Guidelines for market entry business development

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Executive Summary

This document *D1.4 Guidelines for market entry business development* is a deliverable of SIMBe, which is a multidisciplinary research project funded by the Tekes Sustainable Community programme. For more details about SIMBe see www.simbe.fi.

The aim of this report is to provide guidelines for market entry business development. This report builds on and complements other work done and reported within SIMBe project e.g. SIMBe deliverable 1.5 Organisational Development in the E-Mobility Ecosystem.

The uncertainty management is an underlining concept when designing market entry business development. Objective was to reduce the uncertainty by providing

- scenarios
- country comparison
- roadmap
- end user behavior analysis
- review of new the EV meanings i.e. batteries on wheels analysis chapter 4.6.

Building on that we provided an introduction of market entry use cases concluding with models to initiate the business.

The key findings in this document are:

- The shift to electric mobility from oil-based transportation is an enormous socio-technical change and requires several different changes to happen parallel and iterative thus this transition is very slow and complex.
- There is a great uncertainty which creates challenges to adapt to the circumstances of the emerging industry. Public private partnerships (ppp) are needed to share the risks.
- Electric vehicles need to be understood completely different from the traditional ICE vehicles and new meanings and services need to be designed.

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1. Introduction

1.1. Target audience

This document is targeted for an audience interested in business aspects related to electric mobility. Particularly this document is targeted to industry representatives in the field as well as academic and other researchers e-mobility.

1.2. Scope

This document is a deliverable of the Tekes research project SIMBe = Smart Infrastructures for Electric Mobility in Built Environments (see www.simbe.fi). Thus the scope of this document is within the scope of the project.

1.3. Objectives

The aim of this document is to give information to help to reduce the uncertainty by providing scenarios and roadmap. A further objective is to give guidelines for market entry business development by reviewing three market entry use cases and possible models for initiating the business.

Research questions:

- What kind of phenomenon are we facing in case of electric mobility?
- What are the scenarios for short term – year 2015 – and long term – year 2050?
- What kind of road maps will lead to these scenarios?
- What are the market entry use cases?
- What kind of models could be deployed for initiating the business?

2. Theoretical background

Value creation models and industrial value chain analysis of electric mobility have been described in our earlier report (Pirhonen et al. 2010). Understanding value creation and the networks needed to fulfil all the roles of the value chains is the foundation for the business analysis.

What kind of business models the firms can utilize for their value creation depends on their business strategies. A brief analysis of business models within the SIMBe consortium is presented in another report (Pirhonen et al. 2011). Because electric mobility is a new and emerging technological transition, we have to widen our scope and analysis to societal landscape in order to understand the development as a whole. In the following we extend our analysis deeper into this aspect and search an answer to the question, what kind of phenomenon are we facing in case of electric mobility.

2.1. Sociotechnical change

When talking about changes caused by new technologies the focus is often very strongly in technology itself. What kind of new features and possibilities the technology is going to offer for it's users or for products and applications where it will be utilized. Depending of the novelty of the technology and it's transitions it's effects in the society and the societal functions are taken into minor account.

Technological transitions are defined as major long-term technological transformations in the way societal functions are fulfilled. Technological transitions do not only involve changes in technology, but also changes in user practices, regulation, industrial networks, infrastructure, and symbolic meaning or culture. This means that only in association with human agency, social structures and organizations technology fulfills functions, not just alone (Geels, 2002).

Frank W. Geels has developed a model for sociotechnical change, which is a multi-level framework for describing technological transitions (figure 1.). The model has three levels. Micro level where technological niches provide seeds for change. The technological transition starts in these niches. Meso level represents technological regimes. Technological regimes are formed of similar routines and systems shared by engineers and organizations. Technological regimes result technological trajectories, common directions for the development. Further on the regimes create stability and guide the innovation activity towards incremental improvements along these trajectories. The top most macro level is a sociotechnical landscapes, which contains a set of heterogeneous factors like oil prices, economic growth, politics, cultural and normative values, environmental problems etc. Landscapes will change, but more slowly than regimes.

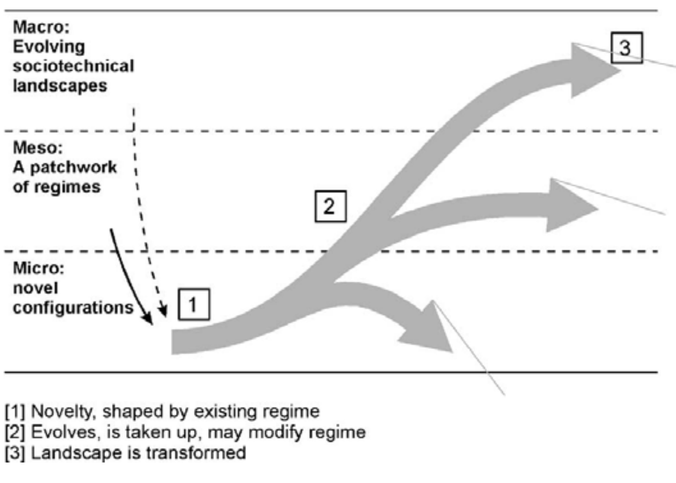


Figure 1: The dynamics of sociotechnical change (Geels, 2002)

The sociotechnical model developed by Geels is described in more details in figure 2. He distinguished seven dimensions in the sociotechnical regime; technology, user practices and application domains (markets), symbolic meaning of technology, infrastructure, industry structure, policy and techno-scientific knowledge. The dimensions are linked and co-evolve having also internal dynamics. Uncertainty and differences of opinions (short arrows) result tensions in the regularly ongoing incremental processes (longer arrows). These tensions may lead to periods in which linkages are weakening.

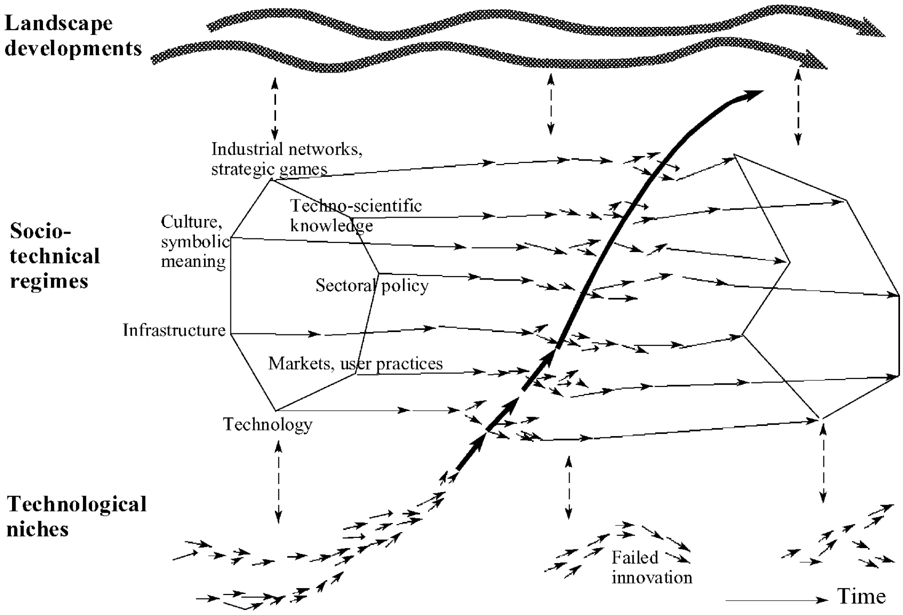


Figure 2: Framework of the sociotechnical change (Geels, 2002)

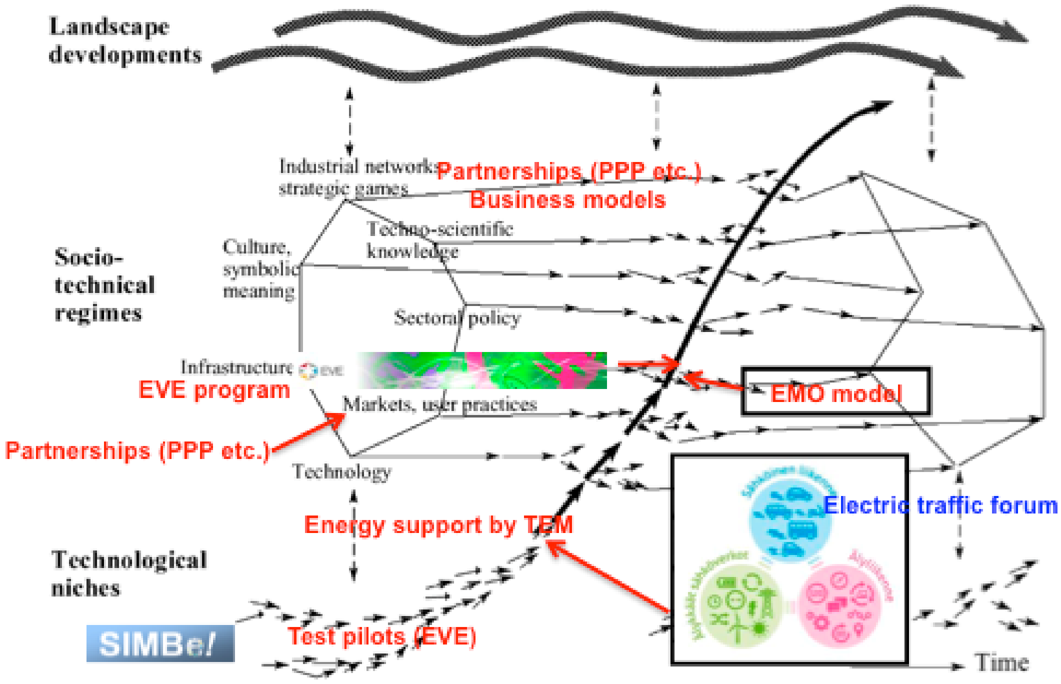
On the landscape level changes usually take place slowly due to cultural changes, demographic trends and political changes. These slowly evolving landscape developments are shown with fat long arrows in the figure. The small arrows on the niche level represent innovation efforts going in different directions, because dominant design has not yet stabilized. Radical innovations may gradually stabilize into a dominant design (arrows going longer and fatter in the figure). The major point in the model is that technical transitions occur as the outcome of linkages between developments at multiple levels, represented with vertical dotted arrows. Radical innovations break out of the niche-level when ongoing processes at the levels of regime and landscape create a window of opportunity.

2.2. Electric mobility as a sociotechnical change

Electric mobility is a good example of a technological transition. It has effects on many societal functions related to personal transportation and transport of goods. The sociotechnical model well describes the electric mobility as a sociotechnical change. The elements of this change process are many-folded and will be described in the following.

SIMBe project (2010 – 3/2012) is the first high volume project in Finland focusing in electric mobility in built environments. SIMBE has had a holistic approach in trying to understand the pig picture of electric mobility in the capital area of Helsinki. As a two years research project it has been operating as a kind of the home plate for starting to build the foundation for electric mobility’s arrival to Finland. SIMBe has been very active in open discussions with different stakeholders, both public and private organizations, and by these transactions created shared understanding between them.

Later on Tekes started the EVE programme and opened a call for test pilots for electric vehicles in the spring 2011. In connection with the EVE funding the ministry of employment and the economy decided to grant the energy investment support for electric vehicles and charging infrastructure investments. This support combination has been a very strategic signal from the government to support the electric mobility in Finland.



2011

Figure 3: Electric mobility as a sociotechnical change (background from Geels, 2002)

Another very important element in this transition has been the electric traffic initiative. The major goal of this national initiative started by Electric Vehicle Action Group has been to create an international innovation cluster in Finland for electric mobility. To start the electric traffic forum the letter of intent was signed on 21.1.2011 in Helsinki by 43 organizations. Finally this forum has been organized officially as the Electro Mobility Finland group under the Federation of Finnish Technology Industries. This is also a very strong signal from different stakeholders to demonstrate the mutual will and trust for collaboration.

New partnerships are needed in order to aggregate the well started development. Both private partnerships and collaboration with public authorities are needed in order to share risks in this progress. One promising business model is the EMO model (Electric Mobility Operator) for charging integration, which will be described later in this document.

So we can say that a very promising and positive progress is going on in this technology transition. It will take time to get all the necessary changes onto the sociotechnical landscape. But we are on the right track.

3. Uncertainty In The E-Mobility Ecosystem

This chapter is based on Giesecke (2012a, chapter 4) with tables 1 and 2 as main excerpt. The actual assessment of uncertainty was performed through a survey and within workshop discussions, all within the SIMBe project consortium. Table 1 (page 6) provides the final analysis of the uncertainties assessed. The theoretical background is documented in Giesecke (2012a, section 2.1).

Within the SIMBe project the three main areas of uncertainty, **hidden**, **complex** and **chaos**, are considered most important, whereas **complicated risks and opportunities** are considered typical for network or company internal project management. They are not in the SIMBe research scope.

Whereas Giesecke (2012a) draws conclusions from the existing uncertainties towards organisational development needs of stakeholders in the Finnish e-mobility field, in this document we use the uncertainty assessment to suggest and perform, where possible, **uncertainty reducing measures in the SIMBe project** as such.

SIMBe as a project has involved various ways of uncertainty management already:

1. Started with active stakeholder management (outcome: SIMBe project plan with its updates)
2. Recommends networking and emphasises the SIMBe consortium as an active network (SIMBe internal way of working)
3. Provides cognitive maps of, e.g. value offering and networking in Finnish e-mobility (see Pirhonen et al 2011, p. 14)
4. Regards e-mobility as dynamic system (see chapter 2) and collaboration as systemic.

Table 2 (page 7) suggests further actions to manage e-mobility uncertainty in Finland. Within the uncertainty area of complex context, the following actions are suggested regarding **market, policies and consumers**:

1. Develop scenarios and plan according to them
2. Investigate in the systemic dynamics of e-mobility
3. Investigate in the “battery on wheels” concept: what contexts beyond mobility are possible?
4. Reflect practices applied between industry and authorities, including private-public relationships
5. Apply user profiling

In this document, we perform the suggested actions in the following way:

1. We outline two scenarios, one for the year 2015 and one for the year 2050 – see section 4.1
2. We investigate the systemic dynamics of e-mobility as a socio-technical change phenomenon – see chapter 2.
3. We outline the “battery on wheels” concept as described in Giesecke (2012b) – see section 4.4
4. We investigate public-private partnerships in section 7.2
5. We investigate the end user behaviour in section 4.3

Additionally, we investigate how Finnland is positioned in international comparison (section 4.2) so that, drawing from the scenarios, we can suggest a roadmap for Finnish e-mobility in chapter 5. Last not least we address the existing **market uncertainty** with market entry use cases (chapter 6), along with models for initiating the (e-mobility) business (chapter 7).

Finally, section 4.3.3 provides a vision and mission of Finnish e-mobility, as suggested in table 2.

Table 1. Types of uncertainties – final analysis

Hidden Uncertainties	Complicated Risks & Opportunities
Technology impacts (mainly on business) • V2Home and V2Grid Market, policies and consumers • Behavioural changes in the EV adaption	Technology • Batteries and their life time costs • Performance of e-cars Business development • Organisational development • Collaboration (incl. entity building) • Availability of adequate human resources (skills, competences) Market, policies and consumers • Availability of e-cars • EV price development • Political/Social atmosphere toward EVs Public transport • Role of e-buses • Development of electric public transport
Chaos – Unidentified Uncertainties	**Identified Uncertainties (Complexity)**
Technology based phenomena • Too many designs and technologies in combination Energy policies based phenomena • Role of bio fuels and hydrogen • Energy supply mix policies • Impact on price of oil, coal and electricity	Business development • Charging infrastructure value network • Battery e-car schemes Market, policies and consumers • EV attractiveness (price, batteries, charging infrastructure) • EVs as alternative to ICE powered cars • Charging infrastructure regulation and standardization • Market uncertainty • Political situation and decision making • Political decision reliability • Increase of total amount of vehicles

Table 2 shows exemplary actions, suggested by applying theories of uncertainty management to the uncertainties listed in table 1.

Table 2. Exemplary actions to manage e-mobility uncertainty in Finland

Relate to Uncover Hidden Uncertainties	Apply Risk- and Opportunity Management
Technology impacts • Collaborate with smart grid experts to investigate technology impacts of V2Home and V2Grid Market, policies and consumers • Intensify networking and stakeholder management: describe possible networks and complete the stakeholder ecosystem • Connect to possible target groups and analyse their behavioural changes in EV adaption	Technology • Solve problems, think lateral (e.g. V2Home and V2Grid) Business development • Think lateral, take examples from other industries (e.g. “Otto” ATMs) • Avoid chasing red herrings
Develop a Vision, Apply Flexibility and Intuition	**Make Sense of the Complex Context**
Establish and promote a vision for Finnish e-mobility, based on shared values. The vision will:- • guide design and engineering work • provide more certainty to politicians in their task to establish and promote energy policies Retain flexibility and agility (Miller and Lessard 2000) while avoiding herding. Apply intuition.	Business development • Understand the operational context of e-mobility through dedicated fleet based field studies • Apply trial and error learning based on real-life large scale fleet tests • Map possible value networks Market, policies and consumers • Develop scenarios and plan according to them (see section 4.1) • Investigate in the systemic dynamics of e-mobility (see chapter 2) • Investigate in the “battery on wheels” concept: what contexts beyond mobility are possible? (see Giesecke 2012b) • Reflect practices applied between industry and authorities, including private-public relationships (see section 7.2) • Apply user profiling

4. Scenarios, End User Behaviour and Contexts

4.1. SIMBe Scenarios – Overview

In SIMBe it was produced two scenarios to describe possible e-mobility progress. Overall objective of this scenario work was to construct a shared understanding of the e-mobility development rate with all the partners in the SIMBe project.

One objective of the scenario work was to reduce the uncertainty when designing future actions both in research and business development. Naturally the scenarios are rough estimates and became outdated rather soon particularly if certain conditions change e.g. government policies. In addition the scenarios support other work e.g. roadmap working

Two scenarios were produced for the years 2015 and 2050. The key figures are provided in the table 3 and the full scenarios are provided below.

Table 3. Key figures of the 2015 and 2050 scenarios

Figures for the Greater Helsinki Area	Year 2015	Year 2050
Mode 3 charging points (max. 22kW)	1000	260 000
• in public places, incl. shopping centers, garages and parking lots	300	60 000
• in company parking lots	400	80 000
• in private (home) garages and parking lots	100	80 000
• in park-and-ride places	150	30 000
• on curb side	50	10 000
EVs on the streets	8000	180 000
• battery-electric vehicles	1 000	150 000
• PHEVs or EVs with fuel/Diesel range extender	3 000	30 000
• light EVs (registered as mopoauto or mönkijä)	900	? 000
• lorries	80	1 800
• buses (2050: 100% penetration)	20	all
• electric scooters and bicycles (pedelecs)	3 000	? 000
Grid emissions, average, in g/kWh	117/220	0
• energy is produced completely carbon neutral in 2050!		

4.2. SIMBe Year 2015 Scenario for the Greater Helsinki Area

Most of the figures below vary only a little from those of 2009 and 2010. EVs gradually enter the roads, on a rather small scale.

4.2.1. The Grid

The **costs for the end customer** for slow charging are assumed to be stable at 6c (production) + 5c (distribution) + 1.06c (tax) = **12cent/kWh** until 2015 (baseline).

The pessimistic scenario would be **15cent/kWh**.

We assume the following electric energy production mix (in brackets: used for peak load production): Finland in TWh and % for 2015-2020

- Hydro: 15 (16%)
- Wind: 6 (7%)
- CHP: 15 (16%)
- CHP-Industry: 9 (10%)
- Nuclear (current plus OL3): 36 (39%)
- Others (import + new nuclear + lauhde): 12 (13%)
- Total: 91 TWh
- average emission: pessimistic baseline **220g/kWh;** optimistic baseline (Nordic Market average) **117g/kWh;** Source (pessimistic): TEM

See also Helen Oy Annual report 2009

Overall yearly electricity consumption in Helsinki is 5.2 TWh, and in Vantaa 1.9 TWh (with 2% increase/year).
A typical minimum to peak load in Helsinki is

- July 228-497 MW
- January 499-940 MW

We assume similar figures for 2015.

4.2.2. 3. Charging Infrastructure

Normal to fast charging

We assume the following number of **mode 1** "sähkölämpöpisteet" (max. 3.7kW): **300 000 - 400 000** (all parking places other than curb side). With an in service time of 20-30 years. Of which can be converted to smart individual timing control device: 90%

We assume the following number of **mode 3** charging points as produced by, e.g. Ensto (max. 22kW): **1 000**.

With an in service time of 10 years. Of which are prepared for **feed-in** (EV-to-grid): **500**.

Which are located in:

- public places, incl. shopping centers, garages and parking lots: 300

- company parking lots: 400
- private (home) garages and parking lots: 100
- park-and-ride places: 150
- curb side: 50

We assume the following number of **mode 4** charging points (max. 400kW with 1000V DC): **5**

Of which are prepared for **feed-in** (EV-to-grid): **5**.

Recommended max. **fast charging**: **3C** (battery capacity x 3, e.g. 90kW for a 30kWh battery), equal to minimal 20min. charging.

Operation limits for Li-Ion batteries: **15-95%** of full capacity (source: EB Oy).

Typical **plug-in times** per day are **9:00-15:00** and **20:00-6:00**

See also a map of public available charging points in Finland, by Fortum

Inductive charging

Same as above, just without cable. Not likely for 2015. Minimum energy loss: 10%

Charging "en-route" not feasible for e-cars until 2030.

Battery swapping

For 2015, we assume some swapping pilots.

We assume that an amount of **15-50%** of all batteries in the EVs will be **additionally in the stores** (battery racks) at any time.

We assume that swapping time takes **1-5 minutes** (source: Better Place). We assume that **swapping makes sense for commercial vehicles** (taxis, buses, lorries) and/or if the **battery capacity** in a vehicle is **larger than 100kWh.**

Charging Intelligence

No assumptions.

4.2.3. The EVs

We assume the following numbers (note the difference between EV and e-car!):

Share of **new e-cars** (as EV or PHEV) **sold**, of all new cars in 2015: **5%**

EVs on the streets of the greater Helsinki area by 2015: **8 000**

- Battery-electric vehicles: **1000**
- PHEVs or EVs with with fuel/Diesel range extender: **3000**
- light EVs (registered as mopoauto or mönkijä): 900
- Lorries: 80

- Buses: 20
- Electric scooters and bicycles a.k.a Pedelecs: 3000

Basic data

- in 2007: 127 000 new passenger cars sold in Finland, 25 000 in greater Helsinki area
- in 2010, 2000 hybrids on the roads in Finland
- growth estimation for hybrids (not PHEVs!): 500 per year

E-car energy **consumption** in Finland: **0.15-0.25 kWh/km** (=15-25 kWh/100km)

E-car **range**: **100-250 km**

E-car average **weight**: **1 100 kg**

E-bus (full size) **consumption**: **1-1.2 kWh/km** (=100-120 kWh/100km)

4.2.4. Urban and environmental impact

Average driving assumptions are:

- overall, average car: 25-65km/day
- home-to-job and return, average car: 11-25km/day
- overall, e-car: 20-55km/day
- home-to-job and return, e-car: 11-20km/day

The following share of car drivers will migrate from cars to public transport: 5-10%
The following share of public transport users will migrate from public transport to own or shared car use: 5-10%

New forms of mobility will have a share of 5%.

4.2.5. Value network

The most active e-mobility market players in the greater Helsinki area by 2015 are:

- Helsingin Energia and Fortum
- Car sharing and renting companies
- Car converters
- Car retailers (e.g. o2media and Oliivi)
- Parking space providers
- Companies with fleets of EVs (e.g. Itella)
- Infrastructure providers (such as Ensto)
- Battery suppliers
- Service providers
- Helsinki Vantaa airport
- Cities of Helsinki, Espoo, Vantaa, Kauniainen

4.3. SIMBe Year 2050 Scenario for the Greater Helsinki Area

This scenario is driven by the assumption that one third (33%) of all passenger cars on the roads in Finland will be EVs and **half (50%) of all passenger cars on the roads** in the Greater Helsinki Area will be **EVs: 180 000**

4.3.1. The Grid

The **costs for the end customer** will most likely rise significantly **above 12cent/kWh.**

Assumption: power grid is much more connected to EU market

We assume that energy is produced completely (100%) carbon neutral

Thus the average **emission** is: **0g/kWh**

As overall electricity consumption has dropped sharply by 2050 due to price and efficiency, Finnish **energy production** is assumed to be **73 TWh plus EV consumption.**

Overall yearly electricity consumption in Helsinki is assumed to be 3.8 TWh, and in Vantaa 1.4 TWh

4.3.2. Charging Infrastructure

Normal to fast charging

We assume the following number of **mode 1** "sähkölämpöpisteet" (max. 3.7kW): **100 000 - 200 000** (all parking places other than curb side). Of which can be converted to smart individual timing control device: 90%

We assume the following number of **mode 3** charging points as produced by, e.g. Ensto (max. 22kW): **260 000**. Of which are prepared for **feed-in** (EV-to-grid): **130 000**. Which are located in...

- public places, incl. shopping centers, garages and parking lots: 60 000
- company parking lots: 80 000
- private (home) garages and parking lots: 80 000
- park-and-ride places: 30 000
- curb side: 10 000

We assume the following number of **mode 4** charging points (max. 400kW with 1000V DC): **1 000**.

Of which are prepared for **feed-in** (EV-to-grid): **1 000**.

Recommended max. **fast charging**: **10C** (battery capacity x 10, e.g. 1000kW for a 100kWh battery), equal to minimal 6min. charging.

Operation limits for post Li-Ion battery generations: **5-95%** of full capacity

Typical **plug-in times** per day are **9:00-15:00** and **20:00-6:00**

Inductive charging

Same as above, just without cable. Minimum energy loss: 10%

Charging "en-route" might be feasible for e-cars by 2050.

Battery swapping

For 2050, we assume swapping **for commercial vehicles** (taxis, buses, lorries) and/or if the **battery capacity** in a vehicle is **larger than 200kWh**.

We assume that an amount of **15-50%** of all batteries in the EVs will be **additionally in the stores** (battery racks) at any time.

We assume that swapping time takes **1-5 minutes** (source: Better Place).

Charging Intelligence

There are 6 players for charging, independent of public/company/home, the first 5 having a unique IP address (Internet of Things):

1. car owner, interested in capacity of the battery (or range of car) at a next given time in the future (e.g. "I want 80% capacity tomorrow at 8:00").
2. car, communicates the battery status (e.g. 18kWh out of 24kWh).
3. pole (on/off)
4. metering device (meters kWhs)
5. grid or electricity utility (indicates peak load times and times of overcapacity)
6. "third party" - a market participant processing all information and providing smart signals to the poles

4.3.3. The EVs

We assume the following numbers (note the difference between EV and e-car!):

Share of **new e-cars** (as EV or PHEV) **sold**, of all new cars in 2050: **50%**

EVs on the streets of the greater Helsinki area by 2050: **180 000**

- Battery-electric vehicles: **150 000**
- PHEVs or EVs with with fuel/Diesel range extender: **30 000**
- light EVs (registered as mopoauto or mönkijä): no assumption
- Lorries: 1800
- Buses: all city buses (100% penetration)
- Electric scooters and bicycles a.k.a Pedelecs: no assumption

E-car energy **consumption** in Finland: **0.13-0.3 kWh/km** (=13-30 kWh/100km)

E-car **range**: **300-750 km**

E-car average **weight**: **1 000 kg**

E-bus (full size) **consumption**: **1-1.2 kWh/km** (=100-120 kWh/100km)

4.3.4. Urban and environmental impact

Average driving assumptions are:

- overall, average car: 25-70km/day
- home-to-job and return, average car: 11-30km/day
- overall, e-car: 20-70km/day
- home-to-job and return, e-car: 11-30km/day

4.3.5. Value network

No assumption

4.4. Country Comparison

The key question of this section is *how does Finland perform regarding e-mobility, compared to other countries*? Previously international consultancy firms (e.g. Frost & Sullivan 2011, Accenture 2011, MacKinsey 2009 & 2011) tried to convince us that Finland's position is rather weak. Is this true?

In this section we perform two types of analysis, based on available (digital) literature: 1) a quantitative comparison and 2) two qualitative comparisons. Concluding, we suggest key elements of a Finnish e-mobility vision.

4.4.1. Finland in Quantitative Comparison

The quantitative comparison has three key issues: 1) data needs to be available in sufficient quality (e.g. up-to-date, reliable source), 2) data should be relevant for comparison and 3) data should be available for key e-mobility countries. Thus we started by creating a list of countries we intended to benchmark (with interesting e-mobility programmes or data) and then collated data on "typical" e-mobility figures, such as tax incentives, government spending, numbers of existing e-cars etc. Following a data quality check, we experimented with several e-mobility indicators, which ideally should be available for as many as possible countries. Finally, we chose the indicators in such way that for as many as possible countries we could provide as many as possible chosen indicators.

In the end we chose **17 countries** as well as **seven indicators**:

1. Population density: the more dense the better, as the e-mobility infrastructure needs to cover in any case a minimum density (e.g. fast charging possibilities for each 50km of road).
2. Cars per person: the more the better, as many EVs will be bought as second car per household. Also an indicator for (transport related) wealth
3. Fuel price compared to electricity price: the higher the better, as high fuel costs and low electricity prices stimulate the switch to e-mobility due to decreased costs of operation
4. Government EV budget 2009-2012: the higher the better
5. EV budget per capita: the higher the better
6. Price of ICE cars (Toyota Corolla or Auris): the higher the better
7. EV incentives for consumers (composite index): the more the better. Includes various incentives, e.g. tax reductions, one-time monetary incentives etc.

These indicators are all arranged in such way that the actual value should be as high as possible. Thus, a given country should span as big an area using these indicators, as possible. Figures 4-7 provide the overviews per geographic area.

In annex 1 we list the data sources per individual data item (indicator x country) as well as some budget key figures. The Excel table containing the actual data is available on request to the authors of this document.

The figures illustrate some phenomena which contradict consultancy firm statements. In Europe, for instance, Finland's position is not as bad as commonly predicted and in some aspects Finland can even catch up with the USA or Canada. Only the far East countries measured are positioned better, but not in all aspects. With higher incentives, Finland could even start to compete with its Nordic neighbours.

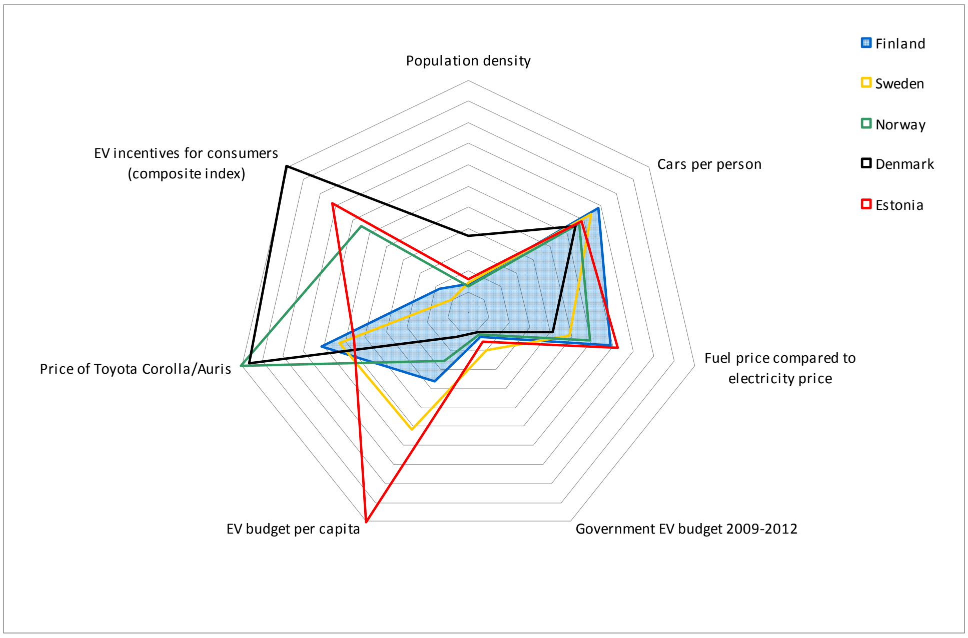


Figure 4: Finland Compared to Nordic Countries

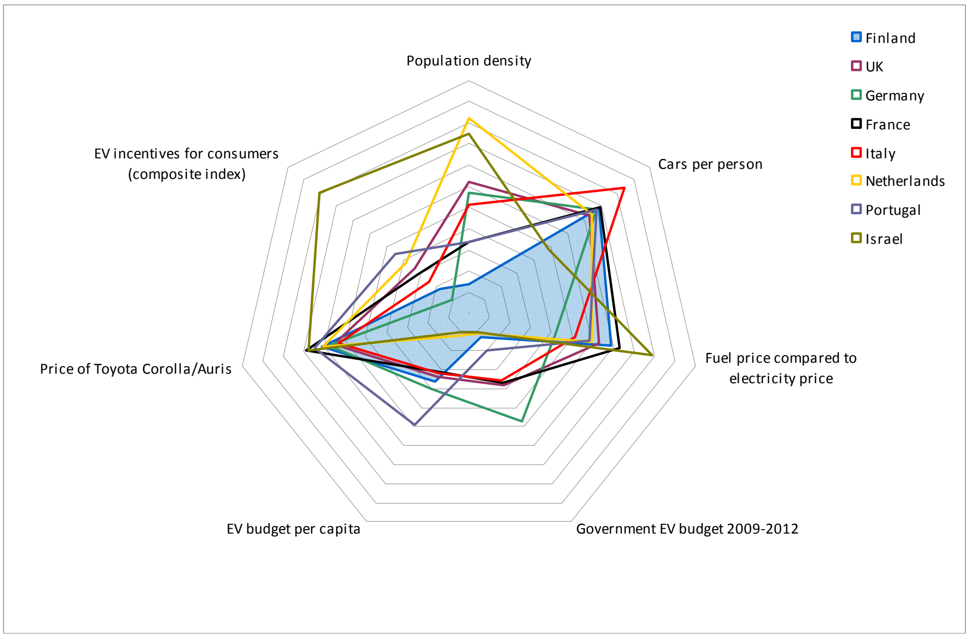


Figure 5: Finland Compared to Further European Countries and Israel

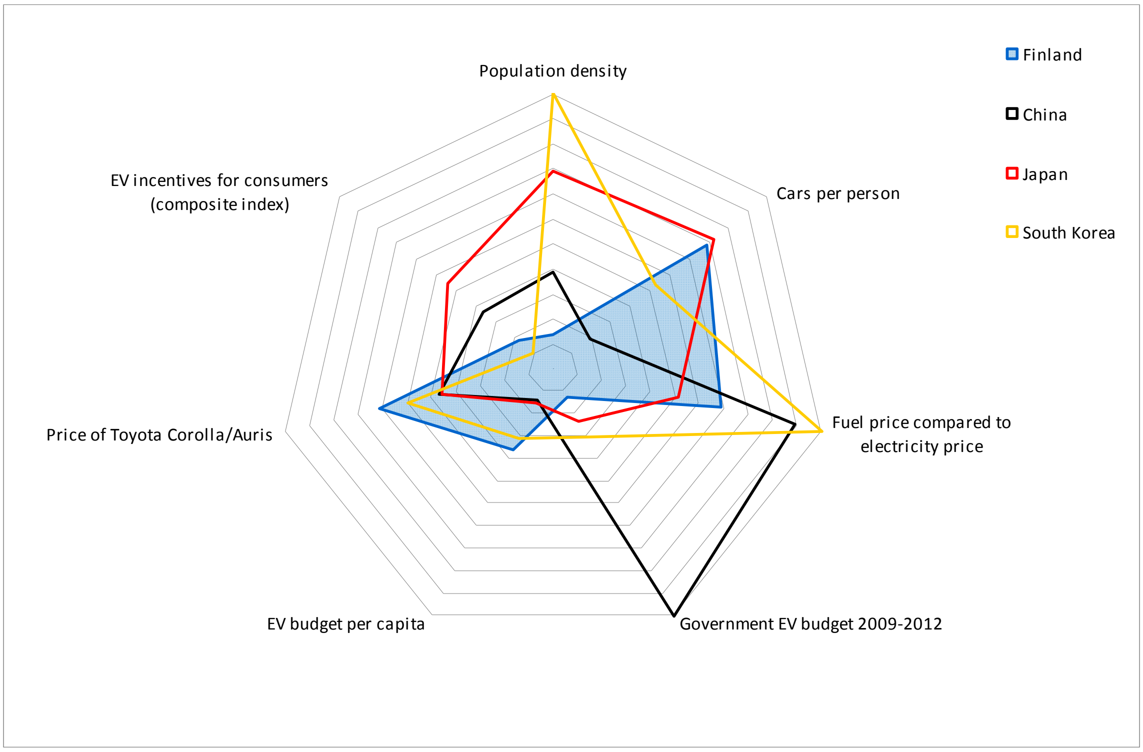


Figure 6: Finland Compared to Far East

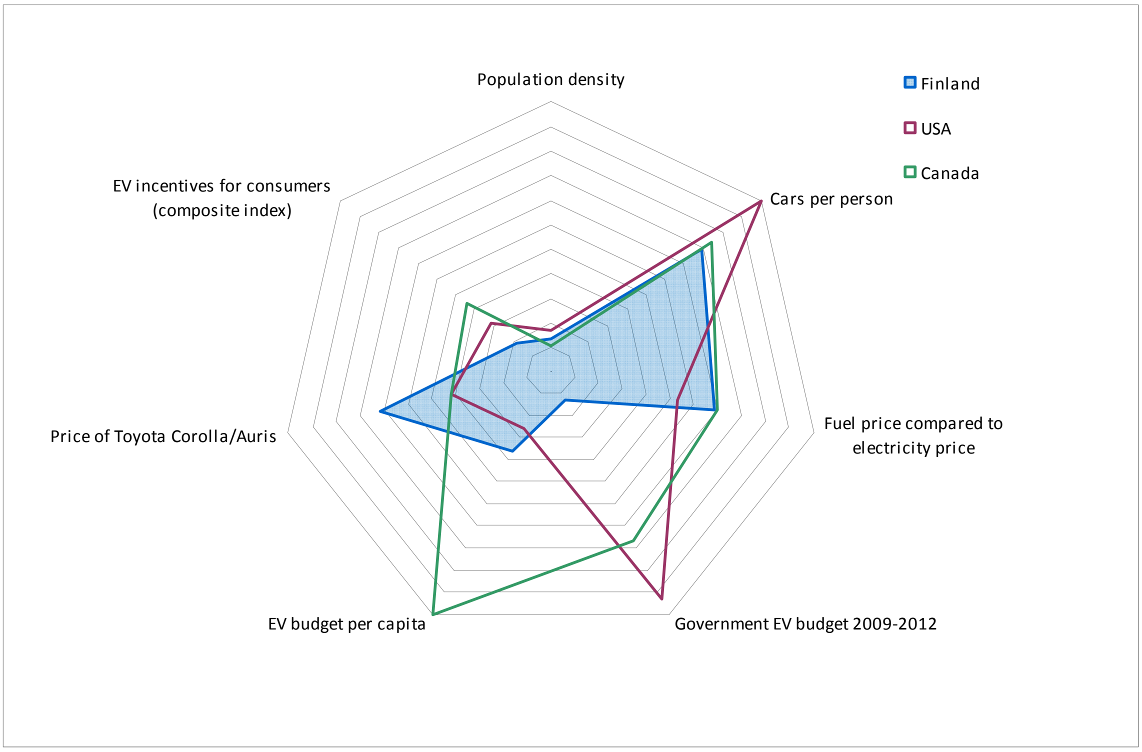


Figure 7: Finland Compared to North America

4.4.2. Finland in Qualitative Comparison

The qualitative analyses were as difficult to perform as the quantitative analysis. Using several approaches we settled for the rather conservative SWOT approach, as well as Porter's Diamond of National Advantage (Porter 1990, p. 83).

One of Finland's strengths are its rather realistic and honest goals and predictions. Because of the imminent risk in failing in emission goals in 2020 many countries have announced rather unrealistic e-mobility goals and either assumed or even declared that their e-mobility markets will be significant already by 2015. Until now, Finland is top performer concerning emission goals. Finland's realistic approach has also been a disadvantage: even though Finland has about 400 000 EV ready poles (currently used for electric car heaters) and its electric grid is in a condition that can handle large amount of e-cars, a few experts have voiced concerns that the grid's vulnerabilities will prevent broad e-car usage. Car drivers have years of experience with plugging in cars and do not mind handling electricity cables in their garages and parking lots. The charging solutions chosen in South Korea (conductive) and in Israel (battery swapping) are much more costly then in Finland.

Finland's electric production is also relatively clean compared to the world's average. Finland has no large scale own ICE car manufacturers, which makes the transition easier than for example for Germany, France or Italy. Regarding labour, the needed competence areas will no longer be mechanics, but power electronics, ICT and battery chemistry. Luckily these are strong and familiar fields to Finns. Figure 8 provides an overview about further strength and weaknesses, along with possible opportunities and threats.

Figure 8: SWOT Analysis of Finnish E-Mobility

The motivation for e-mobility is also very different per country: for instance in the US, the oil price and dependence on oil are drivers towards e-mobility; in China it's air quality in cities; in Denmark smart grid synergies for efficient use of wind power. In Finland there is no great environmental pressure yet, but there still environmental motives. In Finland economic advantages and politics could be discussed more, as the current discussion is focusing too much on traffic and environmental solutions.

Increasing Finland's national advantage can be planned with the help of Porter's Diamond of National Advantage (Porter 1990, p. 83). The government's role, for instance, is to stimulate early demand and focus on specialized factor creation. Demand and substantial export volume are something that has to be built, especially for e-mobility. A small country like Finland has to innovate because of little natural resources and nearly no advantages of scale. Competition in Finland will encourage to do produce and offer better products and services, which is different from, e.g., Israel's situation with only one major e-car company (Better Place).

According to Porter, sustained industrial growth has hardly ever been built on basic inherited factors. He introduced a concept of clusters or groups of interconnected firms, suppliers, related industries, and institutions that arise in particular locations.

The individual points on the diamond and the diamond as a whole (Porter 1990, p. 83) affect four ingredients that lead to a national comparative advantage. These ingredients are:

1. the availability of resources and skills,
2. information that firms use to decide which opportunities to pursue with those resources and skills,
3. the goals of individuals in companies,
4. the pressure on companies to innovate and invest.

Figure 9 applies Porter's theory to Finnish e-mobility.

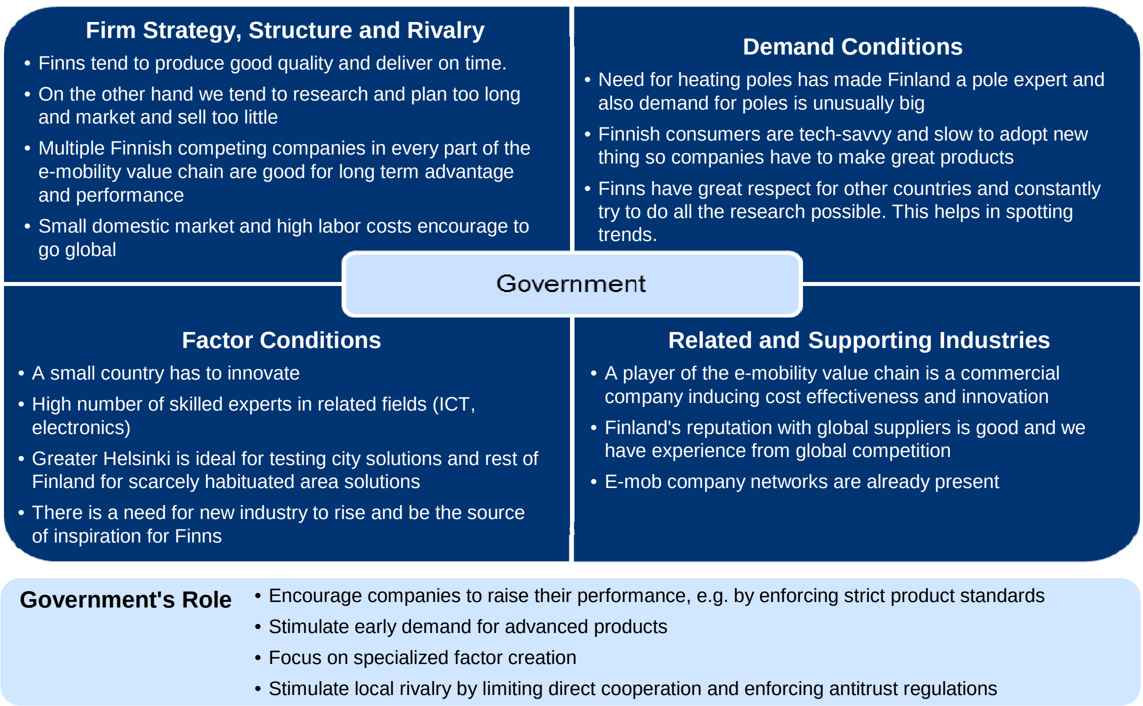


Figure 9: Porter's Diamond of National Advantage for Finland

4.4.3. Elements of A Finnish E-Mobility Vision

As suggested in table 2, it makes sense to establish a comprehensive vision to reduce chaotic uncertainty. Figure 10 outlines an exemplary view.

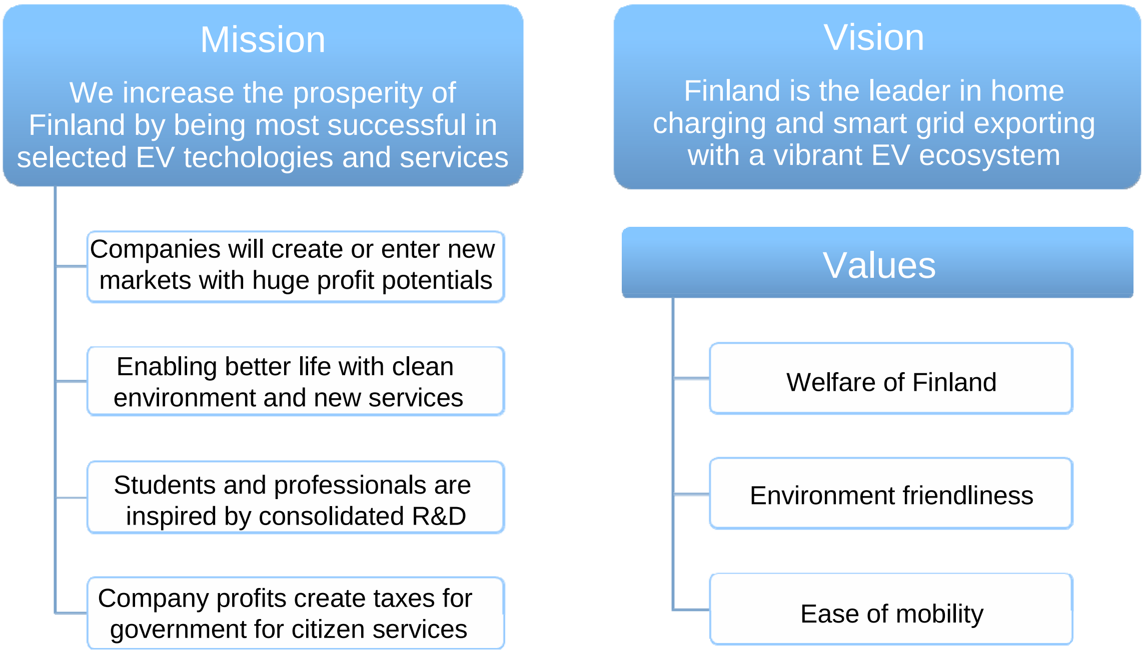


Figure 10: Mission, Vision and Values for E-mobility in Finland

4.5. End user behaviour

One of the challenges in designing new service concepts, business models or schemes to support the diffusion of electric vehicles is the inadequate end user experience due the scarcity of electric vehicles. Furthermore the small amount of EVs on the roads is mostly used by early adopters or demonstration environments which won't necessary provided realistic understanding of the EV end user. Secondly, EV adoption requires that there are sufficient services, charging infrastructure and other supporting ecosystem to create trust and enable the potential end users beyond the early adopters to shift to the electrically powered transportation. This status could be described as the chicken or egg problem.

In SIMBe it was conducted an end user survey to explore potential *early adopters'* expectations for EVs in Finland (Hutri, 2011). The study suggests that technical enthusiast and green consumers are the most potential early adopters of EVs which is a similar result than what the Danish had in 2010 (etrans, 2010). Also Nissan and Chevrolet share the same views on early adopters (Kranz, 2011). This suggest that also in the near future when it is possible to gather end user information from real EV drivers those early adopters could be labelled as technical enthusiast and green consumers. Evidently the first service concepts, charging infrastructure or incentives will be exploited by the early adopters but when the objective is also to accelerate the market the *early majority* need to be considered as well (Rogers 2003).

The current situation where real end user information is not available is challenging. It is beneficial to make end user studies which are based on respondents' ideas or beliefs of their possible behavior but it is important to consider the possible limitations of reliability. One example from electricity utility perspective: customers were asked if they would like their energy company to invest more for renewably energy resources. 85% answered absolutely (5 in the scale 1-5). Then they were asked who would like to choose the electricity mix with the renewably energy with the price increase of 5% and it was only 20%. But the most interesting is that less than 5% finally took the more expensive but environment friendly electricity mix. (Energy, 2010). There could be an analogy with these end user surveys where respondents are in a hypothetical situation.

Another perspective for possible limitations of the information gathered from hypothetical surveys is when potential EV adopters are asked how much they would pay premium for an EV. As well as other requirements the early adopters might not have compared the average consumer. Electric cars have been adopted very slow in the last 20 years and even the last 3 years have not been fast. Apparent reason for slow take off is the very limited production numbers. Also the lack of sufficient EV charging infrastructure is listed as a hindering element (Hutri, 2011 ; etrans, 2010) which is also interesting as the respondents do not necessary guess correctly their recharging needs.

The lack of reliable information of EV owners recharging requirements is creating uncertainty and hampering the design of new business concepts. Again the real life end user interface is in a pivotal role and the current situation is to only make estimations of the possible charging profile of an EV driver. One estimate is provided in figure 11.

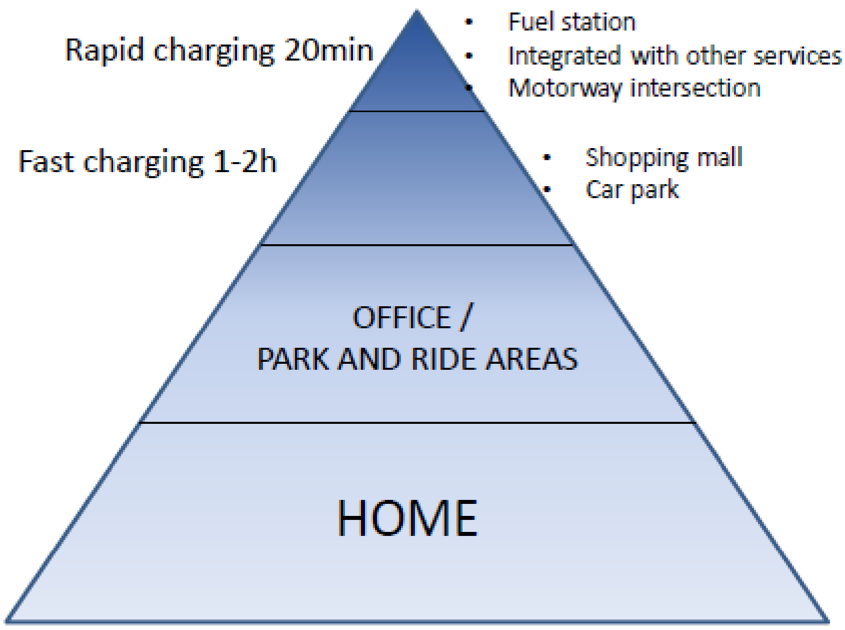


Figure 11: Approximate EV charging profile.

Tokyo Electric Power Company studied if installing a quick charging stations would change the driving patterns of their own employees using EVs during the work day.

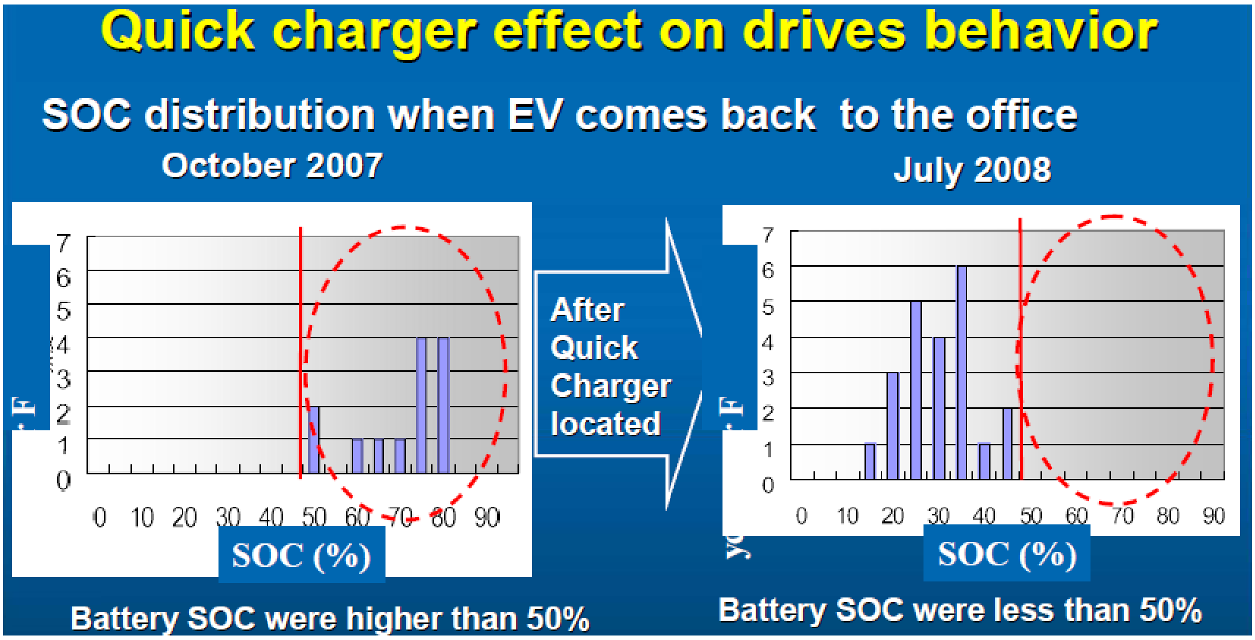


Figure 12:Quick charger effect on drives behavior source: (Anegawa, 2011)

Figure 12 illustrates how after the quick charging station EV users felt comfortable to return the EV battery much emptier than before the quick charging was installed. Furthermore this does not yet give indications weather their charging profile would look different than before the quick charging option but the most relevant thing is that they extract the battery potential. (Anegawa, 2011)

62% of the Danes state that they would be interested in owning an electric car once the infrastructure is in place (etrans, 2010) without knowing how would the charging profile look like and how needed the public charging infrastructure for them would be. The key learning in this chapter is the salient role of reliable end user information, interface and experiences. The current end user information and analysis available is more or less guesswork.

4.6. Contexts of EV Features, Meanings and Services

The following section is based on Giesecke (2012b) with additional elaboration and examples based on the EVER'12 conference feedback. For theory and further reasoning see Giesecke (2012b). Human needs are based on Maslow's (1943) Hierarchy of Needs.

4.6.1. Problem Statement

The underlying problem of EVs has been stated by the OECD (2011, p. 189):

"Electric vehicles should not be considered as a new version or new sub-branch of auto industry. One must think radically new demand, preferences and usages to imagine innovative offers and the potentially credible associated market. Otherwise electric vehicles are likely to remain a niche segment for a very long time, as the have been for more than a century."

The following subsections provide contexts in which the problem might be overcome.

4.6.2. The Necessity: Tapping the Power Source

With batteries being more expensive than the rest of the particular EV that they propel, we currently observe two opposite schools of thought which can be summarized as follows:

1. Leave the battery in peace as it is precious. Use it only to propel the EV of which it is an integral part. The EV's sole purpose is being a transport device.
2. Make as much use of the battery as possible as it is precious. Involve V2G or vehicle to home charging. Also, be creative with further usage ideas regarding battery power.

Currently especially traditional, large scale car manufacturers in Europe and the US embrace the first school of though while Japanese manufacturers[1] consider the second tentatively. This is not surprising as a battery, along with its drive and the electric engine(s), is relatively new to car manufacturers. In comparison, detailed experience with combustion engines and transmissions has been accumulated for 125 years. In contrast, the dominant feeling in the industry concerning battery usage is fear. However, with all empathy towards troubled decision makers, this fear keeps the product EV from being meaningful in all possible ways.

Thus we need to tap the battery even if this means more frequent charging cycles and thus accelerated battery ageing, as well as updated power electronics (the *drive* should ideally power both e-motor and V2G/V2home supply functions) to enable the various EV power source functions:

Firstly, safety and security needs call for the use as a power back-up: a mobile energy storage which acts as a back-up during emergencies, such as earthquakes, storms or floods, in case the electrical grid (locally) collapses. It also doubles as an emergency power supply for both home and outdoor use.

Figure 13: Nissan concept study of a movable home, with a Leaf as energy buffer

The second use is that of a buffer with which people can "do good" to the environment, live sustainable and express their green consciousness. This meaning is much closer to esteem needs and even allows self-actualization (see fig. 13).

[1]announced by, e.g., Toyota, Nissan and Mitsubishi

The buffer should use excess energy from the grid or local production and be source of power when needed, allowing also sales of energy to the grid. It is a mobile, personal energy storage which can be shared when and if needed. It is evident that EVs need to be able to charge electric devices both inside the vehicle and outside (home, cottage, other EVs etc.) For shared activities, EVs should also be able to be “stacked” like battery racks.

A special application and meaning is the *virtual power plant* as described by Haanpää et al. (2011, p. 169): an aggregator controls a fleet of EVs regarding charging and discharging according to (local) grid needs and user contracts and preferences. The meaning for the (traditional) energy producers and distributors is unchanged which may reduce their initial fear to make use of EVs. Frequency stabilizing would be a starting point, with voltage stabilizing being more complex and requiring larger fleets.

The **services** in this context start from local smart grid applications and extend to the whole gamut of services imaginable for energy storage, buffering and backup in the contexts of individual EVs up to large fleets of EVs.

Korompili (2011) distinguishes the following grid related features and services, which are in line with the findings of Romana (2011) and Giesecke et al (2010):

- Features creating functional framework for providing services to grid (Clement-Nyns et al. 2009, Green et al. 2010)
- Services provided to grid (Clement-Nyns et al. 2009, Green et al. 2010, White et al. 2010)
- Key-factors affecting benefits from provided services (Green et al. 2010, White et al. 2010, Andersson et al. 2010)

A good example for preparatory activities for the concrete deployment of such services is the field testing on the Danish island of Bornholm conducted within the EDISON project[2].

4.6.3. Individual, Mobile Work- & Living Space

This meaning of an EV primarily addresses safety and security needs but also esteem needs. It emphasizes the EV as a multi-purpose shelter, a peaceful, protective environment which can be used for living and working. The target group includes primarily singles, but also couples and small families. As no engine needs to run while being stationary and used, an EV has a much better capacity to be used as a mobile office and living room than an ICE vehicle. The mobile living room could come with computer and television but also with kitchen elements such as a fridge or outside BBQ grill.

Figure 14: Mobile Work- and Living Space. Photo: Prof. Aristide Antonas

Regarding **services** the usage of such shelter EV is closer to a boat or caravan than a car. Still, features and services should embrace and promote Finnish values: fair, gender-equal, silent and robust.

[2] see www.edison-net.dk & www.bornholm.dk/cms

4.6.4. iPhone with Transport Capability

While safety and security needs are still addressed, esteem needs and self-actualization are the main focus of this context. Jensen et al (2010) introduced the term “iCar” for an EV styled as a design icon with additional meanings. Similar as an iPhone’s main purpose is not anymore the telephone voice communication the meaning of an iCar is mostly beyond transport, even if it still includes transport capability. It needs to provide a *good fun* experience involving gaming elements and artificial intelligence gadgets. It also needs to be a communication platform with internet that is voice driven; an organizer and planning platform, voice driven; a personal diary (e.g. after work) and finally a personal coach which, as needed, relaxes or cheers up the users. It is obvious that the dashboard experience, touch screen, switches (e.g. for volume, heat and/or indicators) should include lots of gadgets and may be located where the user wants them, following individual needs and interests. Head Up displays could be used for, e.g., (dis-) charging opportunities and electricity market prices. The problem with this context is that too many features may be available for ICE vehicles as well.

Figure 15: “iCar” impression taken from Worth1000.com

The **services** for such EV can be developed in a similar way as iPhone apps and services are developed: “sky is the limit” with plenty of crowd sourcing, user interaction and feedback, but a strict quality control and interface standardizations.

4.6.5. EV in Community Contexts

This context addresses social needs and can be applied as an additional meaning to both the mobile work- and living space as well as the iCar. The EV as such needs to be a communication platform but also promote the following values: share, not own; together, not alone; mobility as a service; networking; collaboration. It needs to integrate well into both interests driven and geo-local communities. It should be ideal for model villages and city-size demonstration sites. Integration capability into public- or on-demand transport systems is a must. Figure 16 illustrates mobility on demand, yet mostly based on ICE vehicles.

Figure 16: CAR2GO, a fast expanding mobility on demand company. Photo by CAR2GO.

The **services** tracks here are two-fold: mobility as a service is obvious but as well (individual) EVs serving the shared interests of communities of interest (e.g. energy buffering) or geo-local communities (i.e. islands, villages, precincts) open up a rather unexplored gamut of potential services.

4.6.6. Simple EV in A Developing Country Context

This meaning is basically the anti-thesis of the iCar with some aspects of the mobile work- and living space, the community EV and the power source – customized to the target market. The simple EV needs to be easy and intuitive to use, simple in its components and technology on system level, easy to repair (e.g. with the tools needed for a 1970's Lada) and its maintenance and usage costs need to be low. The core concept would be plug & play – in all meanings. Still the battery power needs to be accessible as both buffer and emergency backup. It needs to be a mobile energy storage answering the local needs in developing countries. Furthermore the simple EV needs to promote equality, help the poor and create local industries and jobs. In its use a possible "intimidation by design" needs to be avoided. In the final meaning, however, this kind of EV is to pave the way to increase the quality of life in developing countries towards Western standards while being environmental friendly and making most effective and sustainable use of local and global resources. Figure 16 (next page) illustrates the simple EV concept with the *Sun* vehicle, built by SimplyCity, a subsidiary of the French Eco&Mobilité.

Figure 17: The SimplyCity "Sun"

Proposing **services** in this context needs more research and collaboration with different research fields. However "sky is the limit".

4.6.7. Contexts Summary

Figure 17 illustrates the five EV contexts in relation to meaning for humans and EV complexity.

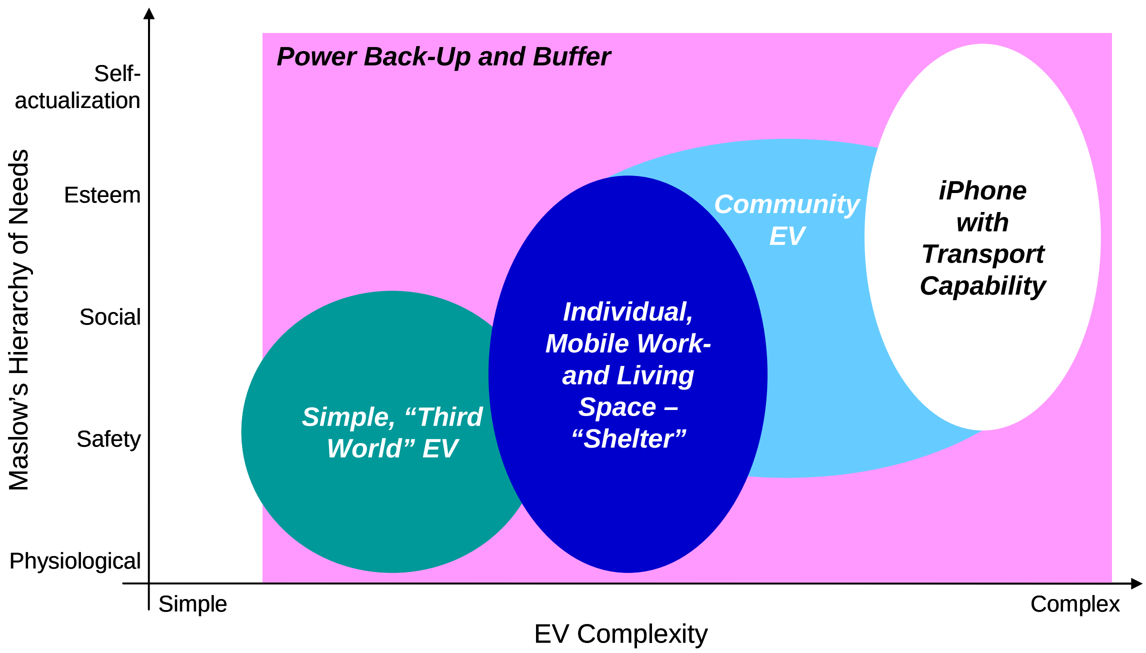


Figure 18: Map of EV contexts, depending on human needs and EV complexity

Summaries per context are provided in table 4.

Table 4. Summary of EV contexts

Context	Remark
Power source and buffer	Precondition to all other contexts • Without tapping the battery, any ICE vehicle could respond to contexts
Mobile shelter	An EV novelty • safety needs as applicable to EVs as to ICE vehicles • safety needs are human inherent
iCar	”Cool”, but innovations will end up in ICE cars
Community EV	Provides all the synergies towards • interests driven user groups • smart use of renewable power • communities, islands and cities • sustainable housing • mobility as a service
Simple EV	Has potential but needs more research

5. Roadmaps

This chapter describes an E-mobility Business Roadmap 2011-2050. Its purpose is to tell fast the current situation of e-mobility in Finland and the possible future development of different sectors. Roadmapping is done as a single answer for many possible scenarios. Goals and predictions of the roadmap are mainly from SIMBe scenarios and from TEM, 2009, Sähköajoneuvot Suomessa Työryhmämietintö. First of the sections is PESTEL analysis, second are value chain actors and third are resources.

Strategic choices of the roadmap include development of e-mobility user portal for web and mobile devices and focusing research on Finnish strengths like home charging, arctic conditions and smart grid solutions. Because of its clear link to sales also billing solutions are very attractive field. Existing solutions like mobile payment and credit card are also very compatible with e-mobility. Current challenges for e-car users in Finland could be mapped with current e-car users' interviews. Besides the user portal also other kinds of broadcasting about e-mobility's current state is needed: courses in schools and universities, research published also in easy to read summaries, e-mobility roadshows and more visible infrastructure presence. Common knowledge can lead to faster growing demand and related start-ups.

Point of view of the roadmap is very much long term. For example IEA believes that e-mobility is a profitable business after 2020. By developing costly solutions for the few e-mobility customers we have in Finland now, we could sabotage the development that can lead to big opportunities in the future. Interesting major change in the mobility field is the predicted transformation from vertical value chains (one actor from R&D to sales) to horizontal value chains (different actors in one value chain). Partners for future exporting efforts to countries with no strong local automotive history should be searched from new players, not only from the old ICE car manufacturers.

The full roadmap is provided in annex 2.

6. Market entry use cases

In this chapter we do projections from the E-mobility Value Chain in figure 13. The use cases will evolve smarter step by step, starting from very simply arrangements.

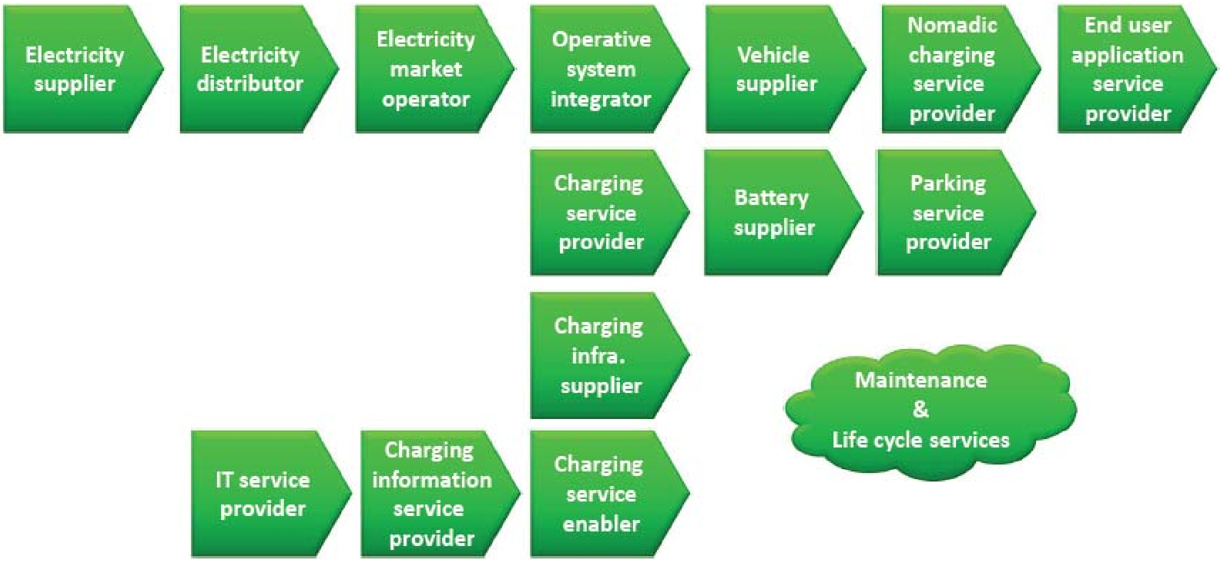


Figure 19: The generic E-mobility Value Chain, adopted from Pirhonen et al., SIMBe report D1.2

6.1. Home / office charging

The simplest home charging scheme is in detached house where e-car owner just uses an electricity plug in the outer wall of the house and plugs in when needed as described in fig. 14 . This is not labelled as a dedicated electric car charging system and would perhaps have some risks e.g. thermo risks.

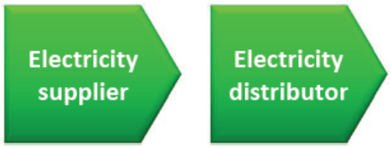


Figure 20: Value chain in the simplest home charging scheme.

It is possible that this additional electricity load requires the strengthening of the electricity wiring but otherwise it is a low cost arrangement. Some of the big OEM's (e.g. Nissan) encourages EV buyers to install a dedicated EV charging system even for home charging and advise the EV owner to contact the utility company to ensure the correct installation and sufficiency of the wiring. The figure 15 represent the value chain for the simple but an EV dedicated charging system at e.g. home or office.

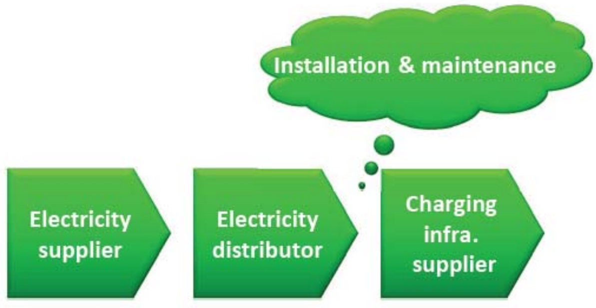


Figure 21: Electric car dedicated home charging system value chain in the very beginning

However we assume it is an overall objective that the home/office charging will be smarter even in the mid-term future.

Home/office charging where the charging times are optimized to support electricity production and distribution as well as the end users' needs requires co-operation of different actors. First steps towards the more optimized charging event will involve charging service provider, electricity market operator, and operative system integrator to the value chain illustrated in figure 16. It could even include end user application service provider as in the Adjuntantti apartment house in Espoo there is a car sharing company City Car Club cooperating with Skanska, Fortum and ABB (Talotekniikka, 2010).

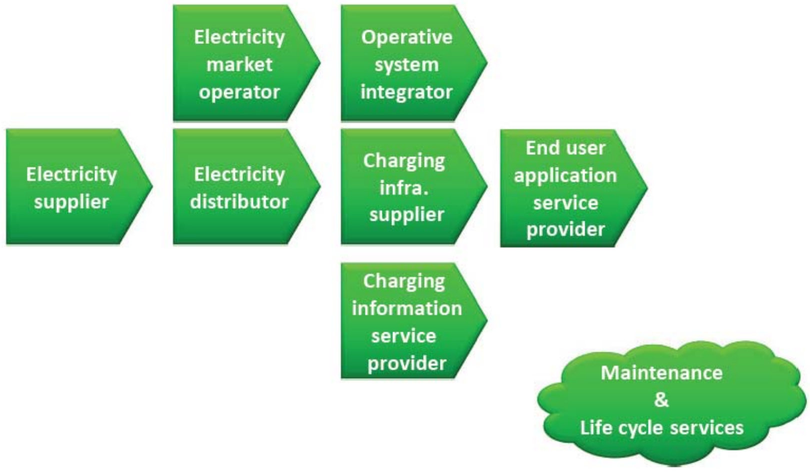


Figure 22: Value chain towards smarter home charging system

In the simplest home charging scheme without intelligence the additional costs could lowest be close to zero and the earning model is to the electricity utility to sell the needed electricity. Once there will be more requirements for the charging system the costs and earning possibilities grow as well.

As an example San Diego Gas and Electric have a demonstration with customers who bought full electric car Nissan Leaf and wanted to save in their electricity bill. In the demonstration the utility offers a free charging pole for the car owner funded half from the government side and lower electricity price if the customer gives rights to the utility to control the charging event e.g. stop the charging for 30 minutes if needed. The customer needs to apply permission form the city planning authorities for the charging pole which costs approximately 50 dollars. The customer also needs to pay the pole installation which is approximately 200-1000 dollars depending on the work needed. The San Diego Gas and Electric has cooperation with ECOtality, Inc. which delivers the charging poles and the information and communication technology installed in the poles.

The cost evaluation in this demonstration gives an understanding of the magnitude. The electricity utility wants to test the control over the charging event and the possibly benefits for example for the peak time challenges. Furthermore the utility prefers to buy the ICT from ECOtality instead of developing it in-house. The total investment of the new charging spot including electricity cabling, the charging equipment and installing is approximately 2000-8000 depending the installation work e.g. ground opening for rewiring.

6.2. "Shopping mall" related charging

Retail establishments e.g. shopping malls and Ikea are starting to offer slow charging possibilities for customers. These examples often represent simple solutions without additional services where only a plug is offered for charging the e-car while visiting the store and often the electricity is offered complementary. However when the number of e-cars and the density of charging spots or the charging power increase more sophisticated systems will be needed.

The simplest shopping mall related EV charging infrastructure value chain has analogy with the home charging system illustrated in the figure 15. And similar to the home charging scheme this simplicity will most likely not be wanted anymore when the density of charging spots or the charging power increase substantially and then the value chain develops towards that is represented in the figure 16 above.

The cost evaluation of the simple solution includes the charging station equipment, the installation and the cabling starting from approximately 3000e depending on the work and cabling needed. The earning model for the charging station owner is to attract customers and improve customer service, for utility electricity selling, licenced electrician does the installation and the charging station provider sells charging equipment's.

Figure 17 represents a comprehensive approach when the system needs to support communication between the e-car, charging pole and the grid for enabling efficiency, metering, billing and peak load/highest price avoidance.

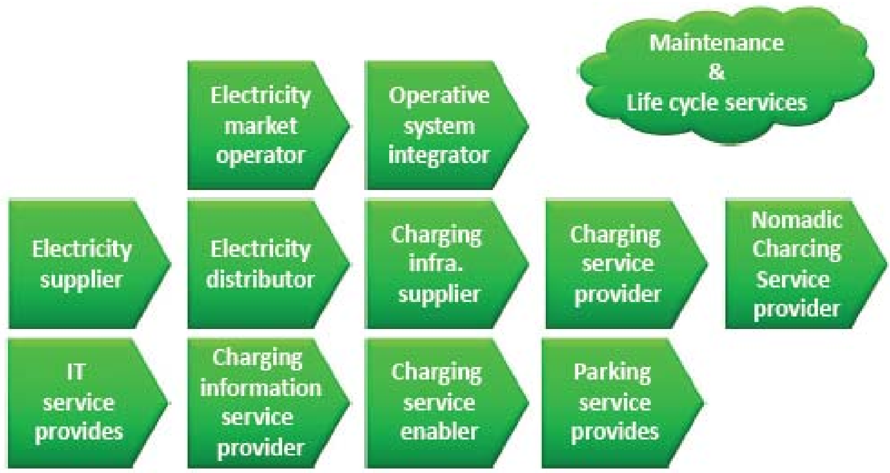


Figure 23: The comprehensive approach for the shopping mall related charging value chain

If the shopping mall owner wishes to offer more powerful charging, the number of charging stations increase substantially or wants to avoid peak-time electricity prices or for some other reason needs to improve the system to more intelligent e.g. enable customer billing then investment costs will grow. The intelligent charging arrangement requires good ICT capabilities as well as good cooperation between different actors in the value chain. The earning models could then also evolve e.g. electricity utility could grow from electricity selling to utilizing the electric car batteries for ancillary services i.e. voltage and frequency control and shopping mall owner could sell fast charging for all electric car users not only the store customers.

The lack of public EV charging infrastructure is seen to hinder the adoption of EVs therefore several countries have created initiatives and programs to support the installations of public charging stations. The challenge of making the charging service a lucrative business case is a reality for private actors who hesitate to invest for charging stations if the customer demand is yet non-existent and the investment payback period too long. Nonetheless the charging service business offered as an integrated part of other services at shopping malls or at gas stations could reduce the importance of independent business potential of charging services.

The present-day fuel station business dynamics could offer a relevant reference for this use case as electric cars will have similar requirements as internal combustion engine cars e.g. car wash and tire pressure checks. In addition the current business model of gas stations is concentrated on many different offerings additionally to fuel sale. Fuel stations are no longer only supporting the car and road users but attracting customers with restaurants and mini markets. 90% of all customers do not purchase fuel. Even if it is possible to drive 15 hours with ICE car before refuelling the fuel station is visited 10 times more often. This could indicate how fuel stations might have potential to offer charging services as a similar function as the fuelling service is now. (Laitinen, 2012 ; ÖKL, 2011)

As learned from the end user survey (see Hutri 2011) the customers expects average 38 minutes fast charging in shopping malls and are willing to pay 7.45 e. Assuming the customer is willing to pay the 7.45 e fee and the utilization rate would be 80% 12 hours a day and the investment payback period is two years and if the operative costs and the electricity costs would be approximately 4 e per charging event then the fast charger investment could be approximately 35 000 e. At the same time this means 14 customers per day and if one would need a fast charging service twice a month one fast charging station would serve 200 electric cars. Thus there need to be sufficient number of electric cars which are enabled to receive fast charging on the roads before there is a real business case.

The fuel station founding costs are substantially high compared to EV fast charging infrastructure investment costs. The investment for fuel pump infrastructure is between 200 000 – 300 000 and the land and property is anything between 1000 000 – 5000 000. However the profit from the fuel sale is only a small portion of the overall profit of fuel stations. The average sale is ca. 1.1 million liters per fuel station and the marginal profit is ca. 5 cents per litre. This gives a perspective for the possible role for charging services as an additional service for customers in e.g. shopping malls, fuel stations and other retail places. (Laitinen, 2012 ; ÖKL, 2011)

6.3. Energy self-sufficient communities

This use case takes the home charging scheme further. The idea of an energy self-sufficient community is to employ the e-car battery as storage for local renewable energy production and it can only be built on sophisticated home charging capabilities. With a sufficient total battery capacity a community could avoid peak time energy usage from the grid and with a sufficient local energy production the centralized energy distribution could be not needed at all, e.g. in areas with poor grid connection.

In order to create a system which enables a community to employ e-car batteries and local energy production in an innovative way many new actors need to work together. The figure 18 illustrates needed value chain and actors whose co-operation is required.

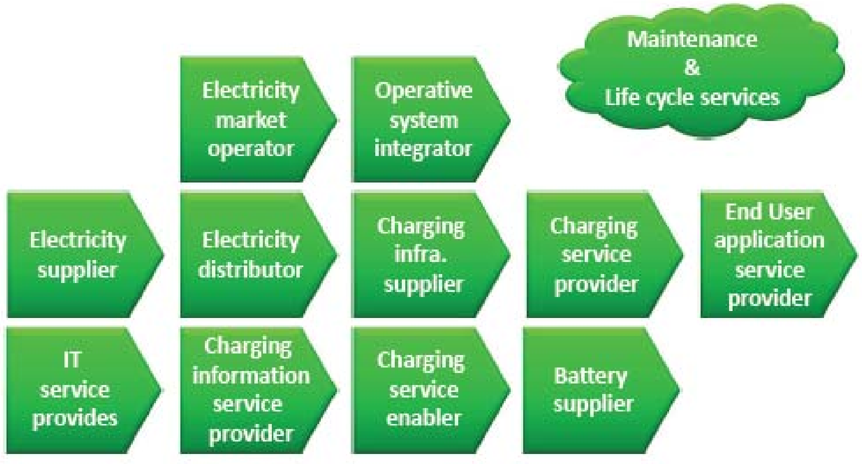


Figure 24: The energy self-sufficient community value chain

This use case is clearly full of uncertainties and estimations because there a not even a demonstration planning that we are aware of. For the earning model perspective the end customers are in the central position. There need to be a clear demand from e-car owners for this system as someone needs to be ready to make the investments. The end user need to benefit from lower electricity price as avoiding the peak times or from even greater independents from the big electricity utilities.

Cost evaluation compared to home charging use case there need to be more intelligent charging stations, substantially more ICT capabilities and investments in local production of solar or wind power.

7. Models for initiating the business

7.1. Innovations

Companies have to be innovative in order to ensure their competitiveness in today's dynamic business environment. Some innovations are short term incremental innovations and don't lead to any longstanding business benefits. Some of them may be more radical in nature and lead to greater business potential. The winners lead finally to dominant designs. Dominant designs are able to get changes on existing sociotechnical regimes. The ways to get changes are various. The dominant design can be focusing and have effects on any of the seven dimensions on the regime level. Dominant designs can be based on technology platforms, products and services, business processes or business models, but in the long term also on policy sectors and culture.

The creation of innovations and dominant designs depends on strategies and capabilities of the organizations. One organization cannot have all the necessary capabilities for the break through and that is why companies have to network with other companies having missing capabilities. Companies have to make their strategy work carefully and analyse clearly their role and position in the value chains and respectively in the corresponding value networks.

The value chain analysis has to be done in the following three value chains (Malinen, 2009):

1. Analysis of industry value chain

- Questions to be answered: What is our value proposition (based on our core competences)? Which parts of the value chain our value proposition fits? What are parts in the value chain we should to be linked with?

2. Analysis of own value chain

- Competitiveness analysis: costs related to every single activity, identification of potential cost advantages compared with competitors and finally identification of differentiation factors.

3. Analysis of customers' value chains

- Integration with customers' business: Who are our customers? How does our products fit and add value into their value chains? Where do the customers see such potential?

The value chain analysis indicates the competitive position of the organization and shows the directions for the networking.

7.2. Public Private Partnership

In slow technology transitions, which effect on sociotechnical regimes and the landscape in the long run, getting into profitable business may take time. The investments can also be quite heavy in the beginning and their payback time not acceptable for single players. In this kind of sociotechnical changes the public authorities both on the national and regional levels can help private organizations by establishing public private partnerships (PPP). PPP's can be validated by the following arguments:

- accelerating the start of infrastructure development
- sharing the risks between different players
- providing uniform services and user experiences for users
- no one makes profitable business in the beginning

- public authorities do not pay this all, private partnerships are needed, and vice versa

Potential partners for PPP's in the field of electric mobility are for example the following players:

- cities
- transport service providers (both public and private, e.g. park and ride integration)
- energy suppliers and distributors
- infranet solutions providers
- car sharing clubs
- ICT service providers
- etc.

In the greater Helsinki area potential partners could be correspondingly:

- City of Helsinki (+ Espoo, Vantaa, Kauniainen, Lahti)
- Helsinki region transport (HSL), VR Group
- Helsingin Energia (+ Fortum, Vantaan Energia, Lahden Energia)
- Eltel, Lemminkäinen
- City Car Club
- NSN, Siemens
- etc.

In Finland public private collaboration has already many established practices like for example public funding for private organizations from Tekes (the Finnish Funding Agency for Technology and Innovations). And as we now have seen in connection with the EVE programme funded by Tekes the ministry of employment and the economy decided to grant the energy investment support for electric vehicle and charging infrastructure investments. But these activities don't exclude the other PPP models as well.

There are many examples of these kinds of PPP's globally. Autolib in Paris is one good example. Paris is planning to deploy a fleet of 2.000 electric cars that customers can pick up and drop of at rental stands around the city. Another 2.000 vehicles will be offered in two dozen surrounding cities (Bloomberg Businessweek, August 7, 2009). The program Autolib (short for "automobile" and "liberte") likely will be operated as a PPP. A group including Avis car rental, the French national railway company SNCF and the Paris transit authority RATP has said it plans to bid on the initial contract. Other bids are also being prepared by French utility group Veolia Environnement and by French public transport operator Transdev. Several automakers have expressed interest in delivering the cars.

Naturally there are also private partnerships on board for arranging services and infrastructure for EV's. One example is Polar Network in UK (Chargemaster Plc, October 12, 2011). The Polar Network was launched by Chargemaster Plc, Europe's leading provider of electric vehicle charging infrastructure. POLAR is a privately funded EV network that stems from a need for a national infrastructure of charging points across the country. The network is supported by the motoring industry and government. The extensive partnerships include also Little Chef, Waitrose, NCP and Britannia Parking, amongst others.

7.3. EMO

There is a huge transition going on from oil supply chain to electric mobility supply chain. This is a big threat for the oil industry and respectively a big opportunity for electricity utilities and other stakeholders linked with the electric mobility. In the following this opportunity is investigated from the energy utility's point of view (Palola, 2011).

Currently large energy utilities are building new charging service points for electric mobility independently. The figure 19 below describes the electricity supply chain from electricity suppliers to end customer. Between these there is a description about charging service development, where many independent electricity retailers are building their own electric vehicle charging service points. For example in the Helsinki capital area there are four different electricity distribution operators and utilities planning electric vehicle charging services independently.

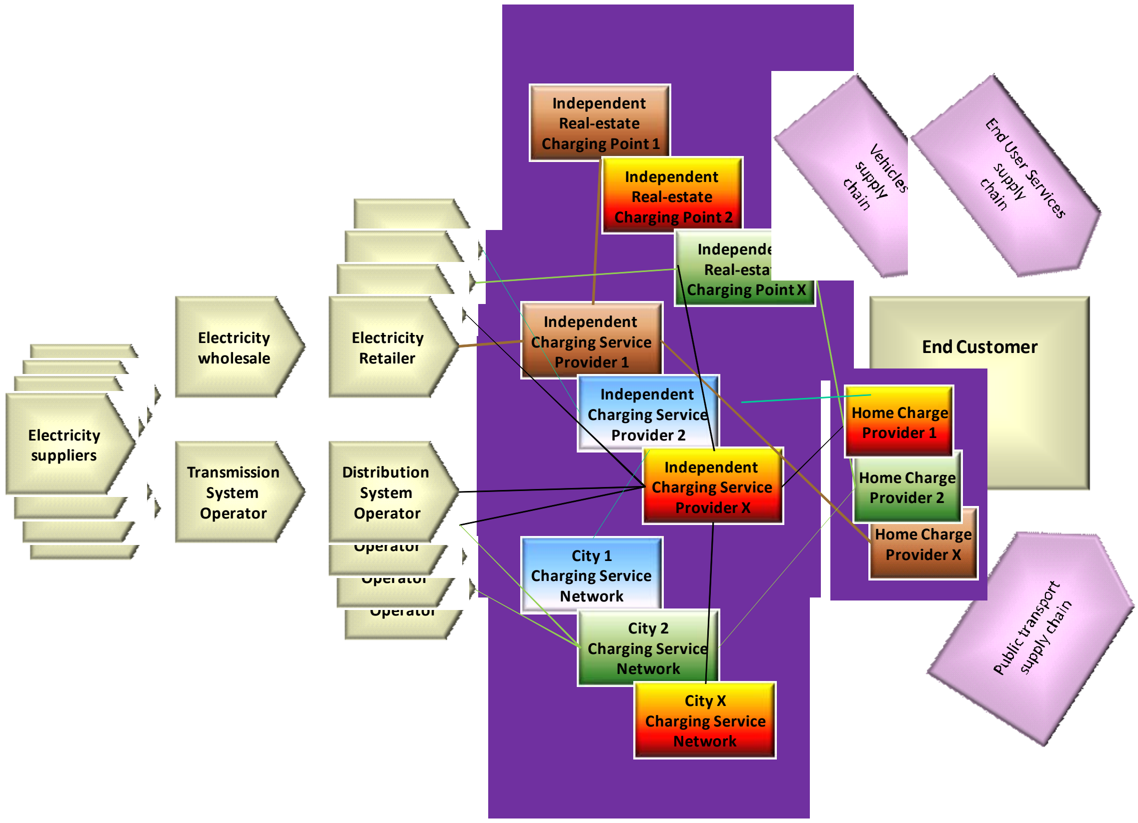


Figure 25: Current charging service networks, built independently by electricity retailers (Palola, 2011)

Several independent electric vehicle charging service providers cannot guarantee the required service level in the mobility where customer travel between different charging service regions. So with this model electricity mobility chain cannot compete with oil-based mobility supply chain in the business.

If this is the situation, it does not guarantee an optimal service solution for the end users. The end users have to adapt to several kinds of user experiences and payment procedures. That is why new service integrators are rising to enhance electric mobility supply chain in different countries and these are called Electric Mobility Operators. There is a clear need to build a service integrator, Electric Mobility Operator, which is competition neutral to different electricity retailers, vehicle suppliers and parking service providers.

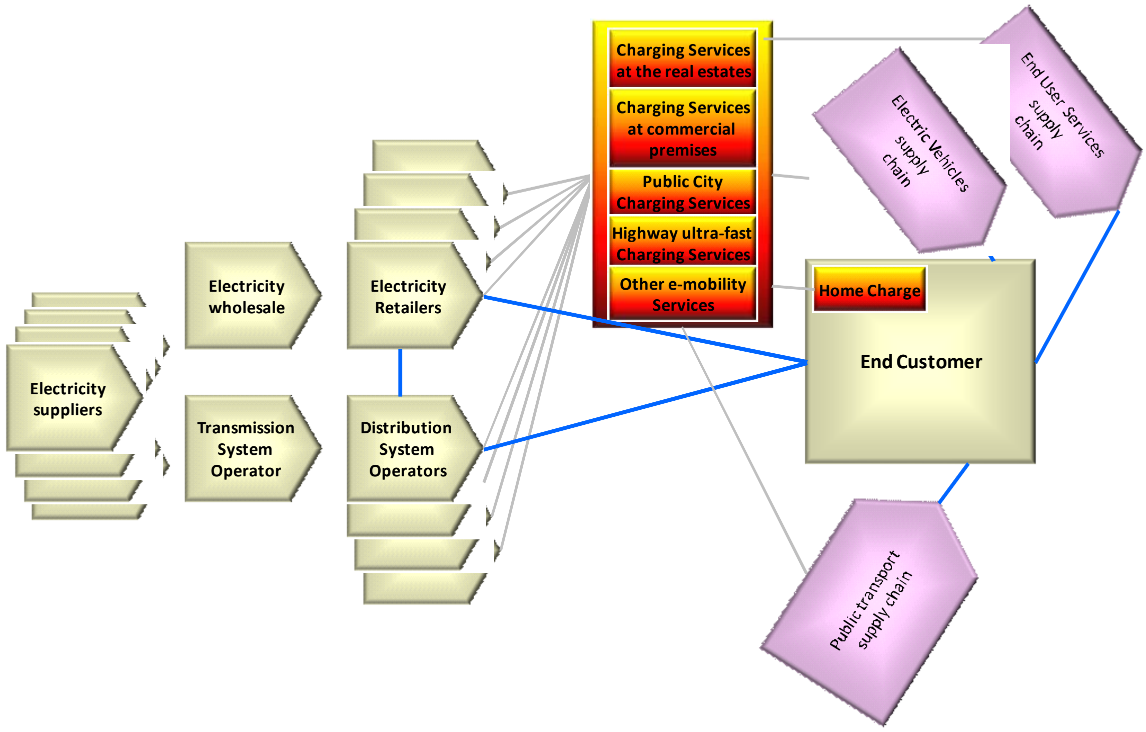


Figure 26: New service integrator: Electric Mobility Operator EMO (Palola, 2011)

The figure 20 above illustrates this new service integrator model. Electric Mobility Operator provides charging services for the real estates, commercial premises, home charging and for public entities. Also collaboration with current mobility service station vendors for highway ultra-fast charging services is one requirement for electric vehicle range extension and better user experience.

EMO type of models are definitely needed in the sociotechnical change of electric mobility. To get these into practice requires shared understanding and trust building between players. This presumes existence of network platforms for sharing the ideas and for reaching mutual development agendas and investment plans.

8. Conclusion

Electric mobility is slowly taking off at the least in the demonstration platforms and test beds arising in Finland. The extensive diffusion of electric mobility requires large socio-technical transition which is very slow by its nature as described in figure 3 at page 4. Thus companies active in this field are dealing with challenges particularly related to uncertainty.

The aim of this document was to give information to help to reduce the uncertainty by providing scenarios and a roadmap. A further objective was to give guidelines for market entry business development by reviewing three market entry use cases and possible models for initiating the business.

The key findings in this document are:

- The shift to electric mobility from oil-based transportation is an enormous socio-technical change and requires several different changes to happen parallel and iterative thus this transition is very slow and complex.

- There is a great uncertainty which creates challenges to adapt to the circumstances of the emerging industry. Public private partnerships (ppp) are needed to share the risks.

- Electric vehicles need to be understood completely different from the traditional ICE vehicles and new meanings and services need to be designed.

References

Accenture, 2011, Plug-in electric vehicles: Changing Perceptions, hedging bets, Accenture end-consumer survey on the electrification of private transport

Andersson, S.-L. et al. 2010. Plug-in hybrid electric vehicles as regulating power providers: Case studies of Sweden and Germany, Energy Policy vol. 38 pp. 2751-2762

Anegawa, T. 2011. Desirable characteristics of public quick charger, [Online], available on: http://www.emc-mec.ca/phev/Presentations_en/S12/PHEV09-S12-3_TakafumiAnegawa.pdf [accessed: February 2012].

Businessweek, http://www.businessweek.com/globalbiz/content/aug2009/gb2009087_330677.htm

Chargemaster Plc, http://chargemasterplc.com/launch-of-polar-network/

Clement-Nyns, K. et al. 2009. The impact of vehicle-to-grid on the distribution grid, Electric Power Systems Research vol.81 pp.185-192

etrans (2010) Seven types of consumer. [Online], available on: http://www.etrans.dk/index.php?id=113 [accessed: February 2012].

Energy, 2010. An interview of one big Energy utility in the U.S.A. The interviewed wishes to stay anonymous.

Frost & Sullivan, 2011, The evolution of the supply chain in the automotive industry, The Evolution of the Automotive Ecosystem – The Emerging Business Models & Stakeholders

Geels, F.W., "From sectoral systems of innovation to socio-technical systems. Insights about dynamics and change from sociology and institutional theory." Research Policy 33, p. 897-920

Giesecke, R. 2012 (a), Organisational Development in the E-Mobility Ecosystem. SIMBe project, Aalto University, Helsinki
http://simbe.tkk.fi/Results/Results?action=upload&upname=IMBe_D15_Organisational_Development.pdf

Giesecke, R. 2012 (b), The Electric Vehicle beyond Transport: Ideas for Features, Meanings and Services Related To Batteries on Wheels. EVER'12 Conference on Ecological Vehicles and Renewable Energies, 22-25 March 2012, Monaco

Giesecke, R., Pirhonen, V., Malinen, P., Romana, L. & Lehtinen, J. 2010. Electric Mobility Needs Smart Infrastructures. SB10 Finland Sustainable Community Conference proceedings, 22-24 September 2010, Espoo, Finland, pp. 759-766.
http://simbe.tkk.fi/Home/Home?action=download&upname=eMobilityNeedsSmartInfrastructuresV1paper.pdf

Green II, C., R. et al. 2010. The impact of plug-in hybrid electric vehicles on distribution networks: A review and outlook, Renewable and Sustainable Energy Reviews vol. 15 pp. 544-553

Haanpää, S. (ed.) et al. 2011. Student Posters, final report of the Nordic Climate Festival @Aalto [Online]. Available: http://www.climatefestival2011.fi/wp-content/uploads/2011/11/NCF_report_small_student-posters1.pdf

Hutri, J. 2011. End user expectations on eMobilty in Finland. Simbe report D1.3, 23 June. 2011.

Jensen, A. F., Mikkelsen, M. & Flinck, A. 2010 A Design Manual for The Electric Car Market. Report 1 of the etrans project. http://www.designskolenkolding.dk/fileadmin/PDF/E-trans/etrans1_uk_samlet.pdf

Korompili, A. 2011. Beneficial Features & Services of EVs. Nordic Climate Festival @Aalto poster

Kranz, R. 2011. First customers key to EV sales. Automotive News. [Online], available on: http://news.ibisworldwide.com/news/first-customers-key-to-ev-sales/ [accessed: February 2012].

Laitinen, Hannu. 2012. An interview of the Suomen Bensiinikauppiaitten ja liikennepalvelu alojen liitto SBL ry. Communication and Reserach director.

MacKinsey Quaterly, Hensley, Russell; Knupfer, Stefan M; Krieger, Axel, 2011, Leading Edge, The fast lane to the adoption of electric cars

MacKinsey Quaterly, Hensley, Russell; Knupfer, Stefan M; Dickon, Pinner, 2009, Electrifying cars: How three industries will evolve

Malinen, Pekka, 2009. How to build complete value chains? FinNano Commercialisation Workshop, Innopoli 2, Otaniemi, 17.11.2009

Maslow, A. H. 1943. A theory of human motivation. Psychological Review, Vol 50(4), Jul 1943, pp. 370-396. doi: 10.1037/h0054346

OECD 2011. Better Policies to Support Eco-innovation, OECD Studies on Environmental Innovation, OECD Publishing. http://dx.doi.org/10.1787/9789264096684-en

ÖKL, 2011.Öljyalan vuosikirja 2010-2011. Publisher Öljyalan Keskusliitto, 2011. on Aldus Oy, Lahti. ISSN 1457-3601

Palola, Jussi. Outlining the electric mobility supply chain and the role of electric mobility operator in it, working paper, Helsingin Energia, 22.11.2011

Porter, M. 1990. The Competitive Advantage of Nations. Harvard business review 68.2 (1990): 73-93.

Pirhonen, Veikka, Malinen, Pekka (editor), Giesecke, Raphael. "Value Creation Schemes of Electric Mobility". SIMBe report D1.1, 25 October 2010

Pirhonen, Veikka, Malinen, Giesecke, Raphael, Pekka (editor), "Business Models". SIMBe report D1.2, 6 June 2011

Romana, L., Lehtonen, M. 2011. Billing And Metering Infrastructure - Communication Needs. Deliverable D4.2 of the SIMBe project. [Online]. Available: http://simbe.tkk.fi/Results/Results?action=download&upname=SIMBe_D42_Billing_And_Metering_Infrastructure.pdf

Talotekniikka , 2010. http://talotekniikka-lehti.fi/www/fi/talotekniikka_uutislista.php?we_objectID=2777

White, D. C., Zhang, K. M. 2010. Using vehicle-to-grid technology for frequency regulation and peak-load reduction, Journal of Power Sources vol. 196 pp. 3972-3980

Annex 1: Data of e-mobility country comparison

List of Countries – Budget figures

No	Country	Government EV budget 2009-12		Voltage
-	Name	Million €	€ per inhabitant	V
1	Finland	40	7,43 €	230
2	Sweden	140	14,85 €	230
3	Norway	22	4,43 €	230
4	Denmark	4	0,72 €	230
5	Estonia	79.2	59,10 €	230
6	UK	424	6,81 €	230
7	Germany	700	8,56 €	230
8	France	400	6,08 €	230
9	Italy	380	6,27 €	230
10	Netherlands	10	0,60 €	230
11	Portugal	150	14,09 €	230
12	USA	2 400	4,53 €	120
13	Canada	1 000	28,98 €	120
14	China	3 000	1,12 €	220
15	Japan	200	1,56 €	100
16	South Korea	300	6,14 €	220
17	Israel	*relatively small*	*relatively small*	220

Equations

Cars per person

- Current amount of cars / inhabitant
- Preferably only cars in use, excluding motorcycles

95 octane fuel price compared to household electricity price

- Small monthly consumption of about 2000 kWh
- 95-octane fuel price / household electricity price
- China's electricity price is calculated from several values
- Basic electricity price included

Government EV budget, 2009-2012

- Government EV budget, 2009-2012 / inhabitants
- Cumulative budget for approximately four years
- Preferably without budget reserved for tax incentives

EV Incentives for consumers, combined (without circulation/road tax incentives)

- Used for incentives: e-car factory price = 25 000€
- Tax incentives as percentage of 25 000€
- Cash/tax incentives per consumer, no circulation/road tax discounts included, CO_2 registration tax & VAT incentives included.
- Note the country with most incentives does not necessary mean the country with cheapest e-car consumer price or even cheapest price relative to ICE cars. Even if the e-car tax reduction is big in percentage, the absolute value of tax can still be big compared to ICE cars.

Data Sources

Nils-Olof Nylund, 2011, Sähköautojen tulevaisuus Suomessa. Sähköautot liikenne- ja ilmastopolitiikan näkökulmasta

Swot Consulting Finland, 2010, Hypätään kyytiin – keskittämällä tuloksia. Selvitys sähköajoneuvoklusterin liiketoimintamahdollisuuksista

Frost & Sullivan, 2011, The evolution of the supply chain in the automotive industry, The Evolution of the Automotive Ecosystem – The Emerging Business Models & Stakeholders

Finpro, 2010, Electric vehicles - global overview and country overviews, http://www.finpro.fi/web/10304/419

International Energy Agency, 2010, Country perspectives, IEA Advanced Vehicle Leadership Forum: Electric Vehicles Initiative Launch and Roundtable Event, http://www.iea.org/work/workshopdetail.asp?WS_ID=482

Specific Data Sources

Letters for different columns of the data tables in Excel:

A. Population, population density (as stated, not calculated from population and area)
B. Electricity price per kWh, households, including basic charge
C. 95 octane fuel price per liter
D. Current amount of cars, preferably only the ones in use, without motorcycles
E. Government EV budget, 2009-2012
F. Price of cars (ICE), Toyota Corolla/Auris 1.6 Valvematic 6 M/T 5 doors
G. Combined:
   CO_2 Emission Based Cash Incentive
   EV Cash Incentive
   CO_2 Based Registration Tax
   Registration tax EV Incentive
   VAT Exemption CO_2/EV

Data source per field in Excel (letter from above, number from country table above)

A1. A5. A6. A7. A9. A12. A14. A16.
Wikipedia, 2010
http://en.wikipedia.org/wiki/Main_Page

A2. A3. A4. A8. A10. A11. A13. A15. A17.
Wikipedia, 2011
http://en.wikipedia.org/wiki/Main_Page

B1. – B11. European Commission eurostat, 2010
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_and_natural_gas_price_statistics
B12. U.S. Energy Information Administration eia, 2011
http://www.eia.gov/electricity/data.cfm#sales
B13. Hydro Quebec Price Comparison, 2010
http://www.hydroquebec.com/publications/en/comparison_prices/pdf/comp_2010_en.pdf
B14. China State Power Information network, price rise in 2011
http://www.sp-china.com/news/powernews/201106/t20110603_179194.htm
East Day Finance News, average residential price in 2007, price rise in 2009
http://finance.eastday.com/m/20091119/u1a4821529.html
X-rates service, Dollar to yuan exchange rate in 2007
http://www.x-rates.com/d/USD/CNY/hist2007.html
B15. Honkawa data Tribune, 2011
http://www2.ttcn.ne.jp/honkawa/4105.html
B16. Korea Electric Power Corporation, 2010
http://www.kepco.co.kr/eng/
B17. Israeli Electricity company, old website, 2010
http://www.israel-electric.co.il/

C1. – C2., C4. – C11. Europe's energy portal, 2011
http://www.energy.eu/
C3. DinSide consumer portal, 2011
http://www.dinside.no/php/oko/bensin/vis_prisliste.php
C12. U.S. Energy Information Administration eia, 2011
http://www.eia.gov/
C13. Natural resources Canada, 2011
http://www2.nrcan.gc.ca/eneene/sources/pripri/prices_bycity_e.cfm?PriceYear=2011&ProductID=1&LocationID=66&dummy=#PriceGraph
C14. Business Spectator, "China ups fuel prices as crude rise hits refiners", 2011
http://www.businessspectator.com.au/bs.nsf/Article/UPDATE-3-China-ups-fuel-prices-as-crude-rise-hits--FNMJ4?opendocument&src=rss
C15. International energy agency iea, End-use petroleum product prices and average crude oil import costs August 2011
http://www.iea.org/stats/surveys/mps.pdf
C16. Chosun Biz news, 2011
http://biz.chosun.com/site/data/html_dir/2011/07/16/2011071600080.html
C17. Israeli Ministry of National Infrastructures, 2011
http://www.mni.gov.il/NR/rdonlyres/09B46EA6-13F2-45EB-9E58-9C958DE63FF8/0/stationprice2011.xls

D1. TraFi Tieliikenne, Liikenteessä olevat ajoneuvot, 2011
http://www.ake.fi/AKE/Tilastot/Ajoneuvokanta/Liikenteess%C3%A4+olevat+ajoneuvot+2011.htm
D2. – D6., D8. - D10. Eurostat, Stock of vehicles by category at regional level, 2009, UK (D6.) 2008
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tran_r_vehst&lang=en
D7. Mikko Koskue, Finpro Germany, VDA 2010
http://www.finpro.fi/documents/10304/ba84ab40-65d1-4a38-b171-c55777d13ea7
D11. ACAP – ASSOCIAÇÃO AUTOMÓVEL DE PORTUGAL, ESTATÍSTICAS DO SECTOR AUTOMÓVEL, 2009
http://www.autoinforma.pt/suporte/documentos/%7B981016913-20100723-140742%7D_Estatisticas_Sector_Automovel_Edicao_2010.pdf
D12. Wikipedia, 2008
http://en.wikipedia.org/wiki/Passenger_vehicles_in_the_United_States#Total_number_of_vehicles
D13. Statistics Canada, 2009
http://www.statcan.gc.ca/pub/53-223-x/2009000/t054-eng.htm
D14. TheTycho's Car News China, 2011
http://www.carnewschina.com/2011/07/20/number-of-motor-vehicles-in-china-hits-217-million/
D15. Japan Ministry of Internal Affairs and Communication, Statistics Bureau, the Director-General for Policy Planning (Statistical Standards) and the Statistical Research and Training Institute, 2008
http://www.stat.go.jp/english/data/handbook/pdf/t9_2.pdf
D16. Ari Virtanen, Yeon-Mi Lee, Finpro, 2010, Electric Vehicles South Korea
http://www.finpro.fi/documents/10304/9b52fef5-e0d1-4938-8ec8-961ea6c87491
D17. Israel Ministry of Environmental Protection, 2009
http://www.sviva.gov.il/bin/en.jsp?enPage=e_BlankPage&enDisplay=view&enDispWhat=Zone&enDispWho=transport_facts&enZone=transport_facts

E1. EVE, TEKES program for electric vehicles and machinery, introduction presentation, 2011
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/eve_esittelykalvot.pdfFfgfg
E2. – E4. Nils-Olof Nylund, 2011, Sähköautojen tulevaisuus Suomessa.
Sähköautot liikenne- ja ilmastopolitiikan näkökulmasta
E5. Estonian Ministry of Economic Affairs and Communications, Electric Mobility Programme, 2011
http://www.mkm.ee/electric-mobility-programme-for-estonia/
Point Carbon Advisory, Assigned Amount Unit: Seller/buyer analysis and impact on post-2012 climate regime, A report by Point Carbon for CAN Europe, 2009

http://www.climnet.org/index.php?option=com_docman&task=doc_view&gid=1512&Itemid=2
love to know green living, How to Measure and Price Carbon Credits, 2011
http://greenliving.lovetoknow.com/How_to_Measure_and_Price_Carbon_Credits
E6. World Bank and PRTM Management consultants, The China New Energy Vehicles Program: Challenges and Opportunities, 2011
http://www.prtm.com/uploadedFiles/Thought_Leadership/Articles/External_Articles/The_China_New_Energy_Vehicles_Program_.pdf
E7. Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf
Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, Nationaler Entwicklungsplan Elektromobilität Zentrale Handlungsfelder der Bundesregierung, 2009
http://www.pt-elektromobilitaet.de/foerderprogramm/foerderprogramm/downloads/praesentation_nep_090922.pdf/view
E8. Die Bundesregierung, 2009, Nationaler Entwicklungsplan Elektromobilität der Bundesregierung
http://www.bmbf.de/pubRD/nationaler_entwicklungsplan_elektromobilitaet.pdf
E9. Finpro, 2010, Electromobility in Spain, Portugal and Italy
http://www.finpro.fi/documents/10304/1f7f5cd7-8911-4624-abe5-6639361f7ceb
E10. – E11. Frost & Sullivan, 2011, The evolution of the supply chain in the automotive industry, The Evolution of the Automotive Ecosystem – The Emerging Business Models & Stakeholders
E12. Finpro/Tekes, US Study on EV Demostration, 2011
http://www.finpro.fi/documents/10304/7e13a754-1c32-46aa-9383-c6b5b6ff8d6c, us_study_on_ev_demonstration.pdf
E13. Natural Resources Canada, The ecoENERGY Innovation Initiative, 2011
http://www.nrcan.gc.ca/eneene/science/ecii-eng.php
Industry Canada, Government of Canada Supports Auto Innovation, 2011
http://www.ic.gc.ca/eic/site/ic1.nsf/eng/05952.html
Polaris Institute, 2011, Electric Car Report, What are the prospects for an Electric Car Industry in Canada and is this a Real or False Solution for Climate Change?
http://www.polarisinstitute.org/files/electriccarreport.pdf
E14. Die Bundesregierung, 2009, Nationaler Entwicklungsplan Elektromobilität der Bundesregierung
http://www.bmbf.de/pubRD/nationaler_entwicklungsplan_elektromobilitaet.pdf
E15. Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf
E16. Ari Virtanen, Yeon-Mi Lee, Finpro, 2010, Electric Vehicles South Korea
http://www.finpro.fi/documents/10304/9b52fef5-e0d1-4938-8ec8-961ea6c87491
E17. N/A, small because of Better Place company with its investors is present

F1. – F13., F15. – F17. Toyota Official Country Sites, 2011
F14. China Cars New Domestic Cars, 2011
http://db.chinacars.com/

G1. Frost & Sullivan, 2011, The evolution of the supply chain in the automotive industry, The Evolution of the Automotive Ecosystem – The Emerging Business Models & Stakeholders
TraFi Tieliikenne, Car tax information 2011
http://www.ake.fi/AKE/Verotus/Autovero/Autovero+Suomessa/
AKE, Autoverolain muutokset 1.4.2009
G2. Nils-Olof Nylund, 2011, Sähköautojen tulevaisuus Suomessa. Sähköautot liikenne- ja ilmastopolitiikan näkökulmasta.
Swot Consulting Finland, 2010, Hypätään kyytiin – keskittämällä tuloksia. Selvitys sähköajoneuvoklusterin liiketoimintamahdollisuuksista.

G3. Lars Ole Valøen, CTO, Miljø Innovasjon AS, 2010, Electric Vehicle Policies in Norway
http%3A%2F%2Fwww.emc-mec.ca%2Ffiles%2FElectric_Mobility_Canada_2008_open.pdf&ei=sKWETrOZL63V4QSPzY2XDw&usg=AFQjCNHEvSM9UGsV4I3WuhvwYxWOPNCuAw&cad=rja
Nils-Olof Nylund, 2011, Sähköautojen tulevaisuus Suomessa.
Sähköautot liikenne- ja ilmastopolitiikan näkökulmasta.

G4. Nils-Olof Nylund, 2011, Sähköautojen tulevaisuus Suomessa.
Sähköautot liikenne- ja ilmastopolitiikan näkökulmasta.

G5. Estonian Ministry of Economic Affairs and Communications, Electric Mobility Programme, 2011
http://www.mkm.ee/electric-mobility-programme-for-estonia/

G6. World Bank and PRTM Management consultants, The China New Energy Vehicles Program: Challenges and Opportunities, 2011
http://www.prtm.com/uploadedFiles/Thought_Leadership/Articles/External_Articles/The_China_New_Energy_Vehicles_Program_.pdf

G7. Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf

G8. Nils-Olof Nylund, 2011, Sähköautojen tulevaisuus Suomessa.
Sähköautot liikenne- ja ilmastopolitiikan näkökulmasta.
Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf
Frost & Sullivan, 2011, The evolution of the supply chain in the automotive industry,
The Evolution of the Automotive Ecosystem – The Emerging Business Models & Stakeholders

G9. Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf

G10. Wikipedia, 2011, Government Incentives for Plug-In Electric Vehicles
http://en.wikipedia.org/wiki/Government_incentives_for_plug-in_electric_vehicles
How to separate Road and registration tax, BPM is the tax on passenger cars and motorised vehicles, Value added tax VAT is in Dutch 'BTW', 2009
http://www.nissan.nl/NL/nl/inside-nissan/innovation-and-technology/leaf_prijzen.html
http://www.vdsautomotive.nl/en/zakelijk/bpm-calculator/bpm-on-new-car

G11. Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf
Swot Consulting Finland, 2010, Hypätään kyytiin – keskittämällä tuloksia.
Selvitys sähköajoneuvoklusterin liiketoimintamahdollisuuksista.
Imposto Sobre Veículos e Imposto Único de Circulação 2011
http://impostosobreveiculos.info/tabela-imposto-sobre-veiculos/

G12. World Bank and PRTM Management consultants, The China New Energy Vehicles Program: Challenges and Opportunities, 2011
http://www.prtm.com/uploadedFiles/Thought_Leadership/Articles/External_Articles/The_China_New_Energy_Vehicles_Program_.pdf

G13. The Canadian Press, CTV News, 2010, Electric cars widely available in Canada by 2012
http://autos.ctv.ca/CTVNews/Autos/20100604/electric-cars-canada-100604/

G14. World Bank and PRTM Management consultants, The China New Energy Vehicles Program: Challenges and Opportunities, 2011 http://www.prtm.com/uploadedFiles/Thought_Leadership/Articles/External_Articles/The_China_New_Energy_Vehicles_Program_.pdf

G15. Koskue Mikko & Talka Markus, Finpro, 2010, Electric vehicles
http://www.tekes.fi/fi/gateway/PTARGS_0_201_403_994_2095_43/http%3B/tekes-ali1%3B7087/publishedcontent/publish/programmes/eve/documents/finproelectricmobilityglobaloverview2011.pdf

G16. Ari Virtanen, Yeon-Mi Lee, Finpro, 2010, Electric Vehicles South Korea
http://www.finpro.fi/documents/10304/9b52fef5-e0d1-4938-8ec8-961ea6c87491

G17. Size doesn't matter blog, 2011, Israel to get electric cars this summer
(Source of the post: Shalomlife.com)
http://sizedoesntmatter.com/technology/israel-to-get-electric-cars-this-summer/

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Annex 2: SIMBe E-Mobility Business Roadmap

		Past	2011 + 4 years	2015 + 10 years	2020 + 20 years	2030 Vision 2050
Trends & Drivers (PESTEL)	Political / Legal / Standards	Many countries have a positive atmosphere for EVs In Finland Government Programme does not mention e-mobility and there are no EV subsidies TEKES project (including SIMBe) 2010 law change for CO2 taxing of cars	Progressivity of CO2 taxes should be increased, 3000€ support per EV (for company cars?) Charging network and electricity market law preparations, EVs taken into account in traffic and construction planning Industry and trade politics should be discussed more, in addition to traffic and environment politics. Reliable and precise actions and statements are needed instead of the current vague ones. For maximum benefit and to improve public knowledge it is necessary to build positive EV atmosphere now. Patents for e-car and battery technology may cause problems for some manufacturing companies Safety of e-mobility is being investigated by TUKES	Clear EU-level policy: common standards for grid, metering, plugs, data etc. (Sesko Ry, SK69) Electricity tax rises under control	"EVs should become commercially viable without significant subsidies; support should continue for widespread expansion of recharging infrastructure. Standards: Common systems for vehicle-to-grid electricity sales, fast recharge and/or battery swapping well established." -IEA	Very positive atmosphere for EVs and substantial profit tax income from Finnish e-mobility companies Not being oil-dependent Easy to follow and not bureaucratic law for EVs
	Environmental	Need to reduce CO2 emissions Green thinking	Sober assumption: Finland's climate goals 2020 met with little help from EVs	New ways to produce renewable energy in test phase Battery recycling planning in big scale Finland's total goal is 15 % decrease in traffic CO2 emissions by 2020 and new car average CO2 of 95 g/km by 2020	Lack of oil pushes towards the usage of "bio fuels" or electricity from renewable sources as a fuel Oil can be used mainly for other purposes than energy/traffic	CO2 emissions 60-80% of the level of 1990 (EU goal) Noise pollution decreased
	Social	Average citizen does not know much about EVs or thinks they are not yet ready for driving Oil companies have been against EVs People want to charge at home and want less maintenance, which can be achieved with eCars	Knowledge spread about EVs will create demand and make EVs more popular choice. Purchase of all necessary equipment will be easy from a single site, where also networking with other EV users is possible. Great about an EV is the possibility to charge at home and need for less maintenance. Schools and universities start to teach courses about EVs. Solution also for "non-green" consumers because of other advantages: home charging, silence (for audio lovers)… eCar is a great solution as a second car for families in suburban areas of greater Helsinki	Peer experiences from EVs create more demand. Benefits of EVs are common knowledge. EV business is interesting business inspiring students and professionals. Car sharing gets more popular Electrification of all machines makes an electric machine a normal choice	EV is a normal option (like today an ICE car) and offers also the possibility to sell electricity back to grid.	EV is the way of mobility and beyond. Finns are inspired by Finland's success and excellent knowledge in EVs.
	Technological	Lack of availability Battery price is high and they are heavy Lithium battery sensitivity to cold (-10) temperatures In 2011 there is 981 fully electric vehicles (cars, scooters etc.) in Finland (TraFi, 2011)	Cars and poles equipped with unique IPs (ivP6) 2-way metering technology prepared and extensively tested for use 9 500 e-cars in Finland (4 000 in greater Helsinki) by 2015 (0,4 % of 2 500 000 cars in Finland), 4% of new cars sold in Finland e-cars by 2015 New ways to produce renewable energy explored Changes in electricity usage due to ventilation and electrification of heavy machinery (e.g. forest machines)	Dominant design emerges, new battery chemistry, e-car under 20 000 €. Ultracapacitors in use. Battery price down over 60% by 2020 (30 kWh battery from 21 000 € to 7500 €) Fast charging gets cheaper and possible for most e-cars. Inductive charging. Goal: 25% of cars sold can be plugged in and 10% of cars sold are fully electric in 2020 Prediction: 10% of cars sold can be plugged in and 3% of cars sold are fully electric in 2020 Car + solar power + house solutions without grid usage developed	E-Car under 15 000€. Fuel cell car a possible competitor for e-car New ways to produce renewable energy developed	33 % of all cars are e-cars in Finland 50 % e-cars in Helsinki area 50 % e-cars of cars sold in Finland Range and other qualities superior to ICE cars.
	Economic	Cheap electricity Not much investments for EVs Temporary shortage of batteries E-mob. cluster revenue 200 M€ in Finland in 2010	Gaining e-mobility fan base is important, not yet making profitable business Competition from abroad, when international consultants start to measure Finland positively EV (battery) price high compared to ICE cars Structure change in mobility industry starts, possibly value chains may change from vertical (one actor from R&D to manufacturing to customer) to horizontal (different actors in different parts of the industry value chain)	Electricity price goes up due to high demand and expensive renewable sources Exporting starts with smart grid, home charging, arctic and billing solutions. E-mobility cluster revenue goal 1-2 billion euros in Finland by 2020. End-user driven market. Building barriers of entry for competitors.	Significantly higher electricity price because of high demand and expensive renewable sources Gas stations and oil companies want to join the business Lack of certain key materials possibly a general economic problem because of growing consumption of developing countries	Profitable business with significant exporting Traffic is not oil dependent
Actors	Battery Supplier, Vehicle Supplier, Maintenance *In SIMBe: European Batteries Oy*	Low volumes, ramping up capacity	Competition of car distributors between EV companies Lot of events with test drives, road shows Offering short term leasing, telephone assistance Repair and maintenance network formed and educated AC outlets for e-cars: Japanese e-cars are V2G capable	With higher volumes the price competition starts Big pressure for more efficient big batteries, new battery chemistry, battery recycling Dominant design emerges	Major switch from ICE manufacturing to EV manufacturing Possible competition from fuel cell industry	Big profitable environmentally friendly industry
	Energy Supplier, Energy distributor *Helsingin Energia*	Co-operation with EV players, researching different possibilities	Offering cheap night prices more aggressively Development of vehicle to grid and big vehicle battery swapping Form active customer relationships with EV owners to offer them more services. Means can include customer events, questionnaires with prizes, leasing poles, special electricity contracts, mobile app and web service presence.	Charging contracts Vehicle to grid and heavy EV battery swapping large scale pilots Local-grid adaptation for new demands and peak loads Control over the poles (turning them off) Energy market operator emerging?	Paying for vehicle to grid electricity to customers Very smooth electricity production with smart grid solutions	Acquiring lot of the income that used to go to fuel/diesel companies, Having new customer relationships
	Charging Infrastructure Supplier *Ensto*	Poles are good to ship, one time earning model	Separate offerings for homes, companies, shopping centres, gas stations and housing companies. Combining installing and maintenance services with current EV products by finding electrician partners to take care of the installing and maintenance	Main provider of EV poles in Finland. Provide electronics for smart grid solutions. Exporting, maintenance and upgrading	Main provider for poles for many countries	Good customer relationships, valuable pole data, multiple earning model, connected to EV ecosystem
	Operative System Integrator		Webpage and free mobile application for end-users (not only for EV enthusiasts) with all relevant EV information. Earnings from in-app purchases, pole owners, car manufacturers etc. Collecting all the data from EV usage and charging. Creating domestic demand for creating exporting strength	Going international with the EV community model		
	IT Information SP, Charging Information SP *NSN*	High interest in global business, Customers very valued in telecom industry	Booking system for poles and EVs, Vehicle tracking, compatibility with phones and other appliances Personal data collection standards, limits and practises explored	Billing system for charging	Vehicle to vehicle communication Connecting all the EV users around the world	Having data and knowledge over all traffic flows (abstract of the total, not individually)
	Nomadic Charging & Parking SP *HOK-Elanto, SPY*	First nomadic charging providers EuroPark Finland Oy offers cheap night parking	Selling fast charging & slow charging (shopping centres etc. offering complementary slow charging) Possibly offering night time parking with charging in city centre	Offering EV charging for those without their own parking lots and to those needing charging immediately & fast & possibly far from home		Active player in the market
	End User Application SP *o2 Media, Oliivi autot*	Investing in first eCars	Leasing pilots Making eCars affordable with car sharing	Getting mainstream		Car sharing is a normal way to use a car
	Other *City of Helsinki*	50% parking discount for EVs in Helsinki	Spreading information about poles and eCar services Registering the poles (with NSN, Helen, Ensto): Offering early adopters (both companies and individuals) recognition as certified environment helpers. This makes owning an EV more fun & known.	E-buses in use in public transportation	Model city for effortless mobility and environmentally friendliness	Modern city with great services
Resources	Competences	Excellent electronics and ICT knowledge Metal, machinery (heavy traffic machinery, forest machinery) and electrical industry present	Acquiring human capital according to individual company objective and strategy developing, benchmarking Inspiring students and professionals (business & maintenance) to learn more about the field Interviewing current EV users in Finland	Customer behaviour knowledge helps in planning billing systems		Best knowledge in smart grids, home charging, arctic and billing solutions
	Finance, Funding	TEKES projects (e.g.SIMBe)	Individual financing models, First investments from companies, Start up projects	Best practises Exports to countries with no strong local automotive history Possibly a common fund for funding EV projects, competitions for rewards from the government and from the industry		Major export income for Finland
	Infrastructure	Heating poles +++ (approximately 1 500 000, of which EV ready about 400 000) Good grid quality, high voltage (230V, not 110V)	Making the existing e-mob. infrastructure common knowledge, 1000 Mode 3 (22 kW) and 5 Mode 4 (400 kW) poles by 2015 to relieve range anxiety Easy to order pole solutions (Ensto) Poles in Helsinki centre, companies and mainly homes	Billing infrastructure developing Energy storages or battery switching stations to even out fast charging spikes Complementation of most recharging infrastructure in OECD and other major economies	Fast charging widespread implementation starts all around Finland MV (medium voltage) level grid needs changes to handle great amounts of EVs, for example 50 % of all cars	Mode 1 (3.7 kW): 200 000 poles Mode 3 (22 kW): 260 000 poles Mode 4 (400 kW): 1000 poles
	Collaboration	Lot of interest EVAG, TEKES projects, eCars now!	Name specific areas (e.g. arctic conditions, billing, home charging, smart grid) related to which co-operation, frequent communication etc. are arranged Web portal: NSN, Ensto, Helsinki City, Car manufacturers, Car renting companies, Parking companies, Aalto Poles: Ensto, Helsinki city, pole installer Smart grid: Helen, Battery manufacturers, Ensto, Aalto	Billing: NSN, Helen Energy producers control the poles Plan for continuous discussion: industry, government, researchers, customers, students… Partners from abroad: new players (not the old ICE manufacturers)		Key players in the chosen e-mobility industry niches are Finnish company alliances
	Research	EVE, EVAG SIMBe, value chains, effects for urban environment	Results published in multiple locations, integration of information and communication, cooperative systems Concrete services and deployment plan for e-mobility, earning logics, management of uncertainty, eSINI Networking, abroad and nationally, conditions and structures for sustainable partnerships researched Collecting data from EV usage, especially home charging, interviewing users Arctic conditions research, battery chemistry and thermal management Smart grid, management and environmental effects, inter-European effects and solutions Billing opportunities	Analysing EV data (from NSN, Ensto, EVAG and EV fleet companies) and updating plans accordingly, networking abroad, school and university courses about EVs, continuing to publish results and keep EVs in the news, push standards forward and keep track of the progress	Looking for new opportunities	Number 1 test laboratory for smart grid, home charging, arctic and new payment solutions