needs (Smits and den Hertog, 2007). Therefore it is good to know to what extent the users feel committed to the experiment. Information the users received as well as the personal goals of the user in the experiment influence their commitment.

Next to the commitment, the involvement of the users in the experiment is important. Because information of the users is often 'sticky', providers of the experiment should have close interaction with the users in order to get access to this sticky information (von Hippel, 1994). In a close interaction with the users, the providers increase the social embedding of the technology (Smits and den Hertog, 2007), which is important because societal protest can occur when the experiment has a technology push character without a focus on social embedding of the technology (Verbong et al., 2008).

Conceptual framework

The abovementioned topics can be captured in a conceptual framework. Figure 1 shows this framework where the providers of the experiment formulate the goals, criteria and expectations of the experiment. Next to these formulations, the providers are responsible for the selection of the right users and the monitoring of the experiment. The monitoring consists of both the monitoring of the technology and of the users in the experiment. The users mainly work with the new technology in the experiment and provide feedback on the technology and the experiment. Finally, both the providers and the users learn as well from the experiment as from the technology.
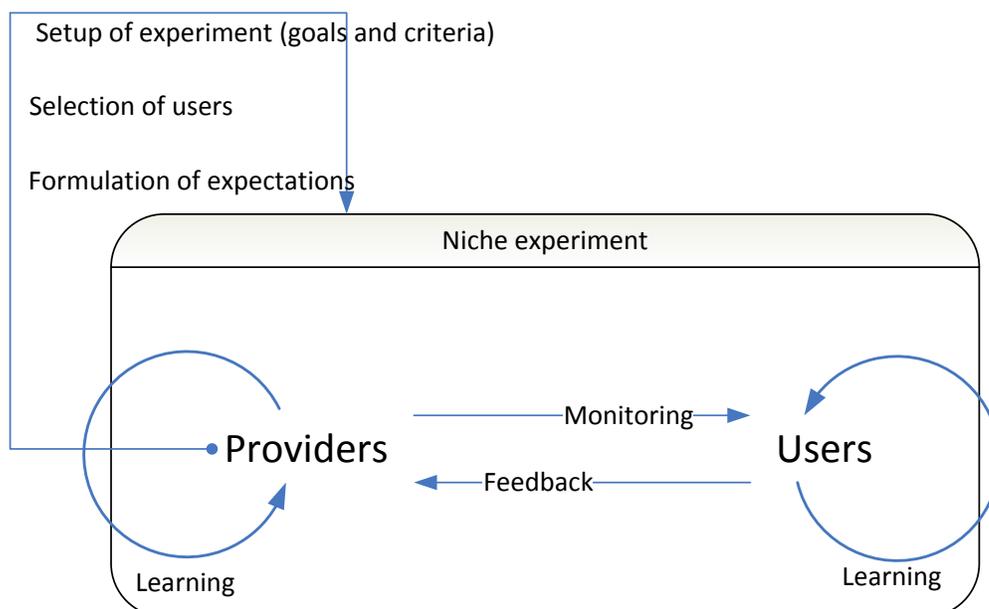

Figure 1: Conceptual model

Method

This chapter elaborates on the research method of this research. It starts with the operationalization of the research, its research design and ends with the sample selection and the validity and reliability of the research.

Operationalization

Providers can get a lot of feedback from users. In order to find out to what extent users are involved, indicators must be found. It is especially important to find out whether users are used for more than just market research but are really involved in the niche experiment. The following tables give an overview of the topics covered in the interviews with the providers for every case.

Table 1: Setup of the experiment

Description	Indicator	Example interview question	Possible answers
Setup of the experiment	Criteria and goals for experiment	Were there any criteria for setting up the experiment? If so, which?	Involvement of different stakeholders, Focus on charging, range, other…

In the tradition of SNM a careful selection of the environment in which the experiment takes place should be made. This is important in order to have clear learning goals and to be sure what mechanisms of the new technology are tested in the experiment (Kemp et al., 1998). This can be seen in table 1.

Table 2: Selection of users

Description	Indicator	Example interview question	Possible answers
Selection of users	Distinction between different users	How are the users selected for this experiment?	Coincidence, age, region, other…
	Knowledge about the users	What information do you have about the users in the experiment?	Age, preferences, other…

Not only is the selection of the environment in which the experiment takes place important. Table 2 shows the careful selection of the users in the experiment, which is also important. It enables the ability to learn from the experiment. Because not all possible users will be able to give proper feedback, it is important to know which kinds of users are involved in the experiment. The indicators for the selection of users are based on the research of Lettl (2007).

Table 3: Expectation of the experiment

Description	Indicator	Example interview question	Possible answers
Expectations of the experiment	Formulated expectations	What are the expectations in this niche experiment? How are these expectations formulated?	Learning, user feedback, experience, other…

Expectations are important to formulate in order to build successful niches (table 3). Focus should be on specific expectations, shared by multiple actors and substantiated by ongoing projects (Elzen et al., 1996; Hoogma et al., 2002; Raven et al., 2010).

Table 4: Monitoring

Description	Indicator	Example interview question	Possible answers
Monitoring	Formalized monitoring channel	In what way(s) is the experiment monitored?	Measuring, involving users (face to face, website, telephone…)
	Involvement of users	On what topics is feedback asked from users in this experiment?	Charging, product, experience, image…

In line with the goal of this research about the role of users in niche experiments and the way they interact with the providers of the experiment, it is important to know to what extent the users are involved in the experiment and how the monitoring is formalized. This can be seen in table 4.

Table 5: Learning from the experiment

Description	Indicator	Example interview question	Possible answers
Learning from the experiment	Expectations and achieved goals	To what extent are the learning goals (with regard to users) achieved?	Interaction was difficult because of…

In order to shed light on the interaction between providers and users in the experiment, it should be known if the learning goals are reached with the current interaction patterns and to what extent first-order and second-order learning are present (van de Kerkhof and Wieczorek, 2005; Schot and Geels, 2008). This is shown in table 5.

Not only the opinion of the providers is important, the extent to which the users experience their participation is also of importance. This way, friction between the provider and the users of electric mobility can be found as well as possible improvement from the user perspective. The following tables give an overview of the topics covered in the interviews with the users for every experiment.

Table 6: Commitment of the user

Description	Indicator	Example interview question	Possible answers
Commitment of the user	Information about the experiment	What information did you receive about the experiment?	How to drive electric car, instruction book, other
	Goal of the user	Why are you participating/ have an electric car?	Climate change, new technology, fun, forced, other

The commitment of the user (table 6) is important to know, in order to place the perception of the user in perspective. If the user for instance did not receive any information beforehand, it can explain possible friction between the goals of the provider with the experiment and the goals of the user in the experiment, which could explain a possible lack of second-order learning.

Table 7: User involvement in the experiment

Description	Indicator	Example interview question	Possible answers
User involvement in the experiment	Involvement in the experiment	On what topics is feedback asked from you in this experiment? And, in what way?	Charging, product, experience, image, preference, other… Face to face, website
	Satisfaction about involvement	What are the reasons you are (un)satisfied about your involvement	Interest in my experience, other…
		Do you feel you could contribute more? In what way?	Driving/charging experience, other…

In order to investigate the interaction between the providers and users in the experiment it is important to ask users about their involvement in the experiment. Users should have the feeling they are able to contribute to the experiment in order to have their full cooperation and to benefit from their ideas (Madhavan and Grover, 1998; Mascitelli, 2000). This can be seen in table 7.

Table 8: Learning

Description	Indicator	Example interview question	Possible answers
Learning	Learning by using	To what extent do you experience differences with a gasoline car?	Automatic gear instead of manual, other…
	Second-order learning	In what way did your expectations about EV change in the experiment? Why did this change?	No change, positive change, negative change, other…

Because the participants in the experiment make use of charging infrastructure and electric vehicles they probably learn by using these products. These learning experiences should be transferred to the providers by giving solid feedback that helps the transition of the electric vehicle in the Netherlands. The assumptions of the users can also change. They might have associated electric vehicles at the start of the experiment as difficult and inconvenient. During the experiment this might have changed towards a more positive attitude. It could also be the other way around. This can all be seen in table 8.

Research design

Literature provides the insight that user involvement is important in experiments in order to have a successful transition towards electric vehicles (Mascitelli, 2000; Smits and den Hertog, 2007; Caniëls and Romijn, 2008; Schot and Geels, 2008). The function of this research is explorative in the sense that there is a focus on in-depth learning mechanisms of user involvement in experiments in practice.

Multiple case study approach

The approach of the research is a multiple case-study approach. An exploratory case study is the preferred method when a 'how' or 'why' question is asked (Yin, 2002), as is the case in this research since the goal is to find out how user involvement and interaction are shaped in experiments with electric vehicles. Every experiment is seen as a unique case with different stakeholders and its own characteristics. Multiple cases can gain multiple insights in the role users play in experiments within a transition because each case will give in-depth insights in the

role users play in that specific case. For every case background information will be collected. For in depth information about the involvement of users, interviews will be held with both the users and the providers of the niche experiments. Because of the uncertainty about the role of users in this transition, the range of answers from interviewees should not be limited. Since interviews enable to gain rich and detailed insights from the interviewee and give the opportunity to explain questions and clarify answers (Frechtling and Sharp, 1997), open questions in a semi-structured interview will be the most appropriate way of data collection in every case.

It is important to have the unit of analysis straight in qualitative research, especially when studying the quality of interaction between two parties, because different foci will lead to different outcomes (Sofaer, 2002). The unit of analysis in this research is the experiment, with a specific focus on the interaction between users and providers in these niche experiments with electric vehicles in the Netherlands.

Sample selection

Within the Netherlands, AgentschapNL has a list of (almost) all electric mobility projects. Not all of these projects are of interest for this research. Some of the projects within the total of 80 are about charging infrastructure which lies outside the scope of this research. Within the projects with users of electric vehicles a selection is made for four specific cases based on personal mobility with multiple users in order to get more information. Multiple interviews can lead to different perspectives on user involvement in a specific case. In every niche experiment, two or three users and at least three providers were interviewed. Interviews with both users and providers in experiments will shed light on the interaction between these two parties in niche experiments from multiple perspectives. Multiple interviews with providers are held to find out if the expectations and goals of the project are clearly formulated and communicated throughout the project. This implies the interviews are not compared in order to find out who of the interviewees is 'right', but in order to get both broad and in-depth insight in the expectations, goals and communication channels in the project.

The four cases that were selected are an experiment in the area of Rotterdam, one in Den Bosch, an experiment at Rijkswaterstaat and an experiment of Greenwheels. The first case, in Rotterdam, is the largest experiment with electric vehicles in Europe with 75 electric vehicles. The municipality is involved as main partner, together with the electricity company Eneco and the infrastructure company Stedin. The second case, in Den Bosch, is an experiment with several pool cars in a joint garage. Multiple organizations are involved and able to make use of the electric vehicles. The third case, of Rijkswaterstaat, is a case were a big, governmental organization, tests electric vehicles in order to find out whether it can be used within the organization. Finally, the fourth case is the case of Greenwheels. Greenwheels is a car sharing company with their typical red cars parked at their own parking spots all over the Netherlands, especially in cities. They try to fit in electric vehicles within their business concept.

Unfortunately, not in all cases users could be interviewed. The experiment of Greenwheels has 10 electric cars within their car sharing formula, but the management would not allow the researcher to interview the users of these electric vehicles. However, Greenwheels did provide the outcomes of their users' research. Table 9 shows the interviewees of the providers and the number of users interviewed for each case.

Table 9: Interviewees

Interviewees			
Name	**Organization**	**Project**	**Nr of users**
Lode Messemaker + Jos Streng	Rotterdam	Rotterdam	3
Henk Fidder	Stedin	Rotterdam	
Sandra Neuray	Eneco	Rotterdam	
Jaap Willems	Den Bosch	Den Bosch	2
Jimmy Ottevanger	Prolease	Den Bosch	
John Theeuwes	Avans	Den Bosch	
Henk de Boer	Brabantwater	Den Bosch	
Frank ten Wolde	Rijkswaterstaat	Rijkswaterstaat	3
Mark Bolech	TNO	Rijkswaterstaat	
Derk van Rossem	Leaseplan	Rijkswaterstaat	
Rick op den Brouw	Greenwheels	Greenwheels	0
Robert Motshagen	Municipalities	Greenwheels	
Eric Woittiez	Essent	Greenwheels	

Validity and reliability

All cases are analyzed on the basis of qualitative interviews with stakeholders. Interpretative qualitative research often comes with problems of trustworthiness. Several criteria are therefore developed to uphold the validity and reliability of qualitative research of which credibility and transferability are the two most important. Credibility is concerned with the focus of the research and how well the categories cover the data (Graneheim & Lundman, 2004). This research tries to make use of data triangulation in order to guarantee the credibility of the research. Data triangulation consists of multiple interviews to ensure that the same questions could be answered by multiple sources involved in the investigated area. This will help to reduce biases like politically correct or socially desirable answers and will thereby also increase the reliability of the data. Triangulation in the sense that multiple cases are under investigation gives a more reliable insight in transition experiments with electric vehicles in general.

Transferability (or external validity) refers to the extent to which the method of this research can be applied in other cases with a different focus and a different context. This study is specifically focused on experiments in the transition towards electric mobility which makes it transferable to other transition experiments, especially sustainable transitions in a transport context.

Often, qualitative research attempts to generate impressions based on a review instead of what was observed or heard in the interviews, the raw data, which makes it important to distinguish between the observations and the researcher's interpretation (Sofaer, 2002). In this research all the reports of the interviews are checked by the interviewees in order to prevent the researcher to code his own interpretation in stead of the observation.

Coding

After conducting the interviews they should be analyzed in order to find out if the interviews match the other data sources about the case. With the help of coding (Corbin and Strauss, 1990), the interviews can be compared to each other, other documents about the case and with other cases. The interviews will be structured towards concepts from literature about niche experiments and the derived conceptual model used in this research. The overarching, thematic

codes of the interviews are derived from the conceptual framework, based on insights in niche experiments. Insights from SNM, user involvement and transition management are used as some kind of 'sensitizing concept' (Blumer, 1954), as opposed to definitive concepts. Definitive concepts have a clear reference and benchmark, but sensitizing concepts lack this kind of identification. Concepts in theories within the literature streams of transition management and SNM are all definitive concepts, but here used as sensitizing concept in the way that they are not literally used in the interviews. The semi structured interview with open questions is based on insights from these literature streams and only propose direction in the interviews. The interviewees have all the space to give their view on the way interactions are shaped and maybe should be shaped in experiments. The interview questions are included in Appendix A and B.

After structuring the interview within the overarching codes from the sensitizing concepts, the interview is sent back to the interviewee to check whether the researcher did not put any interpretations of his own in the interview. After the return of the interview and some feedback the researcher can start with the next coding phase, axial coding. In axial coding, categories are related to subcategories and a further development of categories takes place next to the existing ones (Corbin and Strauss, 1990). With this type of coding, underlying principles could be found. A list of all the codes of the interviews with the providers of the experiment is included in Appendix C. The codes of the interviews with the users are included in Appendix D.

With the help of official documents of a case and the interviews, a description of the case can be given. All themes from the conceptual framework will be touched upon in order to find out in what way interactions are shaped in experiments with electric vehicles in the Netherlands. After this is done, the cases will be both compared to each other and to the theory in order to shed light on the differences between theory and practices.

Case Results

This chapter gives the results of the cases under investigation in this research. Every case will first be shortly described by some facts about the duration of the experiment, the organizations involved in the experiment and other basic information. Hereafter, the results from the interviews with the stakeholders will be described.

Case 1: Rotterdam

Description

The Rotterdam experiment is one of the biggest experiments in Europe with a total of 75 electric vehicles, and is one of the nine projects within the Dutch 'electric testing grounds'. Three organizations are involved in the experiment, namely the municipality of Rotterdam, Eneco and Stedin. The results of this case are based on the project plan for the experiment (Project plan Rotterdam, 2009), interviews with Jos Streng and Lode Messemaker from the municipality of Rotterdam, Henk Fidder from Stedin, Sandra Neuray from Eneco and interviews with three users participating in the project.

When looking at the project plan it shows the experiment in Rotterdam is part of a bigger sustainability program called 'Rotterdam Climate Initiative'. This initiative has a focus on improving the climate for the benefit of people, the environment and the economy. It has a target to halve the CO_2 emissions of 1990 in the year 2025. The sustainable mobility program within this initiative is divided in three approaches namely, the clean use, clean vehicles and clean fuels. Clean use focuses on the reduction of distances driven and the change in behavior. Clean vehicles focus on the more efficient combustion engines and other technologies. The clean fuels have a focus on the replacement of fossil fuels by other, cleaner, fuels. A combination of the clean vehicle and clean fuel approaches resulted in a project plan for an experiment with clean vehicles. Electric vehicles are one of these clean vehicles. The project with electric vehicles has five main goals (Project plan Rotterdam, 2009):

- Practical experience with a large group of electric vehicles of different models and brands. Not only the usage, but also the management, maintenance and the comparison with a reference group of conventional cars is important.
- Get insight in energy flows and energy use of electric vehicles in different applications.
- Practical experience with customer identification and payment systems.
- Get insight in decentralized generation of sustainable energy and direct supply to electric vehicles.
- Get insight in the safety in usage of electric vehicles for both company processes and the environment.

These main goals should give insight in a lot of uncertainties involved with electric vehicles. Some goals are more specific to one organization than another, because all organizations have different focus areas. Eneco, as an energy company, is responsible for the customer identification and payment systems in their own developed charging spots called NRGSPOT. Stedin as a grid administrator is responsible for the construction, expansion and maintenance of the grid, with a special focus on the load of the electricity grid and the decentralized generation. The city of Rotterdam has a focus on the air quality in the city and the transition towards

sustainable mobility in the city. Information from the interviews will hereafter be described, structured by the main topics from the theoretical framework and the operationalization.

Setup of the niche experiment

At the beginning of the experiment there were multiple partners and multiple goals involved. Overall, all parties wanted to experience electric driving in practice with several goals in mind. Eneco is, according to the interview, especially interested in the charging infrastructure and insight in possible business cases with electric vehicles. The energy use in the whole energy chain is therefore important just like the total cost of ownership in comparison with a conventional car. For Eneco it is therefore especially important that the cars in the experiment are on the road. The project is also placed in the section business development and not as an innovation project which makes the pressure on the project bigger. Next to this, Eneco wants their car fleet to be as sustainable as possible. The interview with Stedin indicated a focus on the grid impact of electric driving and Stedin also wants to find out in what way the car fleet could be more sustainable. The city of Rotterdam is especially interested in the impact electric vehicles have on air quality and the impact electric vehicles have on the public space according to the interview. Parking spots reserved for electric vehicles and home charging are potential problems for cities when electric driving becomes mainstream. Next to this, the city also wants to learn about innovation projects and collaboration with other parties in the project. Knowledge from experiments should be open to everyone in order to create broad learning experiences.

In order to achieve the goals, the organizations formulated some criteria for the experiment. The criteria for the subsidy from the Dutch government played a big role in the setting of these criteria. Therefore the original goal of decentralized generation is not incorporated in the experiment. With the incorporation of decentralized generation the electric vehicle experiment would also be partly an experiment with smart grids, which was not allowed in the subsidy criteria according to the interview with Stedin. It was important for the involved parties in the experiment to have a big pool of cars with a lot of different cars. In the eyes of the concerned parties this was important to have enough comparison between cars and to have enough data for statistical analyses. In order to stimulate the driving in the electric vehicles, Stedin deviated from their company rules. Normal lease car users in Stedin are not allowed to drive their car for personal use, but the electric cars are allowed for personal use. The deviation from the company rules has the goal to stimulate the users in the experiment to make use of the electric cars. In the interview with the municipality of Rotterdam, the interviewees explained in which way the electric cars were protected. Almost all electric cars in the experiment only charge behind the fences of the organization in which they are tested. Because of this protection there are no troubles with vandalism at charging spots or stolen charging cables.

All involved parties had the freedom to choose the cars they wanted in the experiment. The city of Rotterdam had bad experiences with converted vehicles and therefore gave the advice not to use converted vehicles. Of the 75 cars in the project, 30 are however converted cars from the firm AGV, that was declared bankruptcy in November 2011. Extra costs and a bad service for broken converted cars is the result. Stedin and Eneco did choose for the converted cars because these cars were readily available at the time the project plan was written and the cars were ordered. The warning from the municipality about their bad experience with these converted vehicles was of less importance than a quick start of the experiment for these companies. In the interviews with Stedin and Eneco a difference surfaced about the way they looked back at the order of the converted cars. Stedin sees it as part of the problems that come along with

experiments. One of the reasons the Dutch government gives subsidy is to deal with these problems. Therefore the interviewee from Stedin still thinks the decision was the right one because innovation projects are always risky and if you want to change something, someone has to start experimenting. In the interview with Eneco, the decision was regretted. The interviewee there told that the decision to order converted cars was not the right one with hindsight. At that time however, Eneco wanted to start with the project. But if the decision could have been changed, Eneco would have waited for manufactured electric vehicles instead of a quick start with converted cars.

Selection of users

Again, all three parties involved had their own selection mechanisms of the users in the experiment. The city of Rotterdam simply looked at the expiring lease contracts within their car fleet. Within this group, a talk with the manager would clarify if the user of that car was a good option for an electric vehicle. The user should for instance not drive more than 100 km a day. In Stedin the selection procedure was slightly different. At Stedin there are a lot of mechanics who work from their homes with a Stedin car. Their work area should therefore not be too big for an electric vehicle. The other criteria for Stedin employees who were eligible for driving an electric car were their motivation to participate and the availability to charge at their home. There were too little users who met these criteria which led to the usage of a lot of electric vehicles in a pooling system. Most potential users were not very enthusiastic in the beginning about getting an electric vehicle. They did not like the idea to be monitored in every move they made with the car. Next to this, the interviewee from Stedin indicated that new initiatives in companies are often difficult. Eneco selected all mechanics that drove less than 100 km a day. These mechanics are known because all company cars are monitored about the distance they drive. Next to this, the managers of different departments would then select the most probable enthusiastic drivers for an electric car.

Some of the personally assigned electric cars driving in the experiment are not converted. At Stedin it was striking to see, according to the interview, that these cars are much more used than the cars of the mechanics. The five personally assigned Volvo's drove all between the 2000 and 10000 km within 4 months. The converted vans for the mechanics drove far less. The mechanics who were used to have a conventional van really did not like the electric converted van. Mechanics that did not have a van before are pleased with the electric van. In the interview with Eneco the mechanics turned out to get negative about the electric vehicles after the first problems with their converted cars. The ones who really got in trouble with the range of 100 km for their work got their conventional car back. In these cases Eneco searched for new mechanics for the electric vans according to the same criteria.

Expectations of the experiment

The expectations were not particularly high regarding the range within Eneco. The converting company promised a range of 160 km while the parties relied on a range of 100 km. In practice, especially with cold weather, this is not always achieved. Expectations about the technology were for all parties that electric vehicles would not have the same possibilities as conventional cars. These expectations were however not shared with each other. All interviewees had their own expectation about the technology or the project, but did not formulate this in a project meeting, at least not documented. All interviewees also mentioned that they wanted to go 'blank' into the experiment.

Asking interviewees about their expectations of the experiment often led to expectations about electric driving in general. The expectations within Stedin are now that the next generation of electric vehicles in four years will be better than the current generation but that the transition will at least take 15 years. The city of Rotterdam believes that the goal of the EU to have zero emission in cities in 2050 can only be achieved with electric vehicles. In the coming years they therefore expect a higher percentage of the car fleet to become electric. Electric vehicles will, according to the interview with the city of Rotterdam, in the coming years only be attractive for companies because the cars are simply too expensive for individuals. Eneco now sees a lot more problems within the experiment than they had expected. There were no difficulties expected with installing charging spots in cities because of its sustainable image. However, in a lot of cities, other than Rotterdam, it is very difficult to install charging spots at the homes of the mechanics working for Eneco. At the start of the project, the garage where the electric vehicles charge, had no GPS signal which made the monitoring of the NRGSPOTS in these garages impossible. All together, the whole project is much more time consuming than was expected at the beginning of the project.

Monitoring

Laborelec is the external party responsible for the monitoring. All the data from the cars, NRGSPOTS and distribution centers are analyzed by this party. Also the surveys filled in by the users are analyzed by Laborelec. In the interview with Eneco it was made clear that the measuring in this experiment is also new to the monitoring party which makes it sometimes hard for all participants because no one knows the 'correct' answer.

In order to measure the whole energy chain the energy in and out of the distribution centers is measured, the energy in and out of the NRGSPOTS is measured and the energy into the car is measured. Within the car the energy per km and distance driven is measured. Between all these measuring points, differences in energy flows are measured which is interesting information for both Stedin and Eneco. In order to monitor the users they have to fill in a survey every quarter of a year. All users also have a logbook in the car to fill in experiences during their driving. Information from the logbook should be emailed towards the organization but according to the interview with Eneco this is often forgotten by the users. Therefore the users are called to tell about the information in the logbook. All this information comes together in a report every three months and is discussed in the project meeting which takes place every three weeks.

In order to communicate outcomes towards the users, a website was constructed. Within a few weeks the first results should be published on this website where some users are registered. Most mechanics are not registered on the website which is a problem according to the interview with the municipality of Rotterdam. Only the users that have a car for personal use seem to be registered on the website. The website is meant to share experiences between the users and also to communicate the outcomes. In February 2012, an event was organized for all users in order to communicate the goals of the project, to give the possibility to ask questions and to share expectations. According to the municipality of Rotterdam, the monitoring party Laborelec will make an application for the website which will automatically update the monthly results from the measuring boxes in the car into understandable graphs.

Learning from the experiment

Undeniably not every aspect of the experiment runs without problems is what all interviewees agree on. None of them really experience this as a problem, because the technology is tested in an experiment. Most of the goals formulated beforehand will be met and the experiment

definitely gives a lot of insight in the electric driving experience. One thing which is striking is the difference in the appreciation for the electric car within the group of mechanics. Mechanics that were used to having a conventional car do not like the electric car, while mechanics that were used to not having a car at all do like the electric car.

In the interview with Eneco the thought occurred that for a small experiment a group of 75 vehicles might me too big. All interviewees seem to agree on the fact that the enthusiasm of the project team affects the enthusiasm of the users in the experiment. This makes the task of a project team more than only the monitoring of the experiment, they also have to motivate according to the interview with Stedin. At the municipality of Rotterdam, the interviewees felt that in future experiments a closer interaction with the users would be preferable, but also difficult to arrange. Rotterdam also shares the learned outcomes with other projects since they are also involved in other electric driving experiments. All the interviewees agreed on the fact that this experiment will continue in the upcoming years when the subsidy stops.

User commitment

The three users in the experiment all have an electric car for their working activities. One of them drives a van with his team, but all the interviewees use their electric vehicle on a daily basis. In all cases their direct boss imposed the electric car on them. One user did not like this and the other two users accepted it. They agreed on the fact that little information was given beforehand about the project. The users did get a short introduction on how the car was started, how the charging worked and how the payment system worked. The information day in February 2012 was to most a nice day and to one interviewee a day with too little space for users to participate and too little information about the technology and charging. All cars have a small information book and a logbook to write down experiences.

The information given is not very detailed. One of the users was for instance not aware of how he could open the engine hood. Also the information about the charging infrastructure is poor according to the interviewees. Most of them only charge the car at the office, but it is difficult to find out in what other places the car can be charged. In one case the interviewed user has an electric car which he often charges at the office. There are however two other colleagues with an electric car and only two charging spots. According to the interview it happened more than 10 times in six months that all charging spots were taken and the interviewed user was not able to charge his car. Fortunately he was often able to borrow somebody's gasoline car. All electric drivers now exchanged telephone numbers on their own initiative to contact each other when this happens again.

User involvement in the experiment

According to the users there does not seem to be special attention for them in the experiment. Most of the communication goes via their manager and two of the three users where called about the experiences with electric driving. The other user got a survey sent by e-mail. This survey was especially about what options were present in the car like heating and a navigation system. Problems with the heating in the car was for instance that the button for turning up the heat eventually turned out to be a button for switching between personal use of the car and using the car for business. This user did give some information about his troubles with the car at the user meeting in February but missed questions in the survey about these topics. In the interview, this user explained his feelings about being thrown into the deep end. When there was a problem with the car for six weeks, there was for instance not a backup car for his

activities. Fortunately there was a spare car of a colleague that was not used, but these kinds of events do not contribute to a positive feeling about the experiment for the interviewed user.

The other two users that were interviewed felt less negative about the experiment. Both users accepted the fact they had to drive in an electric car. One of them did get feedback by e-mail about a telephone interview, the other did not. The user who was devoid from feedback would have liked feedback about the telephone interview. To him, it was not a big problem, because he would make use of the electric vehicle anyway.

Learning

One of the users really like the way the electric car drives. Troubles with the car are the fact that it does not make any noise, and in a city like Rotterdam this is sometimes dangerous. He also misses the power in the car. The electric vehicle always charges in a garage and to drive the car out of the garage the car has to drive upon a hillock. Without a 'run-up' of the car, it is impossible to drive upon the hillock. Problems with the duration of the charging are not that problematic because this user has a conventional car as a backup. All users agreed on the fact that the acceleration of their converted car was poor. It is also experienced as difficult when unexpected drives occur: every drive has to be planned. One of the users also does not really trusts the cars range. For a meeting in Utrecht, this user carpooled with a colleague who has a conventional car. In theory, the distance between Rotterdam and Utrecht and back, especially with charging the car in Utrecht, should not be a problem. The interviewed user acknowledges that it should not be a problem, but simply thinks it is too risky.

All users explain that problems with electric driving do not diminish, but that they get used to the troubles. They learned to plan their drives and learned to judge under what circumstances the car performs best. One of the users thinks about buying an electric car for personal use, but only if the cars become as expensive as regular cars and will have an increased range. The second interviewed user expects to drive the electric car for his work in the upcoming years because he works at a sustainable and 'green' company. The third interviewed user hopes to get a conventional car in the future.

Case 2: Den Bosch

Description

This case in the city of Den Bosch is an experiment with a pooling system in cooperation with several companies near 'Paleiskwartier', together with the municipality of Den Bosch. The stakeholders involved are Prolease, Mobility Mixx, Brabant Water, the municipality of Den Bosch, Koning Willem 1 College, the Court of Justice, Avans Hogeschool, HAS Den Bosch, Tribal and Ricoh. Together they have 11 electric vehicles at their disposal. Not all of these stakeholders make use of the electric vehicles. Prolease is leasing the cars, Mobility Mixx provides the booking system for the cars and the municipality is responsible for the infrastructure. These stakeholders do not make use of the electric vehicles. The results of this case are based on the project plan for the experiment (Project plan Paleiskwartier, 2010), interviews with Henk de Boer of Brabant Water, Jaap Willem of the municipality of Den Bosch, Jimmy Ottevanger of Prolease, John Theeuwes of Avans Hogeschool and interviews with two users.

When looking at the project plan the main goal of the experiment is to find a proper business case by combining electrical driving with car sharing for companies and other organizations in 'Paleiskwartier', Den Bosch. There are also six sub goals:

- Sustainability. Electrical driving with sustainable generated energy is important to take steps towards sustainability.
- Commuting with public transport. The use of an electric pooling car fleet leads to less reasons for employees in the area of Paleiskwartier to drive to work with their own car because they have the availability of pooling cars for business trips.
- Make electrical driving accessible. With the car sharing concept a big pool of users (employees in Paleiskwartier) can experience electrical driving.
- Strengthening of the lively and sustainable image of Paleiskwartier. The use of electric vehicles will strengthen the livability around Paleiskwartier.
- Testing electrical parking and charging. The use of electric vehicles will grow in the next years and there is no clear legislation for the parking and charging of electric vehicles in public areas.
- Experience and scaling. Electric corporate car sharing is seen as an important solution to organize electric driving in a feasible and affordable way. If this pilot is successful, this concept can be scaled up to the rest of the Netherlands.

These goals are shared amongst the involved parties in the project. Despite the difficulties of electric driving like the small range and long charging time, the involved parties feel an electric corporate car sharing experiment is the best way of using electric vehicles. In the project plan they acknowledge the difficulty of this experiment because both car sharing and electrical driving are still relatively new.

Setup of the niche experiment

Brabant Water, one of the participating companies in the experiment, took the lead for the experiment according to the interviews. In the interview with Brabant Water, the interviewee explained the choice for a pooling experiment. The company already had a pooling fleet where most cars drove distances that would perfectly fit for electric vehicles. If anyone is able to book an electric car, it would become easier for more employees to experiment with electric driving. Besides, some of the conventional cars needed to be replaced and the replacement for electric cars could partly be subsidized. Therefore, subsidy criteria were quite important for this experiment. In the interview with the municipality of Den Bosch the example was that one of the subsidy criteria from the province of Brabant was that most of the costs should take place in this province. The municipality took care of more participants in the experiment by inviting the signatories of the sustainability covenant of Den Bosch. In the interview with Avans, one of the signers of the sustainability covenant, it was confirmed that the setup of the experiment was largely taken care of by Brabant Water in advance. The setup of a pooling experiment fitted into the ideas of Avans because they wanted to create an extra, sustainable, transportation possibility for their employees. Prolease, the involved leasing company is involved because they wanted to learn and pioneer with electric vehicles. Knowledge of the cars they lease is vital and before the experiment there was no knowledge at all about electric vehicles. The only criteria the experiment had to meet, according to the interview with Prolease, was the sharing of possible downfalls in the costs in the experiment. Hereby, Prolease kept a flexible attitude with the use of their regular terms and conditions.

The goals of the experiment are described above with information from the project plan. All interviewees confirmed the focus on the viability of a future business case for electric driving in a car sharing concept. Another goal was, for most interviewees, to learn as much as possible. Because of the novelty of the technology, little was known about electric driving beforehand.

These learning goals were however different for the several stakeholders. The municipality is especially interested in parking exploitation by the municipality in public spaces according to the interview. Free parking spots for electric vehicles at a charging spot have a negative influence on the cash flow from parking spots for the municipality. Brabant Water however wants to show to their employees that electric vehicles are usable between their two offices in Den Bosch and Breda, 42 km from one another. Next to this, electric vehicles give a green image to the company. According to the interview this is important for a water company because no one is aware of the activities that take place at a pump station of such a company. With the ambition of Brabant Water to be a green company it is important to propagate this in some way. In that case it is better to really contribute to a more sustainable society than only use some kind of 'window dressing' with for instance a mini windmill on the roof of the office, according to the interviewee. In the future, the ambition for Brabant Water is also to involve individuals that live in the area of Paleiskwartier in the car sharing pool. The main goal for Prolease is simply the gathering of information about electric vehicles in the experiment for their possible future business case. For Avans the increase of people's awareness about mobility is an important goal. An internal investigation showed 25% of their employees could use the bicycle for commuting but almost everyone uses their car. With the possibility to use an electric car, Avans tries to stimulate employees to rethink their way of transportation according to the interview.

Selection of users

In the interviews with both the municipality of Den Bosch and Prolease it was evident that the involved companies had their own responsibilities for the use of the electric vehicles in the project. There were no selection criteria formulated within the project team. A central booking system for all companies, operated by Mobility Mixx, is the only centrally decided agreement with regard to the users. According to the interview with Prolease the original idea was to start small and get the teething problems out of the way before a large group could make use of the cars.

In the interviews with the participating organizations, Brabant Water and Avans, it was evident that both organizations had no strict selection criteria for the potential users in the experiment. Avans chose to send an e-mail to all 600 employees in one office to alert them about the experiment. 20 employees chose to participate. Because of some teething problems, little use was made of the electric cars by these employees. Brabant Water chose to promote the electric vehicles actively amongst the departments with the highest use of the conventional pooling fleet. Within these departments, Brabant Water tried to select the most positive people to prevent negative association with the concept of electric driving in the company. Also because of the teething problems, little use was made of the cars. Both companies now want to start a new, more intensive promotion because most teething problems seemed to be solved. Avans again e-mailed their employees and 15 new employees responded. These people will get a small training before they can make use of the electric cars. Brabant Water will start a more intensive promotion after the holiday period by promising for instance a price to the most intensive user of electric vehicles in the experiment.

Expectations of the experiment

When looking at the expectations of the project beforehand, the expectations were merely too optimistic. Avans for instance has two electric vehicles at their disposal but indicated in the interview that they have troubles making intensive use of these two vehicles. While at the start of the experiment this was expected to be no problem at all. In the interview with Brabant Water, the expectations about the users were highlighted. A more enthusiastic reaction of the

users was expected in this company. Instead of being enthusiastic about a new technology and the ability to experiment with it, a lot of employees reacted reserved and afraid because of its novelty. According to the interview this was definitely not expected. Related to this unexpected reaction is the big impact peripheral issues have on electric vehicles. A negative experience with, for instance, the booking system of the electric cars resulted in an overall negative feeling about the electric cars and was communicated as such amongst colleagues. These reactions were very much underestimated according to the interview, but such underestimations are maybe necessary to start an experiment at all. The interviewee mentioned the possibility of the cancellation of an experiment if the expectation is that no one would make use of the electric cars in the experiment.

All interviewees expect more use of electric vehicles in the future. In the case of Prolease they think of more electric vehicles in general just like the municipality of Den Bosch. They want more projects like the project in Paleiskwartier in Den Bosch to give more companies the possibility to experiment with electric vehicles. At Brabant Water the expectation is that all pooling vehicles in the future will be electric and at Avans the idea is that the new transportation possibility for their employees can save costs in the future. Overall, all interviewees indicated that they would probably learn a lot from the experiment.

Monitoring

In all the interviews the focus on technical learning was emphasized. Measuring instruments are built in the electric cars to measure the energy flows in the car. According to the interview with Brabant Water the charging time, energy use per kilometer and the overall energy use are measured. The monitoring instrument is built in by Prolease. None of the companies have a regular survey or other information channel for their users to share their experiences. According to the interview with Brabant Water, such a survey is not needed because problems with the car find their way from user towards project team anyway. Most of these problems are well known problems like the range and the lack of charging infrastructure. Within Avans there is the ambition of starting with a survey for the users but this is not yet customary. The interview with Prolease revealed that besides the technical information from their measuring instruments, the users contacted Prolease when having problems. Because Prolease is leasing the cars, the users contact Prolease in cases of empty batteries or other downfalls of the car. That way a lot of problems and experiences became familiar to the project team. In the ideal case the user experiences would came through the participating organizations according to the interview with Prolease. One thing which is seen as striking by the interviewee is that at the start of the experiment most users only contacted Prolease for problems they encountered with their electric car. Because Prolease is the organization the users have to contact in cases of emergencies or problems, Prolease encounters that users that call for problems tell more about their experiences in stead of only complain about problems they have had.

According to all interviewees, the start of the experiment had some technical difficulties which forced them to focus on these problems instead of focusing on users. There was for instance no GPS-signal in the garage where the electric cars are parked which meant there was no possibility of measuring the behavior of the battery during charging time. Also the decrease of the range of the cars in cold weather was not something that was thought of in advance. Now these small problems are managed the focus is still on the technical aspects of the experiment. In the beginning of the interview, students of Avans Hogeschool monitored a part of the experiment and presented this for the project team. Main conclusions according to the interview with Avans were that the project should be easier and more reliable for the users. This led towards an

easier booking system for employees of Avans, but because the main part of the booking system is centrally managed by the external party Mobility Mixx, it is still complex according to an interview with one of the users from Avans. For all the problems at the different participants and to stay up to date, there are project meetings with all involved organizations once a month.

Learning from the experiment

All interviewees agree on the fact that much is learned during the experiment and that it gave real insight into electrical driving. Especially in the beginning of the experiment there were many technical problems with the monitoring system. Because of these problems the experiment was not very much promoted amongst employees of the companies which led to little use of the electric vehicles. An unexpected problem that occurred with the little use of the cars was the running down of a second, accessories battery, even when the car was charging at a charging spot. This led to troubles starting the cars which eventually led to a first negative experience of a lot of employees of the involved companies. According to the interviewees this led to a false start of the experiment and according to the interview with Brabant Water, Nissan informally acknowledged it to be a manufacturer problem of their electric car. Especially in the beginning of the experiment this led to much technical learning.

Next to the technical learning, all interviewees acknowledge the importance of users. Negative experiences of users are quickly spread according to the interview with Prolease and the interview with Brabant Water. It showed the conservative attitude of people when confronted with a new technology. People are often not that willing to be flexible with a new technology but need to change their behavior for an experiment like this. The users also pointed towards de difficulties with booking the cars according to the interviews with the municipality of Den Bosch and Avans. Avans changed the booking system internally as much as they could, but with the whole project they are looking for an easier way of centrally booking the cars according to the interview with the municipality of Den Bosch.

No one undermines the importance of the project and the learning which has taken place. Prolease even makes use of their experience with electric vehicles in the experiment in advice to other customers. But the interview with Avans showed the difficulties with the information from the experiment for a good business case. This interviewee still sees the experiment as good but feels the use of cars in the experiment should rise in order to speak of a successful experiment because the main goal was to find an appropriate business case.

User commitment

Both users interviewed within this experiment were at first not involved in the experiment. The interviewee from Brabant Water indicated he often drives longer distance and wanted to wait for experiences with electric vehicles from colleagues. The project leader from Brabant Water personally asked for his participation and he agreed. The interviewee from Avans got an e-mail about the experiment just like all of his colleagues. Because of the many e-mails every day he first did not notice the one about the experiment. Besides, he was already carpooling with a colleague with his own car and the electric vehicles were only available for business trips. Therefore he was not interested when he heard of the experiment. When he heard the electric vehicles were barely used in the experiment he asked for permission to use one electric car for personal car pooling use with his colleague. This was approved of by the project leader from Avans which led to his participation in the experiment.

There were plenty of reasons for participation in the experiment. The interviewee from Brabant Water wanted to experience electrical driving and wanted to contribute to sustainability. The interviewee from Avans had the same reasons as his original carpooling reasons. It is more fun to drive with a colleague to work, it is better for the environment and it saves costs. An extra benefit in the case with an electric vehicle of their work was the higher flexibility of the usage in comparison with their own cars. According to the interviewee, everyone wants to bring his own car back home at the end of the day. Not because you do not trust a colleague with your car, but because you may want to drive to a party or want to go shopping. With the electric vehicle from their work as poolcar it does not matter who takes the car home, as long as you can drive together to your work the next day.

User involvement in the experiment

As the interviews with the providers of this experiment indicated there is no structured feedback mechanism for the users within the experiment. Every involved party is responsible for their own users. This is reflected in the interviews with the users. The interviewed user from Brabant Water indicates there is no structured survey about his experiences. Problems with the electric vehicles or experiences are often shared with the car fleet manager but it is not clear whether the fleet manager communicates these experiences towards the project team. Obviously, there was no reaction on feedback from the user so far. The interviewed user from Avans has a different experience. He is aware of three different feedback moments of which he attended two. There was one lunch, one telephone survey and one survey by e-mail. According to this interviewee it is difficult to give feedback because everyone has different experiences. A colleague mentioned the difficulty to drive an electric car, while the interviewee thinks the driving is pretty easy. At least the different feedback moments showed, according to the interviewee, that Avans is trying to get all the information form their users. There is however, also in the case of Avans, no reaction given on the feedback from the users.

Both users indicated they like to drive electric cars in the experiment. The interviewee from Brabant Water indicated the importance of a flexible employer. In the case of a traffic jam with an electric car with an almost empty battery it is important that the employer gives an employee the freedom to work at home or somewhere on the road while the car is charging. Therefore, it would be helpful if there is an easy way of getting a charging spot at your home address according to both interviewees. Both interviewees also mentioned the difficulties with the booking system. The central booking system of an electric car gives a card number which refers to a card at the reception of your company. At the reception, the receptionist has to give this card and with the card the key of one of the electric vehicles can be used. Sometimes however, the wrong card number is given, or the closet with keys will not open or a car with an almost empty battery is booked. The dependency on different people in the process, of whom it is not clear who is in charge, makes it sometimes difficult.

Learning

Although there are troubles with the booking system, the interviewee from Avans indicated the problems are decreasing. Especially because the first time is always more challenging than the twentieth time you do something. The interviewee from Brabant Water also acknowledges the learning curve he is going through as a user. Both users feel the Nissan Leaf is a great car, but just as any other electric vehicle, the range and the long charging time is a problem. An increase of the range would make the other problems less important according to the interview with the user from Avans. Both would see a charging spot at their homes as an improvement. The user from Brabant Water also thinks more could be learned for both users and providers of the

experiment if users are allowed to make personal use of the car and thus not in a pool experiment. Besides the troubles, both users indicated they learned a lot in the experiment about the electric car. The more you use the car, the easier it becomes to book the car and use it, although the user from Avans indicated the driving in electric cars as 'idiot proof'. There is not much you can do wrong. The sharing of the experience of electric driving and the better ability to make use of the electric car is satisfying but the range stays problematic, although the estimation of the range becomes easier.

Case 3: Rijkswaterstaat

Description

The experiment within Rijkswaterstaat is an experiment with 24 electric vehicles. With a total of 1750 cars in their fleet, the Dutch government chose Rijkswaterstaat for this experiment because of their capacity to 'back up' electric vehicles with conventional cars when necessary. Because Leaseplan is responsible for all lease cars in the Rijkswaterstaat fleet they are involved to lease the electric vehicles. TNO is involved as a research partner and responsible for the monitoring.

The results of this case are based on the project plan for the experiment (Project plan RWS, 2010), interviews with the project leader of Rijkswaterstaat, Frank ten Wolde, Derk van Rossem, who is involved with Leaseplan and Mark Bolech who is involved from TNO as monitoring party. There were also three interviews conducted with users involved in this experiment.

When looking at the project plan, the goal of the experiment is to find out if electric driving is a viable option for the car fleet of Rijkswaterstaat (RWS). Overarching goals of the government are a more sustainable transport system in 2020, the strengthening of the energy position of the Netherlands and a structural impulse to the economy. The experiment tries to answer the following nine questions in three categories.

Surroundings:
- What are possible consequences for existing electric facilities?
- What are possible consequences for other road users?
- What level of sustainability will be reached?

Product:
- What kind and how much maintenance is needed?
- What kinds of user effects are visible?
- Are the already existing safety measures sufficient for large-scale usage of electric vehicles?

Users:
- Which behavior and change of behavior is visible in the users?
- What is the user experience on both the short term and the long term, especially with regard to safety?
- What are the costs of usage, both variable and fixed?

These questions should give insight in the three focus areas: the surroundings of electric vehicles, the product and the users. The questions are therefore divided amongst these three focus areas.

With the help of the research questions, the criteria for the experiment were formulated which led to the establishment of the experiment. For instance, the question about the possible

consequences for existing facilities focuses on electric facilities which imply that a criterion is that charging facilities should be monitored at any given time. For all of the nine research questions, sub questions are formulated as well as a description of the importance of the research question and the criteria needed for answering these questions. For instance, the possible consequences for current facilities is divided in two sub questions about how much electrical current is needed and which patterns in charging behavior can be seen. A question about the impact on other road users does not have sub questions. It only has a description about the need of interviews or surveys to question the users about their view on the impact they have in traffic. Information from the interviews will hereafter be described, structured by the main topics from the conceptual model and the operationalization.

Setup of the niche experiment

Because different parties and ministries of the Dutch government looked at the project there were different goals and mindsets. Some focused on sustainability, while others focused on the costs. An external party, Ecofys, formulated the goals and intended learning outcomes but had to deal with the political interference. The interviewees did not experience this as disturbing, but it was something they had to deal with. Still, they feel the responsibility under one ministry since 2010 is good. A few years ago the responsibility for electric driving was divided between two ministries which led to ambiguity in the focus according to the interviews. At this moment, the ministry of economy, agriculture and innovation (EL&I) is responsible for electrical driving in the Netherlands which led to a more economically oriented focus. The interviewees also acknowledge the change in worldview of the society that will have to occur because electrical driving is at the start of a transition.

With regard to the goals of the experiment the interviewees named two overarching goals. First of all, RWS wanted to find the best way to integrate electric vehicles into their car fleet. The second goal was to find out in what way electric vehicles would fit into the business of RWS. These two goals together where more or less derived from an overarching goal of the Dutch government to have 25% of the car fleet electric in 2015. According to the interviews, the Dutch government wants to be on the learning curve for electric driving because of the high potential they see in electric driving.

There were several reasons for an experiment with electric driving for RWS. Firstly, the size of the car fleet was perfect to have conventional back up cars. Secondly, RWS recognizes the importance of CO_2 reduction in the future and thirdly, RWS wanted to practice what they preached about sustainability and the future for electric driving.

In order to find answers to the basic questions some important topics were selected. First, the total cost of ownership would be investigated and second the differences with a conventional car would be under investigation. Especially with a focus on the range and all variables that could influence the battery, like the weather. Other topics on which RWS wanted to learn were how the car was used, how safe the cars were and how much maintenance was needed. Little was known about these topics because making use of EV in the 'real world' was relatively new.

As mentioned before, criteria were set to meet all the goals of the experiment and to be sure they would test what the project team wanted to test. First of all it was important that the users involved in the experiment voluntarily participated, and were not forced to make use of EV. Secondly, the importance of the availability of backup conventional cars was high because the expectation was that electric cars would not be able to fully compete with conventional cars. With the availability of a backup car it was easier to see under what circumstances people would

choose for the electric car and under what circumstances they would prefer a conventional car. To get an even better insight in the usage of electric vehicles, three types of usage were involved in the experiment. Some cars were assigned to one user, who can use the car for commuting and his or her work. Other cars came in a pooling fleet and can thus be booked by a large group of people. The third type of usage is as a car for the field service. In that case the car is assigned to a small group of people that use the car only for work purposes. An experienced partner was therefore needed with a lot of knowledge with regard to mobility and operational affairs. This became the lease party that already leased all the cars in the RWS fleet. The lease party did not have a lot of information on electric cars and their goal is to learn as much as possible about these new types of cars. Especially the costs in the first 3 to 4 years are important when leasing cars. In that sense the project with RWS is too small for the lease party, but it does give a first glance for their possible future market. According to the interview with TNO, the formation of the criteria was not very structured.

Selection of users

The project team wanted to select users that participated voluntarily and who were enthusiastic, but not always succeeded to do so. In some cases people were personally asked because it was well known they were interested in electric driving. In other cases departments were asked for involvement of some interested users. However, sometimes, the decision was made for the department that they should cooperate in the experiment. The 'involuntarily' involved departments are often the departments where the electric vehicles are hardly used. In the interviews this was seen as striking since a criterion for users in the experiment was a voluntary participation, but the reason can be found in the project plan. According to the project plan and the interviews it was important that the electric vehicles were used in all forms cars were normally used within Rijkswaterstaat. This means as a pool car, personal car and as service car. In principle, the car is used for one or two quarters of a year by one person before the car goes to another department to give as much people as possible the opportunity to experience electric driving. In addition the focus was at first hand on the triangle Amsterdam, Utrecht, Den Haag. Apparently some offices were forced to use electric vehicles when there were no volunteers at some important offices with regard to a certain type of car use. Both interviewees from the project team and interviews with users indicated this as sometimes problematic. Despite the intention to select enthusiastic users, there was no special selection of the users according to the interviews. Leaseplan wanted users that were as much as possible like 'normal' lease drivers. Since regular lease drivers often also go on vacation with their leased car this was not possible for the experiment. Leaseplan chose to deal pragmatically with this constraint because setbacks are inherent to electric vehicles and experiments. In the cases where departments could not find enthusiastic users and the electric cars were nevertheless put down, the experiment is not a big success. People at those offices are afraid to drive in the electric vehicles because they have no idea how everything works and what the range is of a charged battery.

TNO organized a meeting for all the interested departments about the goals of the experiment and electric driving in general. This event was well attended by these interested departments, but probably not by the departments that were not interested but still had an electric vehicle. The project team has contact information of all the users involved in order to contact them for monitoring purposes. It is also known in which of the three types of car the user drives.

Expectations of the experiment

Interviewees had troubles formulating the expectations they had about the experiment beforehand. The focus was mainly on expectations in general about electric driving and the future of electric vehicles. In that respect, all interviewees agreed that the expectations from the government now seem to be too high. The goal of 25% electric vehicles in the RWS car fleet is simply too high. Some technical difficulties and less use of the electric cars than expected, is what makes the costs relatively high and what makes it hard to implement EV in society. With a higher use, the financial data would have looked better for instance. Despite this, it is clear that EV is well applicable for personal use. First results show that cars for personal use are better used than the pool cars, probably because people have to get used to the different kind of usage of the car. This will only grow because more and more people will re-think the way they transport themselves. Therefore the expectation now is that RWS will grow along with the market in the usage of EV. Main reason is the inability of the market to deliver enough electric vehicles to meet the goal of 25%. With 24 electric vehicles in the car fleet right now, the expectation is that this will be 160 cars in 2015, which is 9% of the RWS fleet.

Monitoring

There are basically three ways of gathering the information in this experiment. First of all there is a black box in every car that measures for instance the energy use in the car and the distance driven on one battery. Normally the car industry has a monopoly on this kind of information and in the interviews with TNO and Leaseplan the difficulties with installing this black box were highlighted. By making clear which specific information the black boxes of the experiment could extract from the cars the car manufacturers agreed. There is however no track and trace in the cars and also no measuring of the life cycle of the battery. These two things would have been too costly and, although interesting, not the most important to know according to the interview with RWS. Secondly, all users get a survey every quarter of a year with 17 questions about safety, driving experience, charging and usage of the car on a ten point scale. In principle, the users get this survey before they use the car, and a few months later when they stop using the car to make the difference between expectations and experience explicit. The surveys were adjusted on the basis of previous completed surveys and other monitoring information. Before the experiment there was an interview round with several potential users and at the end of the experiment there will be a concluding interview round if possible. Thirdly, all the information from Leaseplan about maintenance and damage is monitored. When a car is brought to a garage, they ask permission at Leaseplan to fix the problems. This way they will find out whether electric vehicles have the same kind of problems like conventional cars and how often they have problems. All this information is discussed in a quarterly meeting with the project team.

Learning from the experiment

RWS would like to tell a positive story about electric vehicles, but this is no requirement. The experiment is allowed to 'fail'. However, by gathering all the data the project team learns a lot, which makes the experiment almost per definition a success. Some insights the project already gave are the better use of electric cars when a car is personally assigned to one person. The pool cars are used less and according to the interviewees this may have to do with the fact that unknown things are often unloved. The availability of conventional cars in a carpool park shows that distances bigger than 30 km are almost always done with conventional cars and not with electric cars. There seems to be no trust in electric cars on longer distances. This really gives insight in possible business cases for the future.

The electric vehicles in this experiment are not as much used as expected. Because of the low usage, the costs per km are relatively high which gives an unnecessary negative idea about the costs of electrical driving. In the interviews, the awareness was present that care should be taken for an adversely affected public opinion. Without the backup of conventional cars there should have been more learning and a lower amount of costs per km. However, the backup of conventional cars does give insights in the situations where people have distrust in electric vehicles and helps to do the business as usual for RWS within the experiment.

The experiment helps Rijkswaterstaat to communicate towards the society about electrical driving because they speak from personal experience. With the experiment they also show the importance of sustainability according to the interviewee from Rijkswaterstaat. If the costs of the experiment will stay a problem, the interviewee thinks a part of the budget can be derived from the communication budget because the experiment really helps the communication department of Rijkswaterstaat in formulating sustainability statements.

User commitment

All the three interviewed users indicated that there was a lot of information given about the experiment. There is a book in the car with information about the car and charging, and some even got a small instruction about the car. One interviewed user was asked to be ambassador for his department because of his enthusiasm for electric driving. They organized a meeting for the 130 people working at that office and 15 people came to hear about the project, its goals and to drive in the car. Eventually, all 15 participated in the project. For the remainder, most of the things about the car were for your own experience. The interviewed user did not indicate this as a problem; it is a good thing that everyone can experience the planning of trips with an EV, the charging and characteristics on his own. However, a course about for instance economical driving would have been helpful according to another user. Even now, it would probably have value, during the experiment. Despite the lack of a course, all interviewed users experienced the information that was given beforehand as sufficient.

However, the reasons to participate were very diverse. One person wanted to participate because he wants to stimulate electric driving from a sustainability perspective and because he is in charge of a pool system. Another participant did not want to know anything about sustainability because there is not enough information for a single user to state that EV is better for the environment. She participated because an electric car seemed to be perfect for her responsibilities within RWS. The third interviewee calls himself a real 'petrol head' and monitors everything around cars. He really likes the innovative character of the experiment and to be an early adopter of a new technology. The freedom in the usage of the car within the experiment is therefore really good according to him. All users were involved because they showed interest in some way in the experiment with electric driving.

User involvement in the experiment

All the users filled in the survey several times. The survey was sent before the first drive, during the participation in the experiment and at the end of the quarter of a year when officially the car should change to another user. The questions in the survey were about the whole driving experience and performance. Some questions were regarded as strange, like the difference in using the brakes in comparison with a conventional car. In the survey is also small space for some comments.

However, the space in the survey for comments is too limited according to most users. It is hard to inform the project with your experiences when the battery fails or when other problems occur. For instance, it is known that not all electric vehicles are used in the experiment, because at some departments, people are afraid to use the car. The users experienced an enthusiastic ambassador for electric driving to be helpful. Or even only a first drive experience in a safe environment with somebody else. Both ways would probably take away the fear of people and make electric vehicles in the experiment more popular. Emotions are of such an importance with new technologies, that there should be more focus on these emotions in the monitoring. Possible solutions are a focus on 'what if' scenario's where users can fill in what happened when the car broke down for instance. Also a closer monitoring on 'example drives' would add value. A lot of people have a few routes they often drive where they face the same problem every time. Troubles on these daily routes might be easy to deal with when asked for in surveys. According to this user there should be more focus on third parties in the experiment. When he had a question about the charging of his electric vehicle in his hometown he got no answer. The monitoring of Rijkswaterstaat should give more attention to these experiences because they partly influence the way people think of electric vehicles. A broader focus on expertise in garages and municipalities would have helped a lot in certain situations. A broken electric car for instance can often not be repaired in a regular garage. One user experienced that his car was shipped to England to fix it. It makes sense that there are problems with such a new technology, but by qualitatively asking the users, a lot of information would come up faster than is the case now. With more qualitative research within the experiment, more would have been learned with regard to user preferences and emotions you're dealing with when experiencing this new technology. It is understandable that quantitative surveys are easier to conduct, but emotions behind experiences cannot be caught on a Likert scale.

For the users it is hard to see what happens with their feedback in the survey. They are also curious about experiences of other participants. There might be more value in the experiment when user experiences could be shared with each other.
Still, all participants mentioned it to be great to have a role in such an experiment with a technology at the start of its development. It is experienced as both fun and hard to make colleagues enthusiastic and to make use of the electric car in different situations. Another good thing indicated by the users is that external research is often conducted and that the project leader of RWS sends these researchers towards the users.

Learning

All users indicated that there were problems with finding charging spots, estimating the distance you could drive on one battery and the planning of every drive. At the same time, these difficulties diminish as you learn how to deal with these difficulties that are inherent to electric driving. Everyone drove in the Nissan Leaf and they agree this car is great and similar to a conventional car. Off course the range is less but overall the car can compete with a conventional car. In contrary to the smaller Peugeot iOn and the Mitsubishi iMiEV, those are both cars with a worse range than the Nissan Leaf and feel more unsafe, according to the interviewees. With better batteries and more quick charge spots it would probably be easier to make use of EV.

One payment system would also be better than the different payment systems available right now in the Netherlands. When driving in a normal way, the Leaf for instance, has a range of 90 km. When driving carefully and 'saving' kilometers, this can be more than 100 km, but eventually you want to make 'normal' use of a car. Most users indicated it as annoying that the

extension of the range of electric cars is at the expense of the comfort. When the range will be 200 km, cars like the Nissan Leaf will be perfectly applicable in the car fleet of RWS because most people at RWS don't drive more than 200 km. Right now, the cars are usable as city cars with the limited range.

Problems with the range of the car and an unclear overview of the charging facilities in the Netherlands can be written down in the survey. Feedback on the car, the use of the charging cable and other 'hardware' is more difficult, because there are no questions about these topics. Overall, experiencing electric driving and experimenting with the range and other aspects are both fun and sometimes hard to do. It is a good thing that RWS is doing this experiment. One user summarized it as follows: "A good internal experiment of RWS, with some missed opportunities with regard to qualitative questions for users and the involvement of more external parties". The external parties refer, in this case, to garages that have no idea what to do with electric vehicles or the municipalities of other cities that do not have any policy on electric vehicles.

Case 4: Greenwheels

Description

The experiment of Greenwheels is the only experiment in this research where a commercial party has a leading role and where basically every Dutch citizen with a driver's license can make use of electric vehicles. Greenwheels is a car sharing company where people can rent a car, minutes before they need it, and pay per kilometer and the time used. In this experiment, 25 of these Greenwheels cars, which can be found in every bigger city in the Netherlands, are replaced by electric Peugeot iOn's. These characteristics make the project a rather unique project.
The results of this case are based on the project plan for the experiment (Project plan Greenwheels, 2009), interviews with the project leader from Greenwheels Rick op den Brouw, Eric Woittiez of Essent and Robert Motshagen, who worked for both the municipality of Amsterdam and Den Haag. Both cities are involved in the experiment together with Rotterdam and Utrecht. Unfortunately, Greenwheels did not give permission to interview their customers, the users in this experiment. They did open up the results of the user survey (Greenwheels, 2012), filled in by 147 of the 320 users of the electric vehicles in the experiment. This case therefore gives less in-depth insight in the opinion of the users in comparison with the other cases, because no interviews with the users were conducted.

When looking at the project plan the main goal is to implement 25 electric vehicles, including charging spots, in the G4, which are the four biggest cities in the Netherlands: Amsterdam, Rotterdam, Den Haag and Utrecht. This main goal includes three sub goals:

- Introducing and stimulating electric driving in an easy accessible way for car users.
- Testing electric vehicles and charging spots within the car sharing concept.
- Testing electric vehicles in daily use by multiple users in an urban environment.

In order to implement the electric vehicles in a good way, there is a partnership with multiple partners. First of all, Peugeot is responsible for the delivery of the electric vehicles and the maintenance of these cars. Second, Essent is responsible for the charging spots and the sustainable energy from these charging spots. Thirdly, the four biggest cities in the Netherlands provide parking spaces and space for the charging infrastructure. Finally, Collect Car BV, better

known as Greenwheels, is responsible for the implementation of electric vehicles in the car sharing concept and the users. In order to reach the goals with the project partners multiple questions were framed in the categories policy development, EV in a car sharing concept, charging of EV, the technology and sustainability. Most of these questions have multiple sub questions. The main questions are respectively:

- Which developments are necessary in the area of policy and regulations for the placement process of charging spots for car sharing spaces? Related questions are about the placement process of charging spots in cities with respect to permits and objection procedures but also about the opinion of local residents.
- How suitable are electric cars in a car sharing concept, and what could be improved? Related questions are here about the experiences of users and their reasons to prefer a conventional car over an electric car.
- In what way can the comfortable charging of an electric car be ensured? Related questions here are about vandalism and user-friendliness of charging.
- What influence does intensive use have on the technical parts of the Peugeot iOn's and what are the focus points in maintenance and repairs for education and technical support from Peugeot's technical specialists? Related questions are about the knowledge level for repairs and components that should be in stock for quick repairs.
- Which contribution does the electric vehicle in practice have in the decrease of harmful emissions? Related questions are about avoided emissions in reference with a conventional car.

These main questions should give insight in the uncertainties with electrical driving for the different project partners. Information from the interviews will hereafter be described, structured by the main topics from the theoretical framework and the operationalization.

Setup of the niche experiment

To start, electric vehicles seem to be perfect for car sharing concepts. Not only the interviewee from Greenwheels indicated this in the interview, but interviews with people from other projects also see a future for electric vehicles in a car sharing concept. Because 90% of the drives with Greenwheels cars are within the range of electric vehicles, this project seems to be a unique project in the sense that the range of the cars is not an issue. This was an important assumption for the start of this project. Most of the criteria for this experiment were dictated by the subsidy criteria according to the interviewees. There were however some demands from the participating parties. Greenwheels wanted to communicate electric vehicles as 'normal' cars and thus chose not to have some special marketing strategy for the electric vehicles according to the interviewee. Next to this the intention of Greenwheels was to have the electric charging spots and the electric cars at the same time at the parking spots of Greenwheels to prevent annoyed reaction by local residents. The interviewee from the municipalities indicated that all cities had their own demands. Den Haag for instance did not want extra parking spots for Greenwheels in the city while Amsterdam did not wanted charging spots from another energy company than Nuon. Because Essent was one of the project partners this was a problem were the municipality of Amsterdam eventually turned out to be flexible by approving the charging spots to be from Essent according to the interviewee. According to the interviewee from Essent, they now deliver 50% of the charging spots in Amsterdam, while Nuon delivers the other 50%.

According to the interview with Greenwheels the goal for them was to find a business case. Electric vehicles in a car sharing concept sounded well, but as a commercial party they wanted

to find out in what way and with what costs a viable business case could be found. The interviewee from the municipalities indicated the placement process of charging spots the most interesting goal of the experiment. Different definitions between cities about these spots led to different approaches and in the ideal situation, all cities would have the same procedure. According to the interview with Greenwheels, Amsterdam wanted the charging spots, Den Haag looked at the charging spots as 'gas stations', Rotterdam thought of the charging spots as advertisement columns and Utrecht preferred no cars at all in the city. Eventually all cities cooperated, but the different definitions and procedures were time consuming. According to the interview with Essent, the original goals for them were to learn from the realization of the charging spots and usage of the charging spots. After the evaluation of the first part, a new goal was formulated to find a business case for Essent around electric cars and charging infrastructure. All interviewees also emphasized the reaction of the public as an important goal. Not only reactions from users are important, but also the reactions of local residents near charging spots. Something all interviewees highlighted as positive was the signing of a contract with all the goals and responsibilities for all parties. This way everyone was aware of the goals of the project and committed to the project because they signed, and thus were responsible for the deployment of the experiment.

Selection of users

The selection of the users was not a big issue in this experiment according to the interviewees. The knowledge Greenwheels had on their customers made it possible to select a small group of users for the experiment. According to the interview with Greenwheels they made the deliberate decision to make the electric cars accessible for all Greenwheels members. At the time of the start of the project there were some negative rumors about electric driving and Greenwheels wanted to show with this experiment that electric cars are easy to use and accessible for everyone. Every electric car has a check list about driving the car, just like the other cars of Greenwheels only adapted for the electric car. This proved to be enough for customers to use the electric cars at the opening event of the first electric car. The original idea of doing an electrical driving course for all interested customers proved to be unnecessary at this event because almost all customers had no problems at all in the first test drive.

Expectations of the experiment

Just like the goals, the expectations were also discussed in the project team which led to more or less shared expectations according to the interviewee with the municipalities. The interviewee from Essent indicated that most of these expectations were however formulated as a goal. The interview with Greenwheels showed that the expectations about the experiment were too optimistic. Regular cars have 15 users per car and because of the novelty of the electric cars; some extra users were expected for the electric cars. This did not happen; electric cars are also used by 15 users, just like the conventional cars. The delay of the delivery of the cars and the installment of the measuring hardware in the car were also not expected. Finally a lot of media attention was expected, but partly due to the start of the Arab Spring, the shoot for the RTL news was replaced by this revolution. According to the interview with Greenwheels the expected positive feedback from the public did occur. Because of the electric cars, Greenwheels is starting to really become 'green' and sustainable. The interviewee from the municipalities emphasized that changing expectations and goals are no problem and merely common in innovative projects. He also found it to be confirmed that commercial parties always underestimate the time needed for innovative projects and experiments. These projects are always more time consuming than planned in the beginning.

Monitoring

The technical monitoring is done by Greenwheels because they have the information by installing the monitoring hardware in every car, just as they do for their conventional cars. Monitoring in the charging spots is done by Essent, but is not regular analyzed according to the interview with Essent. Most of the information from these monitoring is already known. In the case of specific questions, results of the monitoring instruments at the charging spots are always available. According to the interviewee from the municipalities the user monitoring is less interesting because most things are already known; people feel the range is too low, the low noise level is great and it is good for the environment. The most interesting about users is the range they dare to drive and when they use an electric car, but this is probably also known according to the interviewee. He, however, still sees this experiment as a unique project because most experiments only drive with electric vehicles within their own company and this is the only experiment where anybody can make use of an electric car. The interview with Greenwheels indicated a survey for the users is sent every six months by e-mail. Results from these surveys are discussed in the project team and first results showed that many problems of the users are perception based according to the interviewee. This challenges the project team to deal with these problems in a different way. All interviewees indicated a survey with local residents around charging spots should be done in the upcoming months to provide insight in the way they feel about charging spots in their district.

Learning from the experiment

All interviewees indicated that much was learned already in the experiment. The interviewee from the municipalities felt that the municipalities learned the most in the early stage of the experiment about the placement process of the charging spots. He also feels that a lot of the other knowledge was not new, but the knowledge about the placement of charging spots is really helpful and is paying off already in other projects. The same goes for Essent, where the interviewee indicated they already use the knowledge derived from the experiment for placement of other charging spots. The interviewee from Greenwheels indicated that much was learned about the business case and that there is no attractive business case right now. The extra costs for electric driving, like the price of the car and vandalism at charging spots, cannot be recouped in some way for the company, but they do get a lot of positive reactions from the public. Thereby he agreed that a lot is learned about procedures. Most interviewees feel the interviews with local residents could add value to the experiment and see that the communication about the project could have been better. The choice for dealing with the electric car as a 'normal' car was with hindsight not the best decision. Because electric driving is new there are a lot of benefits for users like free parking in some cities. In the future Greenwheels will communicate this towards their customers which might lead to more usage of the electric cars.

Users

Unfortunately no interviews were conducted with users in the Greenwheels experiment. Luckily, the results of the first survey amongst the users were provided by Greenwheels for this research. Consequence is that this case will not give insight in the way the users feel involved in this experiment. However, it does give an idea about the way the users react on the available information and the way they are involved in this experiment.

The regular customers of Greenwheels are according to the survey higher educated, are 43 years in average and the male/female ratio is evenly distributed. Based on a 46% response rate in the survey of Greenwheels, 80% of the electric car users in the experiment are male in the age category between 31 and 54 years old and with a high education. Most of the respondents

(85%) had their first electric drive with the iOn in the Greenwheels experiment and 60% of them prepared this first drive by visiting the website of Greenwheels or reading the instruction book in the car. Most people had a positive expectation about electric driving and for most of the users the real experience exceeded the expectations beforehand. Despite the expectation of the project team that the range of electric cars in a car sharing concept is sufficient, 48% of the users indicated that the range is not sufficient and 51% indicated they felt the fear of suddenly having an empty battery. More charging spots would also be nice according to the respondents. The rest of the experience with driving the electric car was positive like the noise of the car, the driving experience and the safe feeling in the car. When having to choose between driving in the city, outside the city and on the highway, the electric vehicle is best rated when driving in the city. The range of the car is the variable that makes the difference between driving inside or outside the city. Charging the car takes too long according to the respondents, while a small majority of the users feel the process of charging is clear and easy. Communication about electric driving and charging could be improved since the survey did not show a clear answer whether the communication is clear and easy to find. When asked if people would recommend the electric car to others on a ten point scale the average score is a 7,5. For 65% of the users, the availability of electric cars is an extra reason to drive with Greenwheels. And if asked to rate electrical driving with Greenwheels on a ten point scale the average score is a 7,1. Recommendations from the users are for instance better information on the website and on the charging spots and more information about the charging process and the costs of charging and about the range of car when the car is booked on the website. When the car is booked, it is not known how long the car can be used and since the charging time is quite long, users experience this as annoying according to the comments. Overall, the comments hint at more communication about the small range in bad weather and information about charging spots and time.

Analysis

This chapter contains the analysis of all cases under investigation in this research. In the analyses, all cases are compared with literature according to the division made in the theoretical framework and the operationalization.

The setup of the experiment

According to the literature, the setup of an experiment is important. The environment and thus the criteria of the experiment should be in line with the goals of the experiment to make sure what mechanisms of the new technology are tested (Kemp et al., 1998). In that sense, each goal should be reflected in the criteria for the experiment. Similarities between the different cases are that for all cases the subsidy criteria played an important role. This does not necessarily mean the criteria are not in line with the goals of the experiment but it does show the lesser influence of a project team on their own experiment. The project in Rotterdam for instance wanted to incorporate a smart grid experiment in the electric vehicle experiment. Because this was not allowed in the subsidy conditions it was deleted from the project. All cases acknowledged such a big influence of the subsidy criteria on the establishment of their project. An exception in this respect is the case of Rijkswaterstaat. They chose to let an external party, Ecofys, formulate the goals and criteria. The project plan of Rijkswaterstaat therefore clearly shows in what way the criteria of the experiment are based on the goals. Off course this project also had to satisfy subsidy conditions but according to the interviews these conditions were not the most important in the formulation of the criteria. The subsidy criteria are not per definition worse to follow than own criteria since there was often overlap, like the involvement of multiple

partners in the experiment. The alignment between the goals and the criteria of the experiment should however at least be optimized by the project team of an experiment. In that respect, the Rijkswaterstaat project was the only case with a clear alignment between the goals and the criteria of the experiment. In the other cases, the link between the goals and criteria was less clear.

Next to the alignment between the goals and criteria of the experiment, an open and shared vision is important in the experiment (Raven, 2006). Greenwheels is the only experiment in this research that indicated to have written down the goals and responsibilities of all involved organizations and let them sign for it. The other experiments did mention some agreements amongst the parties involved but also acknowledge the freedom for own goals and the unawareness of the specific goals of other involved organizations. While freedom for every involved partner to chose their own goals is important, these differences should be made clear and accepted by all partners (Kemp and Loorbach, 2006; van der Laak et al., 2007). This is what did not happen in three of the four cases in this research. Only Greenwheels managed to made differences and goals explicit for the project partners. This does not necessarily mean that the vision in the other projects was not shared. However, because of the sometimes unawareness of the differences between project partners and implicit differences in these projects, the vision seemed to be less aligned than in the case of Greenwheels.

User selection

Users encounter the problems with electric driving during the experiment and should communicate this towards the project team. Because not all users can play such a role, users should be selected for their openness towards new technologies, their enthusiasm and possible use of the technology in an extreme context (Lettl, 2007). It was striking that in almost all experiments there was no real selection of users. Expiring lease contracts, or a strategic chosen location were in the case of Rotterdam and Rijkswaterstaat important criteria for the placement of electric cars. Next to this, in both cases it was tried to select the most enthusiastic users in these groups, but this proved to be hard because of the reserved attitude of employees towards new technologies. In Den Bosch the companies roughly gave all their employees the possibility to make use of the cars which automatically led to a reaction of the most enthusiastic users. Greenwheels gives all their customers the possibility of using the electric cars because they want to communicate the car as a regular car. This shows that often the selection of the users was not the most important in the choice for providing electric vehicles. It also proved to be difficult for the project teams to select the right users for their experiment. Several interviewed providers at Rotterdam and Den Bosch indicated there were not enough users that indicated to be enthusiastic in joining the experiment.

Another important aspect is the relationship with the users in the experiment. This relationship should be stable and intense according to the literature in order to transfer specific knowledge of the users (Madhavan and Grover, 1998; Mascitelli, 2000). In practice, this proved to be difficult. In advance, none of the experiments in this research composed some kind of communication protocol for an intense relationship with the users. All of the experiments however did already try to improve the communication stream towards the users or is planning to do so. The case of Rotterdam organized a user information day, but still the interviewed providers indicated that a smaller experiment and a more intense relationship with the user would improve the experiment. Interviewees in the case of Rijkswaterstaat indicated that an ambassador at every department or the selection of departments with enthusiastic users would have improved the experiment. In the case of Den Bosch a better communication with possible

users was a point of improvement and in the case of Greenwheels also a better communication was put forward in the interviews. It remains however unclear whether these improvements will take place in this experiment or is taken into account for future experiments.

Expectations

Literature warns for too high expectations in order to prevent disappointments (Verbong et al., 2006). The interviews showed that it proved to be hard in general to formulate clear expectations about the experiments. In all the cases, all interviewees see a future for electric vehicles, but often had no clear expectations about their own experiment, or too high expectations. Several interviewees mentioned they wanted to go blank into the experiment, to be open for all kinds of learning, but in all cases expectations were too high with regard to the range of the cars, difficulties with charging, the commitment of the users and technical problems. The range of the cars is known to be small for electric vehicles, but most of the project teams were not aware of the even smaller range in cold weather. In the Rotterdam experiment some users have troubles with charging because the charging spot does not give a signal when the car is charging. All experiments indicated the sometimes low usage of the electric vehicles by the users and technical problems occurring at charging spots and in cars. These high expectations led to several problems at the start of the experiments and to some minor disappointments in the projects.

It is also important that the expectations amongst the project partners are shared (Hoogma et al., 2002). Again, the Greenwheels project was the only project were, together with the goals, expectations about the experiment were formulated and written down for all participating parties. This did not lead to the prevention of too high expectations. Also the Greenwheels experiment suffered from too high expectations with regard to the use of the cars by the users. Next to this it is striking to see that almost all interviewees indicated the project is more time consuming than was thought of in the beginning.

Monitoring

Good experiments differ from bad experiments with their anticipation on unexpected problems. Such a good anticipation is necessary to prevent the experiment for having a low quality of learning in the experiment (Verbong et al., 2008). All experiments under investigation had their problems and started later than planned. Rotterdam had troubles with the bankruptcy of AVG, the party that converted conventional cars into electric cars. This led to problems with users that drove these cars. The technical monitoring is analyzed by Laborelec and discussed in every project meeting. Results will be displayed on a website for users, even as results from user surveys. Rijkswaterstaat mainly had troubles with the delivery of the electric vehicles. There is however no real feedback mechanism with the users about the project or the outcome of surveys. Den Bosch is really focused on technical learning and also had some troubles with the signal of the charging spots in the garage. These problems are now solved, but still the monitoring focuses on the technical aspects and not the users. Greenwheels also had troubles with the late delivery of the cars and no extra usage of the electric car by users. There is technical monitoring in this experiment, but also regular surveys amongst the users and upcoming interviews with local residents. This seems to be a good mix of information channels.

All experiments started with some kind of trichotomy in the monitoring. Often, there are measuring instruments in the car and in the charging spot, monitoring of the users and finally monitoring of problems with cars when they have to go to garages. The experiments do have a

different focus in the monitoring. However, most of the experiments have some kind of focus on the technical aspects of electric driving. This focus is on the energy flows, the technology in the car or the charging infrastructure. Greenwheels is the only experiment, based on the interviews that really tried to incorporate both users and local residents in the experiment although the latter are not yet involved. This is a missed opportunity for the other experiments since they focus less on the incorporation of the users in their project.

Learning from the experiment

All interviewees from all experiments indicated they learned a lot about electric vehicles and setting up the experiment. Most of the projects got, with their first results, some insight in a possible business case. However, they all learned in some way or another that users should be more involved in the experiment. The Rotterdam experiment wants closer interaction with their users in the future but is not quite sure in which way this should be organized. A user event, like the one organized in February 2012, is likely to be repeated in the near future. The Rijkswaterstaat experiment experiences a too low usage of the electric vehicles. According to the interviewees the back up by a conventional car is debit to this. Closer interaction with the users would probably also raise the usage of the vehicles. The Den Bosch experiment experienced that negative experiences of users after technical problems are hard to transform. Finally, in the Greenwheels case, the project team learned that the users wanted closer communication about the technology and the availability of charging spots. This shows the focus is not on the users because the information about the technology and charging spots is available, but not communicated towards the users. It shows the focus on technological learning in the experiments which literature warns for. Especially in experiments were there is a possibility of learning in multiple dimensions like the societal fit of the technology there is a danger of focusing on the technology (Hoogma et al., 2002). The focus is mainly on first-order learning processes which could by widened with second-order learning processes by for instance closer interaction with users in order to learn from user preferences as well

Commitment of the users

Users should feel committed to the experiment in order to let them formulate their social needs (Smits and den Hertog, 2007). All users had information beforehand about electric driving and most of the users in the different experiments rated the information as sufficient. Some felt like being thrown into the deep end, while others would have liked to have had some kind of electrical driving course. But overall, the information beforehand was not a real problem to most users.

It is easier to feel committed to something one voluntarily joined than something one was forced to do. In that sense it is not a good thing that some users were 'forced' to participate. As was described in the paragraph user selection, the expiring of lease contracts sometimes was a reason to give someone an electric car. Such a way of selecting users is often not ideal to commit users. A lot of users also voluntarily joined the experiments, but had the most divergent reasons; from sustainability, costs, curiosity and accessibility. All were arguments to participate. Whether the users feel really committed to the different projects remains ambiguous. Some of the users were enthusiastic and others accepted their role but did not show commitment to the experiment. In general, the users that voluntarily joined felt, unsurprisingly, more committed to the different projects than the ones that did not spontaneously joined a project. There seems to be a role for the providers of experiments to find the willing users and to commit them to their project.

User involvement

Close involvement with users is important for a project team in order to distract the 'sticky' knowledge of the users (von Hippel, 1994). This implies more activities should take place than just user surveys to capture users experiences, since a survey is not the best method to obtain sticky information (Lettl, 2007). Almost all users have filled in one or multiple surveys about electrical driving in their experiment. Overall, all users in the different experiments missed open questions about problems with the electric cars, most of them accepted this as a fact. But as one of the users rightly mentioned, "it is hard to rate emotions about electric driving on a Likert scale". Since all users had more or less some negative or unexpected experiences with electric driving, most of the project teams missed this information, or at least failed to obtain this kind of information in a formal way. To more or less extent, all users indicated they wanted to give more information to the project, or they wanted to share experiences with others. A user event for each experiment, maybe even with multiple experiments, was raised as an option by some users in order to have the possibility to share experiences with each other and to give each other tips. For the project teams of the experiments, there was however a clear focus on surveys in order to obtain user information instead of other possibilities. In Rotterdam there was a user event, but this event was more focused on giving information to the users than on getting information from the users according to the users interviewed.

In none of the experiments did all users get reaction on the feedback given in the surveys. Interaction with users implies information streams in two directions. The lack of reaction of project teams on feedback given by users is in that sense striking. Without reactions on given feedback it is hard for users to see what happens with their feedback which might lead to less enthusiasm by the users. At least the interviewed users indicated they would like to know what happens with their feedback and if other users experience the same problems.

Learning

Problems with the range of the electric vehicles and the long charging time are problems that will probably last for a couple more years. All users however indicated that they got better in estimating the distance that can be driven with one charged battery. They got used to the silence of the car and the possible danger for pedestrians. The differences with conventional cars are clear and are mainly linked to the range of the car and the long charging time. All the users that drove a Nissan Leaf indicated this car can really compete with conventional cars besides the range. Other cars often are associated with too little power for a small hill or hillock in a parking garage and feel unsafe because they are too small. How and what they exactly learned was often difficult to communicate towards the project team of an experiment, but almost all indicated they like to drive in an electric car once they were used to the restraints of such a car.

Conclusions

In October 2011, there were 946 electric vehicles in the Netherlands (AgentschapNL, 2011). With an ambition of 200.000 electric vehicles in 2020 it is safe to say the electric vehicle is at the start of its transition. All the experiments analyzed in this research are therefore important in this transition towards sustainable (electric) mobility. In this stage of the transition, a close interaction with users is important to complete the transition successfully (Lundvall, 1988). The research question of this research was therefore:

"In what way is interaction with users shaped in niche experiments with electric mobility in the Netherlands?"

Two other questions were important to give a good insight in this interaction namely:
-   What kinds of users are involved in the niche experiments?
-   What kind of learning takes place within the experiments?

Now, an answer can be formulated to these questions. To start with the first sub question; users in experiments with electric vehicles are not specially selected for this task. The users involved are usually employees of the companies that are executing the experiment or in the case of Greenwheels, customers of the company that is executing the experiment. This is not necessarily bad, but within a group of employees there was often no strict selection of the users. The number of involved cars in the experiment and cheap solutions, like the replacement of lease cars with an expiring contract, were more important than the involvement of the right users for the experiment. In that sense, the project teams made the wrong decision by not carefully selecting the right users. This is reflected in the results from the interviews with the providers of the experiment since they almost all have some difficulties with users and the interaction with the users. A recommendation would therefore be to think about the users the project team wants to involve in an experiment, before the experiment starts. When an experiment is running, closer interaction with the users and the opportunity for the users to interact with each other and the project team would be useful for the involvement of the users and the commitment of the users.

The second sub question about the learning experience is more difficult to answer. Providers of experiments seem to have troubles in extracting the learning experiences of users because of a too distant interaction with the users. They do learn a lot about the electric vehicle and the difficulties of setting up an experiment, but the social needs of the users and their experiences with the electric car are often not a focus in the monitoring process. This shows the focus on first-order learning experiences and explains the limited amount of second-order learning processes. At the same time, the users indicate that they do learn to deal with the electric car and they have ideas about how the experiment can be improved. First-order learning is noticeable since the users learn a lot about the technology and how to deal with electric vehicles. A small part of the users got insight in their own assumptions about electric vehicles, enabling second-order learning. In the few cases of second-order learning at the users, the providers of the experiments were not able to extract these lessons. Project teams in an experiment should therefore focus more on the interaction and the monitoring of the users in the experiment in order to extract the experiences with the technology from the users.

This together answers the main research question. Despite the important role users should play in experiments in the early stage of a transition, there are difficulties in selecting and interacting with these users. The interaction is generally one way traffic, since project teams wants users to

fill in a survey but never communicate the outcomes of such surveys. Reactions on the feedback given by users and the opinion of other users can improve the acceptance of the technology and encourage users to reflect on the needs they have. In other words, it would improve second-order learning processes for both the users and the providers in experiments.

These conclusions have a few implications for providers of experiments in practice. First of all, providers of an experiment should not only think about the setup of an experiment and the goals, but also about characteristics the users should have in the experiment and what the providers want from these users. Second, once the users are selected, a close interaction should be established. This can be done through regular user events, a user website and by giving reaction on the feedback given by the users to show what is done with the feedback. Such activities can commit a user to the experiment and will largely prevent users from being negative about the experiment. Since a goal of experiments should be to learn from the technology, a negative experience about the technology cannot be prevented, but extracting negative experiences from users does give more insight in the technology itself and its setting. It is important to keep the necessity in mind to think of these measures before the experiment and not only during the experiment when it is often too late.

Literature indicates that a close relationship with the users in experiments is important for the quality of learning in the experiment (Truffer et al., 2002; Geels and Schot, 2007; Nill and Kemp, 2009). However, most research does not have a focus on the way these interactions are shaped (van der Laak et al., 2007). This research showed the difficulties for providers of experiments to set up this interaction for a good learning experience. Users do have a lot of knowledge which would be useful to extract, but the project teams of the experiments in this research had difficulties extracting these experiences from the users. In that sense, this research can be seen as empirical confirmation of statements in literature about the importance of users. Providers of experiments clearly struggled with the way they could involve users actively in their experiment. Another interesting insight from this research is the difficulties providers of experiments have in formulating expectations about the experiment before it starts. While literature emphasizes the importance of clearly formulated expectations, in practice, almost no experiment really did formulate formal expectations. Finally, as mentioned before in literature (Van den Bergh et al., 2007; Kemp and Rotmans, 2004; Hekkert, 2010), experiments often have a too strong focus on the technology in the transition towards sustainable mobility. This has also proved to be the case for the experiments under investigation in this research.

Discussion

In this research 13 interviews with providers of four different experiments with electric vehicles and 8 interviews with users in these experiments were conducted. The results of this research therefore give a good insight in experiments with electric vehicles, but it is unclear whether this is generalizable towards other experiments in different sectors. Unfortunately there were no users interviewed from the experiment of Greenwheels. Instead of interviews, results from the first user survey were analyzed. Although this gave insight in the role users played in this experiment, the information is less profound and rich than the information from the interviews with users from other experiments.

Next to this, the selection of the cases was not based on a case study design but on the basis of availability of interviewees in the experiment and the size of the experiment. This has as a result that it remains unclear in what way the cases relate to each other and towards other experiments with electric vehicles in the Netherlands.

Finally, it proved to be difficult to ask interviewees about the expectations or hypotheses they had beforehand about the project. Most interviewees indicated they wanted to go 'blank' into the project in order to have an open mind and to learn more. This is however a questionable statement. Further research might shed light on the difference between literature that emphasizes the importance of clearly formulated expectations and the practice, where interviewees think they are able to learn more without these clearly formulated expectations.

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Appendix A: Interview questions providers

This appendix gives a short overview of the questions asked in the interviews with the providers in experiments. All interviewees were shortly introduced about the main topic of the research and its focus on the role of users in experiments. These questions were the guidance in the interviews, but because of the open character of the interviews follow up questions differed in each interview.

Interview questions:
What is your name and function in the experiment?
In what way did your organization got involved in the experiment?
In what way did you get involved in the experiment?
Were there criteria for the setup of this experiment?
        What kind of criteria?
        Why these criteria?
What are the goals of this experiment?
        Why these goals?
Are there specific learning goals?
Was there any kind of consultation with other experiments or third parties in the formulation of goals and/or criteria?
In what way were the users in the experiment selected?
        Were there any difficulties in this selection procedure?
What information do you have about the users in the experiment?
Would you say the interaction with the users in the experiment is close?
What kind of expectations did you have about the experiment beforehand?
        In what way were these expectations formulated and shared?
Did the expectations change during the experiment?
In what way is the experiment monitored, especially with regard to the users?
Which topics are under investigation with the users?
How often are users interviewed or surveyed?
In what way would you say the learning goals are/will be achieved, especially with regard to the users?

Appendix B: Interview questions users

This appendix gives a short overview of the questions asked in the interviews with the users in experiments. All interviewees were shortly introduced about the main topic of the research and its focus on the role of users in experiments. These questions were the guidance in the interviews, but because of the open character of the interviews follow up questions differed in each interview.

Interview questions:
What is your name and function in this company?
In what way did you get involved in the experiment?
Is there a specific reason you participated in the experiment?
What kind of information did you received about the experiment beforehand and during the experiment?
In what way are you able to give feedback?
      Which subjects?
      Is it possible to give points of improvement?
      How often do you give feedback?
      Did you often get reaction on the feedback given?
Are you satisfied with your role in the experiment?
      Why are you (un)satisfied?
      In what way could this be improved?
Do you feel you could add more value to the experiment?
      If positive: In what way could you add more value?
What kind of differences do you experience in comparison with a conventional car?
What are the main difficulties of driving an electric car?
Do these difficulties diminish during the experiment?
In what way did you experience a change of attitude towards electrical driving during the experiment?

Appendix C: Codes Providers

Awareness for transportation
Awareness important
Beginning experiment most learned
Big/diverse experiment
Bigger programme
Broad use
Business
Car choice
Change of goals/expectations common in innovative projects
Charging behavior
Choices with hindsight
Commercial parties underestimate time needed
Communicating results with users
Communication could be improved
Companies have selection criteria
Converted cars too expensive
Criteria too strict
Deviation from rules
Different cars
Different goals within project
Different strategy for new users
Different usages of car
Difficult project
EV applicable
EV better for personal use
Expectations about project too optimistic
External party formulated goals
Find good businesscase
Flexible criteria
Focus on technical monitoring
Goals shared
Good fit in businessmodel car sharing
Greenwheels customers
High costs
Indirect selection of users
Insight
Insight in business case
Learning about EV
Learning expected
Learnings are used
Lease party
Logbook
Lot of insight
Many technical problems at start
Monitoring by students
Monitoring energy chain

Monitoring in car
Monitoring new
More EV in future
More usage needed
More user involvement
Motivation important
Multiple goals
No flexibility in criteria
No shared expectations
No special selection of users
No special treatment
No structured selection criteria
Normal drivers
Open minded
Perception users
Poolcar system
Potential business
Promotion at specific group
Reaction individuals
Regular project meeting
Regular project meetings
Regular survey
Regular user survey
Required participation
Risk in experiment
Shared expectations
Shared goals
Standard procedure needed for chargingspots
Start transition
Street interviews interesting
Street interviews needed
Subsidy criteria important
Sustainability
Technical information
Technical learning
Technical limitations
User contact information
User criteria
User experiences via lease party
User insights not new
User motivation important
User selection
Users important
Voluntarily better
Website for user communication
Wrong attitude of people
Year experiment

Appendix D: Codes Users

Benefits EV in experiment
Broader research view needed
Car imposed
Car is great
Daily use
Deal with problems
Difficulties
Enthusiasm
EV available for department
EV not great
First not involved
First with problems
Good feedback mechanism
Good/fun experiment
Improvements on EV
Information book in car
Information day
Information EV
Leaf great car
Learning and sharing
Little information given
Little use of EV
Logbook in car
Lot of information given
Much research attention
Multiple topics
No feedback
No reaction on feedback
No special attention
Own interest
Participation reason
Planning every drive
Problems EV
Range and charging problems
Regular survey
Satisfying experiment
Satisfying role