



**CHALMERS**  
UNIVERSITY OF TECHNOLOGY



# **A Prestudy of the Diffusion of Small Electric Vehicles in the Gothenburg Area**

## **A project within the Challenge Lab**

Master's Thesis in the Master's Programme Management and Economics of Innovation

JOHANNA HANSSON  
PER HÄRDFELDT

MASTER'S THESIS

# A Prestudy of the Diffusion of Small Electric Vehicles in the Gothenburg Area

Challenge Lab 2014: Sustainable Transport and Mobility Solutions

JOHANNA HANSSON

PER HÄRDFELDT

Supervisor: Kamilla Kohn Rådberg, Ph.D.

Department of Technology Management and Economics  
*Division of Management of Organizational Renewal and Entrepreneurship*  
CHALMERS UNIVERSITY OF TECHNOLOGY  
Göteborg, Sweden, 2014

A Prestudy of the Diffusion of Small Electric Vehicles in the Gothenburg Area  
*Challenge Lab 2014: Sustainable Transport and Mobility Solutions*

JOHANNA HANSSON  
PER HÄRDFELDT

© HÄRDFELDT PER AND HANSSON JOHANNA, 2014

Department of Technology Management and Economics  
*Division of Management of Organizational Renewal and Entrepreneurship*  
Chalmers University of Technology  
SE-412 96 Göteborg, Sweden  
Telephone: +46 (0)31-772 1000

## **Abstract**

Today's society faces large environmental and societal challenges such as a rapid growing population and increasing CO<sub>2</sub> concentrations. Challenge Lab at Chalmers is a multicultural initiative that aims to contribute to the transformation towards a sustainable society and this year, 2014, the focus has been on sustainable transportation and mobility. In order to understand the system complexity and find leverage points where it is possible to intervene for the Challenge lab students a unique process consisting of tools and methods such as backcasting, dialogue tools, self-leadership and socio-technical systems have been used. For this thesis the earlier mentioned process resulted in a specific focus on the diffusion of small electrical vehicles in the Gothenburg area, investigating both possibilities and barriers as well as how a diffusion could be accelerated. Several theories and methods were used investigating this topic such as socio-technical systems, technological trajectories, diffusion theory, buyer behavior and business models. In addition to the theory a case study was conducted using semi-structured interviews with the founder of Clean Motion, a small electrical vehicle producer, as well as with politicians and experts. A self-completion questionnaire was also conducted in order to understand the behavior and values of people living in the Gothenburg area.

The prestudy revealed that the barriers for a larger diffusion most likely are stronger than the opportunities. This is much due to that the perceived relative advantage for an SEV in Gothenburg is rather low due to e.g. behavioral aspects such as car dependency and that the car is seen as freedom symbol. Additionally, problems such as congestion and pollution are not prominent in Gothenburg compared to other larger cities. However, some positive trends were to be found as well. The environmental awareness in Gothenburg is high and the travelling pattern in Gothenburg fits well with the properties of an SEV.

Finally, there are probably niche markets in the Gothenburg area with a limited numbers of early adopters that needs to be found and utilized. However, discovering an alternative business model, e.g. incorporate small electrical vehicles with the public transport system, was identified as a key factor in order to increase the perceived relative advantage and accelerate the diffusion.

Keywords: Small electrical vehicles, diffusion, sustainability transformation, relative advantage, environmental differentiation, preventive innovation, backcasting, dialogue tools, self-leadership, technological lock-in.

## **TABLE OF CONTENTS**

<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Background	2
1.2	Overall aims and objectives	3
1.3	Overall structure	3
<b>2</b>	<b>THE C-LAB PROCESS</b>	<b>6</b>
2.1	Outside-in perspective	6
2.1.1	Backcasting	6
2.2	Inside-out perspective	20
2.2.1	Leadership and self-leadership	20
2.2.2	Dialogues	24
2.3	The socio-technical system	28
2.3.1	The regime	29
2.3.2	The landscape	29
2.3.3	The niche	29
2.3.4	A socio-technical analysis of the transportation system	30
2.3.5	Conclusion from the socio-technical analysis	34
2.4	Research question formation	35
<b>3</b>	<b>A PRESTUDY OF THE DIFFUSION OF SMALL ELECTRIC VEHICLES WITHIN THE GOTHENBURG AREA</b>	<b>37</b>
3.1	Theoretical framework	37
3.1.1	Technological trajectories	38
3.1.2	Disruptive innovation	39
3.1.3	Techno-economic analysis	40
3.1.4	Business models	50
3.2	Method	54
3.2.1	Research design	55
3.2.2	Sample	56
3.2.3	Case study	57
3.2.4	Cross-sectional design	58
<b>4</b>	<b>FINDINGS: SEV PRESTUDY</b>	<b>60</b>
4.1	Clean Motion	60

<b>4.2</b>	<b>Opportunities and barriers</b>	<b>61</b>
<b>4.3</b>	<b>Market segment</b>	<b>63</b>
<b>4.4</b>	<b>Alternative business models</b>	<b>66</b>
<b>5</b>	<b>DISCUSSIONS AND RECOMMENDATIONS C-LAB</b>	<b>68</b>
<b>5.1</b>	<b>Aims and objectives of C-Lab</b>	<b>68</b>
<b>5.2</b>	<b>The C-Lab approach</b>	<b>70</b>
5.2.1	Tools and frameworks	71
<b>6</b>	<b>RECOMMENDATIONS C-LAB</b>	<b>74</b>
<b>7</b>	<b>DISCUSSION: SEV PRESTUDY</b>	<b>75</b>
<b>7.1</b>	<b>Opportunities and barriers</b>	<b>75</b>
<b>7.2</b>	<b>Accelerating the diffusion</b>	<b>77</b>
7.2.1	Market segments and Business models	77
7.2.2	Other alternatives	78
<b>8</b>	<b>RESULTS: SEV PRESTUDY</b>	<b>80</b>
<b>9</b>	<b>CONCLUSION: SEV PRESTUDY</b>	<b>82</b>
<b>10</b>	<b>REFERENCES</b>	<b>84</b>
<b>10.1</b>	<b>Short list of Interviewees</b>	<b>90</b>
<b>11</b>	<b>APPENDIX 1: LIST OF THE C-LAB STUDENT PARTICIPANTS 2014</b>	<b>91</b>
<b>12</b>	<b>APPENDIX 2: FULL LIST OF INTERVIEWEES</b>	<b>92</b>
<b>13</b>	<b>APPENDIX 3: DESIGN OF THE SELF-COMPLETION QUESTIONNAIRE</b>	<b>94</b>

# 1 Introduction

Challenge lab (from now on referred to as C-Lab) is a new initiative at Chalmers where a challenge driven approach to sustainability within different areas is incorporated in the master thesis work through a unique process. This process will be described in more detail in the chapter "the C-Lab process". This first year the area of concern for the C-Lab students has been sustainable transportation and mobility.

The thesis is basically divided in two parts although the first phase of the thesis in many ways has affected both the approach to and the outcome of the second phase. The purpose of phase 1 was to create an understanding of the system dynamics in order to understand why and where to intervene. Further, tools were introduced to be able to both identify deficiencies in it and to be able to intervene. In phase 1 the students learned about the transport system on both a global and a regional level but also got a deeper understanding of our inner motivations. By the end of phase 1 an area of research was formulated for the project conducted in phase 2.

Through different input in phase 1 came the realization that the fossil fueled automobile constitutes a problem both on a global level but especially locally in an urban environment. From the socio-technical system analysis in phase 1 some explanations to this problem was presented as well as potential solutions, which were further investigated in phase 2. One of the solutions having potential to transform the transport system was niche innovation within battery electric vehicles.

This knowledge in addition to general knowledge within areas such as sustainability, innovation and industry transformation lead to a research area for the phase 2 project, which is diffusion of small electric vehicles in the Gothenburg area. The project is to a great extent based on a case study of the start-up company Clean Motion. Their main product, the Zbee, is a so-called small electrical vehicle (SEV). The Zbee is an example of a mobility solution that represents both an alternative technology and a different vehicle concept and though might have potential to contribute to a system transformation. Furthermore has a literature study been carried out in order to get a theoretical understanding of barriers connected with diffusion of an innovative product and technology as well as means to overcome these barriers.

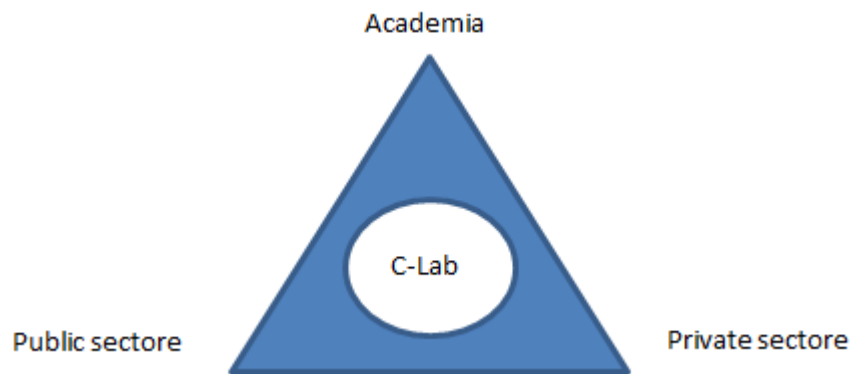
The purpose of the following chapters are to explain what C-Lab is, what it aims to achieve, what main ideas that have been the inspiration and the basic layout for execution of this new type of thesis concept. Further it will also be explained how this concept could be a step towards a transition to a more sustainable society.

## 1.1 Background

Today's society faces large environmental and societal problems that need to be solved in order for future generations to have their needs fulfilled. The idea behind C-Lab at Chalmers is to contribute to the transformation needed for a sustainable society and builds upon a challenge driven approach as well as collaboration with stakeholders within the triple helix, including academia, government and the private industry.

This first group of thesis pilots has been focusing on sustainable mobility and transportation, which is one of Chalmers Areas of Advance. Further the focus will be specifically on the Västra Götaland Region in Sweden, which is where Chalmers is located and also where some of the largest industrial groups in Scandinavia have their business.

The reason for using students within a project such as C-Lab is that students are supposed to have the potential to be an important factor for change. Students in general have the ability to be nonthreatening and challenging at the same time in relation to other actors in the society (Holmberg, 2014). This implies that students could have a unique position, enabling trust and communication, bringing transformative solutions in the society and thus be effective change agents. (Holmberg, 2014) In order for the students to succeed, C-Lab focus on being a dynamic arena where students are in charge of connecting projects, companies and the public sector with academia as well as with each other. This is in order to find leverage points in the system and to suggest and initiate solutions aiming at transforming the society towards more sustainability. The C-Lab position within the triple helix can be seen in figure 1.



*Figure 1: The C-Lab position within the triple helix*

This first C-Lab pilot included 12 master students from 5 different countries with 6 different academic backgrounds in order to ensure diversification in thinking, past experiences and skills and thus enhance the results as well as increasing the personal development. A full list of all students participating in this pilot can be found in Appendix 1, table 1. The reasons for the authors to participate in this pilot project connected with a rather high degree of uncertainty can shortly be described with curiosity and hopes of being able to contribute to a positive development towards sustainable transportation. Additionally, both organizational change and innovations have been some of the favorite subjects throughout the authors' education and they are also strongly connected to the C-Lab approach.



## **1.2 Overall aims and objectives**

The overall aim with C-Lab is to create an arena where transformative solutions can be derived in collaboration between multiple stakeholders in order to drive the change needed for a sustainable society. To fulfill this aim a new form of education at Chalmers has been initiated where students are supposed to take on the role as change agents. C-Lab should further facilitate meetings and dialogues with different stakeholders throughout the society as well as extract and manage knowledge in a complex context. The objective is to give students the opportunity to develop unique skills in working across disciplines from a challenge-driven perspective.

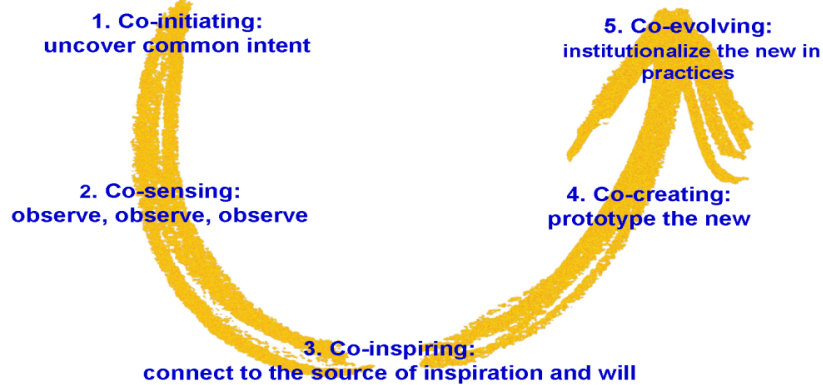
The aim of our individual project, phase 2, is to contribute to the spreading of more environmental friendly transportation methods. This is done by illuminating opportunities, problems and important steps in the diffusion process of new types of environmental friendly vehicles. The objective of our individual phase 2 project is to present an exploratory survey of the diffusion of small electric vehicles within the Västra Götaland Region.

## **1.3 Overall structure**

This chapter aims to give the reader an overview of the process behind C-Lab and this thesis as well as the theory and thoughts behind the method of approach. The C-Lab process is divided mainly into two phases, as illustrated in figure 3. Phase 1 is to provide the students with tools and methods for personal understanding as well as for system understanding to be able to identify challenges connected to sustainability. This first phase was executed in such way that all C-Lab participants worked together as one single team. Phase 1 will also influence phase 2 in such way that it leads to a research topic that further will be investigated and act as a bridge between the two phases. Phase 2 has the character of a normal master thesis, with students writing in pairs, but with the difference that it aims to give a perspective on a challenge connected to sustainable transportation that's been identified within phase 1. The structure of phase 1 will be described on a basic level below and in more detail in the next chapter.

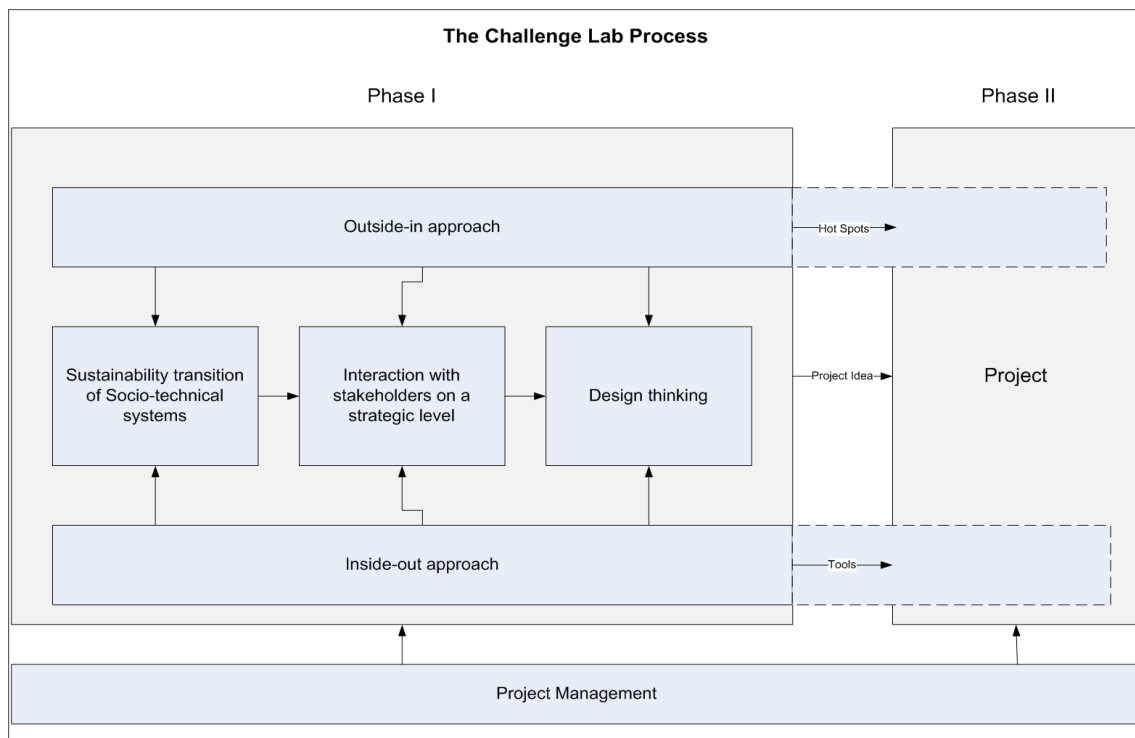
The C-Lab structure and process has its origin from Holmberg (2014) but also several aspects similar to the U theory (see figure 2). Theory U is appropriately used when dealing with big societal changes that need an innovative approach (Scharmer, 2009).

## Theory U



*Figure 2: Overall structure of the U theory (Scharmer, 2009)*

With inspiration from the U theory the first phase can be divided into two blocks that each represents a perspective; the outside-in and the inside-out. The main difference between these blocks is that one focuses on the outer world and the other of the inner world of a person.



*Figure 3: Structure of the C-Lab process (Holmberg, 2014)*

Within the outside-in perspective the outer world is at focus, which should give an understanding of the system in which transformation is needed. The out-side in perspective is connected to the U theory mainly in relation to the second step, co-sensing, where the most important objective is to open-mindedly take in information to create a common

understanding of the system (Scharmer, 2009). In the C-Lab process this was mainly done through applying a backcasting perspective and thus following the steps, structure and tools connected with this method. Further, this part was also meant to make it possible for the students to find leverage points and hot spots in the system where intervention is needed.

The inside-out perspective, on the other hand, has a person's inner values and motivations as starting point for understanding the surrounding system. Within the inside-out block tools and methods for developing leadership, self-leadership, and dialogue-tools was taught to the C-Lab group. The aim was to give the group better understanding of one owns values, visions and strengths and connects to the co-inspiring stage in the U theory. Central to the theory is that true transformation is only possible when the inner motivation of an individual, a group or a system is changed. (Scharmer, 2009)

In addition the outside- in and the inside-out approach other elements such as numerous meetings and lectures with stakeholders, design thinking and project management has been used during the phase 1 process. The stakeholder interaction is an important part of the C-Lab process and included numerous stakeholder meetings representing all parts of the triple helix in order to foster collaboration and to find the important hot spots in the system. Further, the whole phase 1 process should end up in a solution targeting a central issue within the system in line with the fourth stage of the U theory (Scharmer, 2009), which is further investigated in phase 2. The result of the phase 2 will ideally be spread within a stakeholder network to create effect in the system in accordance with the U theory's final step, co-evolving. (Scharmer, 2009) The underlying thought is that the insight and tools given during phase 1 will influence the approach in phase 2 towards more transformative solutions

## **2 The C-Lab process**

Within this chapter the C-Lab process of phase 1 will be described including the tools and methods used in order to be able to achieve an understanding of sustainable development according to a challenge driven perspective.

### **2.1 Outside-in perspective**

As mentioned in the earlier chapter, outside-in has its starting point in the outer world with the purpose to give an understanding of today's unsustainable trends and problems and thus the complexity that it brings. This illustrates the need of having a system perspective. In order to do so this chapter consists of backcasting and therefore follows the structure, steps, and tools connected to this method. Some of the tools used are sustainability criteria, the compass index methodology and global trends visualized by the funnel framework.

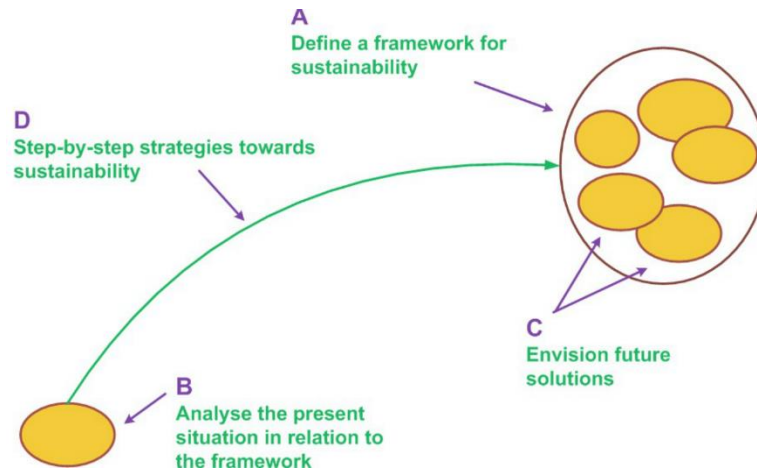
#### **2.1.1 Backcasting**

Backcasting was at first launched as a method but it can also be seen as a general approach of solving long-term complex problems Dreborg (1996), as well as being helpful in order to free the mind from today's existing system (Holmberg, 2014). Backcasting is in particular useful if the problem involves societal aspects that demands innovation and change in order to be solved and meets five criteria:

1. The problem should be complex and concerning several stakeholders and societal levels.
2. The change needed has to be substantial, meaning that smaller changes are not enough to make sufficient impact.
3. The trends that are dominant at the moment enhances the problem, thus is part of the problem.
4. The market power is not enough to correct the problem.
5. The problem has an action horizon that is long enough to be able to make long-term choices and thus steer the future in a deliberate direction.

(Dreborg 1996).

Backcasting can result in strategies for shaping the future and solving the problem at hand. The strategies are results of a process involving four different steps (figure 4): A) Define a framework for sustainability, B) Analyze the present situation in relation to the framework, C) Envision future solutions and lastly D) Step-by-step strategies towards sustainability (Holmberg, 1998. Holmberg & Robert, 2000)



**Figure 4: The four steps of backcasting (Holmberg, 1998. Holmberg & Rob  rt, 2000)**

However, instead of using criteria for a sustainable society it is also possible to use scenarios (Dreborg, 1996). Nonetheless it is interesting to compare it to forecasting. Forecasting has its origin in the trends of today and thus letting them lead the way for how to solve the problems of tomorrow and therefore lacks the ability of foresee major changes. Backcasting approaches the problem in the opposite direction; it starts with a preferred future scenario and is then tracking the initiatives needed to achieve that future back to the current situation. As mentioned the approach is favorable when the current trends are supposed to be part of the problem and there is enough time to make deliberate long-term decision, shaping the future

In C-Lab we have followed the earlier mentioned steps and the results will be presented below. During our time working with phase 1, we worked all together using the walls in our “Lab” in order to illustrate challenges and perspectives. In figure 5 below a part of the wall is illustrated.



**Figure 5: Part of the wall in our workspace used in order to illustrate backcasting**

#### **2.1.1.1 Define a framework for sustainability**

Defining a framework for sustainability is done in order to create a desired future and awareness as well as being a leading star for the rest of the process. The framework for sustainability used within this thesis contains of certain criteria that are related to four fundamental conditions for the society to be sustainable. The society should not:

1. Increase the concentration of substances that derives from the crust of the earth.
2. Increase the concentration of substances that it produces.
3. Over-harvest or manipulate the ecosystem.
4. Use the resources in an unfair way, hindering basic human needs to be met.

(Holmberg et al, 1996)

#### **2.1.1.2 Analyze the present situation in relation to the framework**

Analyzing the present situation in relation to the framework is done in order to describe the current situation by identifying the trends that are dominating the system and receive a baseline analysis. This was executed by using two different tools; the compass index methodology and the funnel framework.

#### **2.1.1.3 The compass index methodology**

The purpose of the compass index methodology is to be used as an accelerator, speeding up the process of learning and doing sustainable development. This is achieved by framing sustainability indicators. (Atkisson, 2011) The method is built upon three design principles:

1. Simplify the presentation of complex sustainability theory, without suffer from a loss of substance, and make it understandable, usable and approachable for anyone.
2. Make it possible for anyone to participate regardless of their understanding of the theory behind by using structured processes.
3. Make sure that the process will lead to a result that have a good chance of creating a tangible, positive, high-leverage change in the world.

(Atkisson, 2011)

The compass consists of, just as normal compass, four different directions where (N) stands for Nature, (E) Economy, (S) Society and (W) Well-being, which is illustrated in figure 6. The general sets of definitions for the directions are:

(N) Refers to underlying health and sustainable management of ecosystems, natural resources and bio-geo-physical cycles. These indicators are usually measured in terms of resource consumption, quality assessments, and emission amounts and such. (Atkisson, 2011)

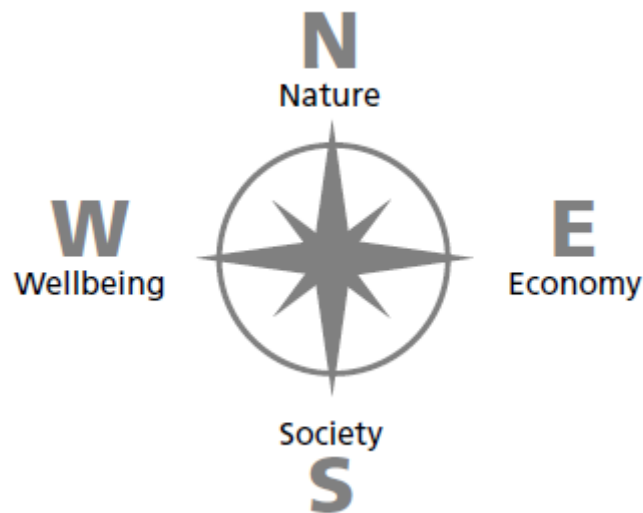
(E) Refers to the ways that humans work with nature in order to produce products and services.

(S) Includes the collective human society such as all social systems, structures and institutions. Examples of indicators can be crime rates, trends in the school system, density of social networks as well as all other measures that are included in social capital.

(W) Focuses on the individual, instead of the collective, and indicators that are crucial to health and happiness. Infant mortality, sick days from work, rates of prescription for anti-depressants are all data that fits herein.

(Atkisson, 2011)

Further, it is possible to use a point system in order to show an overall sustainability state (Atkisson, 2011).



*Figure 6: Part of the wall in our workspace used in order to illustrate backcasting*

The compass index methodology was executed as a group brainstorming in the beginning of phase 1. It was used in order to raise the awareness and create an overview for the team about where the most apparent problems take place. Thus, where changes in the system are necessary to take place in order to enable a transition towards a sustainable society. In short the results showed us that most of the challenges are connected to Society and Economy rather than to Nature.

#### 2.1.1.3.1 Results nature

The most urgent problems that were identified are the increasing pollution due to production and transportation. If the current trend of emissions continues global warming will be a severe threat to future generations as well as for the current flora and fauna. One important factor in decreasing the pollution is to switch from fossil fuels to more sustainable and environmental friendly options.

#### 2.1.1.3.2 Results economy

Within this direction the most urgent problems identified were the unequal distribution between different regions as well as the increasing resource scarcity. Further, today's political and public demands of having a continuous GDP growth is also seen as a problem due to the extra stress this will put on the ecosystems, unless new innovations can increase energy and material efficiency. Additionally, it is needed for manufactures to realize that their current

business model that builds upon a linear economy is not sustainable due to the large amount of waste and low amount of reuse and recycling it creates. This linear economy could be replaced by circular economy.

#### 2.1.1.3.3 Results society

In this direction the increasing population is seen as one of the most threatening problems since it obviously will increase the global demand and therefore put more stress on the societal systems as well as the ecosystems. Additionally, the unequal distribution of resources is a problem due to the tensed relationships between people and nations it can lead to, creating instability. This is a problem since we see peace and stability as a necessity in order to foster the behavioral change needed to transform into a global sustainable society. It is then important that individuals care about what happens in other parts in the world and not just “as far as they can see”.

#### 2.1.1.3.4 Results wellbeing

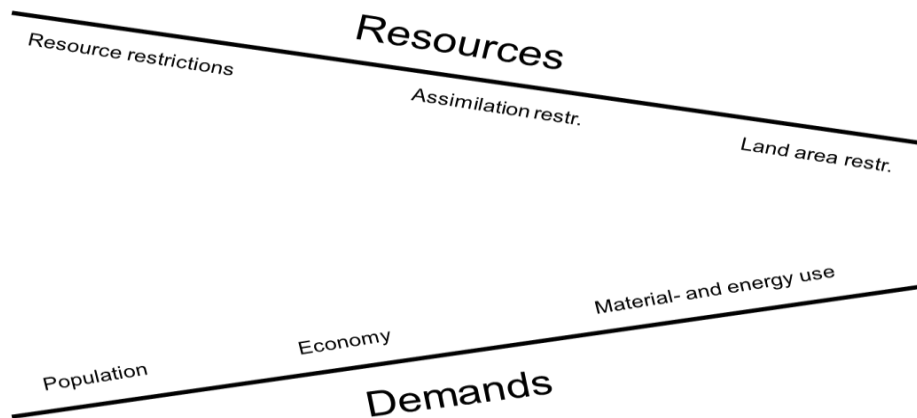
Here one problem is the high infant mortality in the poor world as well as their high overall mortality and low living standards. It is within the poorest part of the world's population that the highest increase in population, which makes it crucial to higher the living standards in these groups specifically.

#### **2.1.1.4 The funnel**

The funnel is used in order to analyze global trends by which it is possible to visualize natural boundaries (Robert et al. 1997). Further, according to Holmberg (1998) resources and ecological functions are declining so that the available resources that are needed within health and economy are decreasing systematically. At the same time both the population and the average demand of services are increasing. It is possible to visualize this into a funnel that becomes narrower, illustrating that it will become harder to satisfy the needs and desires of the human population. Further, the slopes of the funnel can have different entities depending e.g. different aspect, different locations and the subject of dispute. It is in the middle of this funnel that sustainable systems and organizations have to invest and work in order to meet the four principles of sustainability, which have been presented earlier. (Holmberg, 1998)

For this thesis the upper slope, which visualize resources, will constitute of resource restrictions, assimilation capacity and land use restrictions. The lower slope, which visualizes demands, will constitute of population, economy and material and energy intensity. This can further be seen below in figure 7.





*Figure 7: The resource funnel (Holmberg, 1998)*

#### 2.1.1.4.1 Resources

Ever since 2000 there has been a general trend of resources becoming more expensive and in average the prices have more than doubled. The reasons for this are the rapid increase of demand from emerging markets such as India and China together with a more challenging supply landscape. (McKinsey Global Institute, 2013) The resource prices over time are illustrated in figure 8.

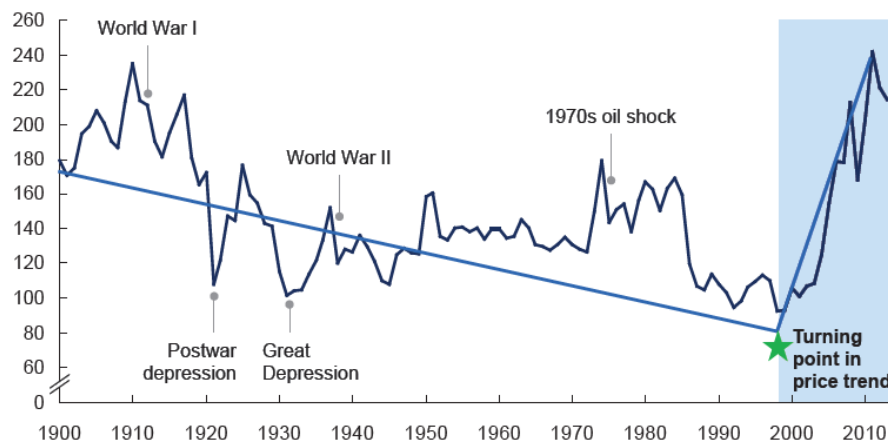
In more detail, the average income in China is today growing ten times faster than it did back in the United Kingdom during the industrial revolution and this with a population 100 times larger. This rapid economic growth has led to a large increase of the demand within mineral resources, energy and non-food agricultural raw materials. Additionally the supply of resources, except of unconventional oil and gas, has become more challenging due to geological issues and rising input costs. (McKinsey Global Institute, 2013) Many resources have moved to a point where the supply is increasingly inelastic, which means that it is increasingly difficult for the supply to meet the rising demand. This in turn leads to the risk that small shift in the demand drive a great volatility in price. (McKinsey Global Institute, 2013)

Furthermore, there is an accelerating depletion of the resource supply, with exception for natural gas and renewable energy, and new sources are mostly located in more difficult and less productive locations than the old ones. Worth mentioning is that the average real cost per unit oil have doubled the last decade and even though the exploration costs connected to mining have been quadrupled very few new opportunities have been found. (McKinsey Global Institute, 2013)

### Resource prices have increased significantly since the turn of the century

McKinsey Commodity Price Index<sup>1</sup>

Real price index: 100 = years 1999–2001<sup>2</sup>



1 Based on arithmetic average of four commodity sub-indices: food, non-food agricultural raw materials, metals, and energy.

2 Data for 2013 are calculated based on average of the first three months of 2013.

**Figure 8: Resource prices over time (McKinsey Global Institute, 2013)**

Sufficient water supply of good quality is one of the most important factors in health and wellbeing for humans as well as ecosystems and for socio-economic development. Freshwater is projected to become an increasingly scarce resource in the near future with an expected increase in costs associated with water quality problems. Additionally, the abstraction rate of global groundwater has tripled over the past 50 years. However, in the short term there will be added water to stream flows, which will increase the water supply due to the shrinking of glaciers. This will however diminish in the long term, decades to centuries, and lead to lesser buffering effect. Furthermore, it is estimated that the worst climate impact of a climate change will be lack of available water of sufficient quality due to changing water cycle. (World water development report, 2012)

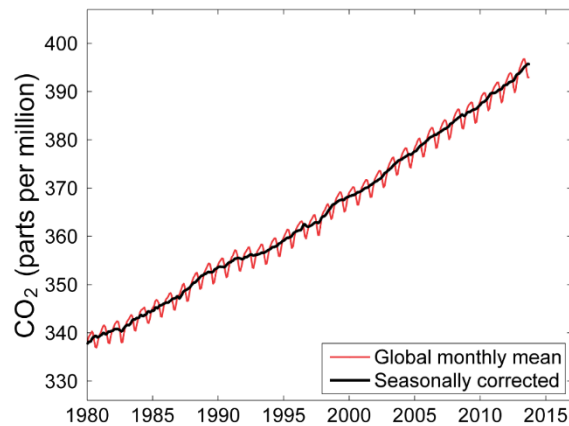
Soil degradation is today a worldwide problem and more and more soils are getting depleted of nutrients, which have serious consequences on agricultural production and food security. This is due to the human transformation of the nutrient cycle, which has led to an excess of nutrients in the oceanic ecosystems and a lack of nutrients within agriculture. (REKACEWICZ, 2002)

#### 2.1.1.4.2 Assimilation capacity

Assimilation capacity refers to the natural system capacity to absorb, breakdown and disperse biologically unavailable materials without it being degraded. If this limited capacity is exceeded the natural system might lose its function and ability to support life on earth. (Cairns, 1999)

As can be seen in figure 9 there has been a steady increase of the carbon dioxide concentration in the atmosphere over the last 30 years and it reached 393 ppm 2012. (Le Quere, 2013) Carbon dioxide further holds a causal relationship with global warming. The estimated concentration in the atmosphere of 700 ppm by year 2100 will yield a significant

increase of the global average temperature, if the casual relationship still holds true. (Climate Change, 2013)



**Figure 9: Carbon dioxide concentrations in the atmosphere (Le Quere, 2013)**

Carbon dioxide emissions has its origin mostly in fossil fuel burning, land use changes and cement production and the atmosphere is the single largest assimilator by 45% year 1959. Additionally oceans constituted by 27% of the emissions and terrestrial sinks for 28%. The carbon dioxide assimilation has resulted in a global increase in temperature, which has led to changes in the sea level as well as changes in snow cover. (Le Quere et al, 2013)

The Asian development bank (2009) projected what impacts a global average temperature increase of 1-5 Celsius would have. It was found that only one-degree increase, relative to baseline 1990, would possible lead to an outbreak of diseases such as malaria and dengue. An increase of five degrees would lead to extreme weathers, failing crop yields, less quality ground water and biodiversity loss.

#### 2.1.1.4.3 Land area

The total ice free land area on earth is 159 million km<sup>2</sup>, of which around 53,5% directly have been modified by human activities. However, this is a rather uncertain number since the impact of land transformations such as roads and railways can have an ecological impact hundreds of meters away from the initial intervention in nature. The rest 46,5% consists of what is called natural lands where 18,7% are unsuitable for agriculture, such as mountainous areas, arid regions and tundra. The area left untouched that is suitable for agriculture is hence 27,8% and consists today mostly of forests and rainforests. Thus, two thirds of the useful land available has already been modified by humans. (Hooke et al. 2012).

Further, cropland is a very important type of land area for the human population and becomes even more so due to the large increase in population. Lately the trend of a growing cropland area has declined and it is estimated that it will fairly soon peak. The declining increase in cropland is due to at least three different trends;

1. Urban areas are increasing at the expense of agricultural land. The estimated loss of agricultural land due to urbanization between years 2000-2030 can be as much as 15000km<sup>2</sup> (Döös, 2002).

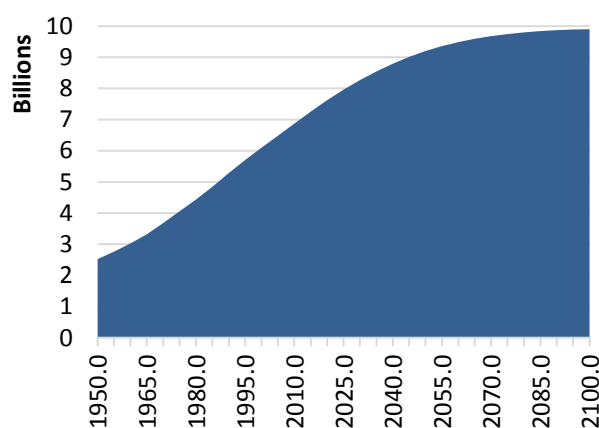
2. There is not much area left that is suitable for agriculture. Two thirds of the useful land available has already been modified by humans, and the last third consists of e.g. rainforest needed to assimilate CO<sub>2</sub>. Furthermore, tropical forest soil rapidly loses its fertility after it is cleared.(Fischer et al. 2000; Ramankutty et al. 2008)

3. Existing agricultural land has deteriorated so much that it is not worth cultivating anymore. Already 1990 40% of the global agricultural land area, nearly 20Mkm<sup>2</sup> had been degraded and over half of this area was so degraded that local framers did not have the means to restore it. (Oldeman et al., 1991, p. 28)

There are different views about the earths capacity of supporting the projected population of 8,9 billions 2050. Fischer et al. (2000, p. 88) believe that it is possible whereas Wackernagel et al. (2002) estimated that the land area needed to sustainable grow crops, graze animals, provide timber, accommodate infrastructure, and absorb waste already exceeded the earth's available area as early as 1978. Moreover it was estimated that 20% more land was needed than what was available 2002, thus the carrying capacity of the environment on earth for humans have been exceeded. If so, it can be dealt with by reducing demand, develop new technical solutions and reducing the population.

#### 2.1.1.4.4 Population

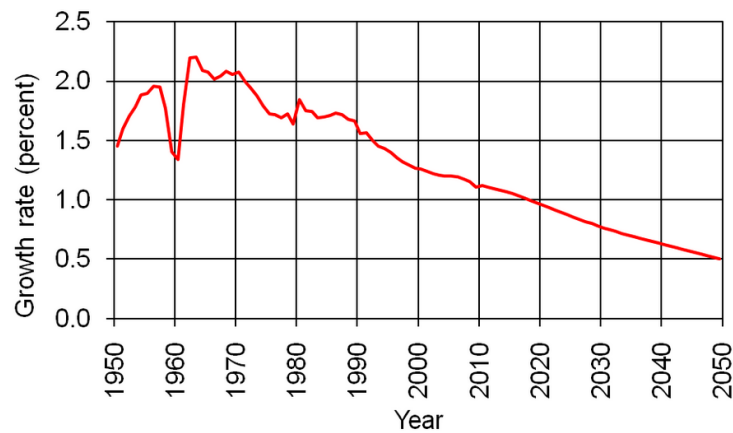
There is an on-going rapid growth of the human population and over the last 60 years the population have increased from 2,7 billion to over 7 billion. Further, the total human population on earth is estimated to be almost 10 billion year 2100. This is an increase of more than 7 billion in only 150 years and can be seen in figure 10. (United Nations, 2012)



**Figure 10: World populations over time (United Nations, 2012)**

However, since the peak of an annual growth rate slightly over 2% in the early 1960s the growth rate has steadily been decreasing, as figure 11 illustrates. The on-going decrease after

this peak can be explained by rising age at marriage and increasing availability as well as use of contraceptive methods. (US Census Bureau, 2011)



**Figure 11: Annual global growth rate (US Census Bureau 2011)**

The growing population results in a higher demand of resources and overpopulation will lead to severe constraints on the planet with limited resources and space per capita. (United Nations, 2001) This puts extra pressure on earth and it becomes more important to be resource efficient and minimize the impact per person so that the system does not crash (Carstedt, 2014). However, there are different opinions about how large the population will have to be for overpopulation to occur. About two thirds of the studies have estimated the carrying capacity of earth to between 4 and 16 billion persons, with a median value of around 10 billion. (United Nations, 2001)

#### 2.1.1.4.5 Economy

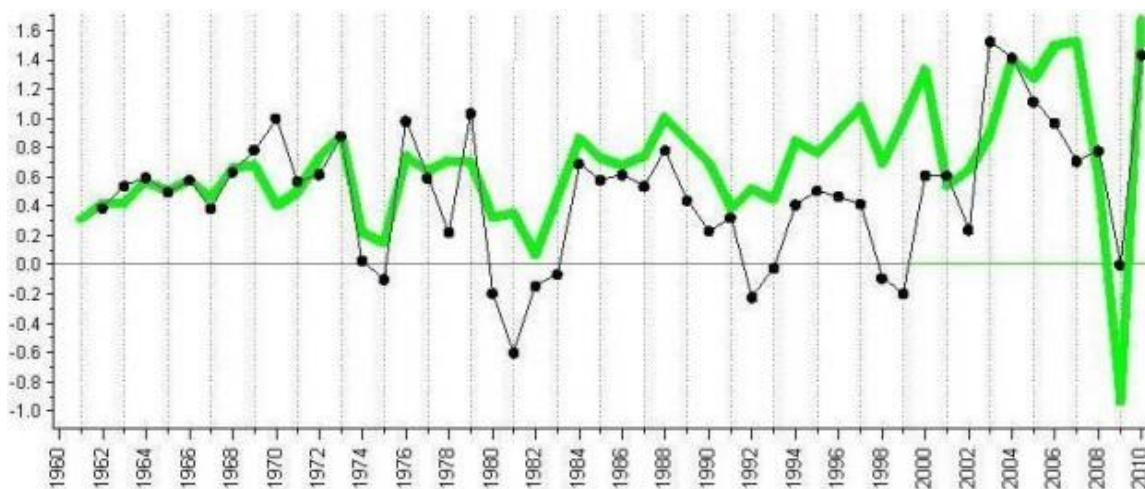
GDP is the sum of all services and goods which are produced in a country over time and has long been an important indicator in order to measure wealth and economic progress (Sahin, 2009). However, according to Carstedt (2014) GDP measures all economic aspects except for those making life worth living. Further, GDP misses out important dimensions of well-being and negates environmental degradation (Dean, 2014).

The world encountered a global recession 2008 but have since then had an annual growth of between 2,1-4.0 % and as can be seen in figure 12 the global economy is starting to grow in a higher pace. This is much due that the euro area has started to grow again and that giants such as USA and China are having better economic results. (United Nations, 2014)



**Figure 12: Growth of world gross product 2006-2015 (United Nations, 2014)**

According to Granados et al (2012) there is a strong correlation between GDP and CO<sub>2</sub> concentrations within the atmosphere, which is illustrated in figure 13. This correlation does indeed make it troublesome for countries to lower their CO<sub>2</sub> emission while at the same time have a continuous GDP growth.



**Figure 13: Annual growth of the world economic output (Granados et al, 2012) Green line is trillions of 2000 US dollar and the black dots are the annual change of estimated CO<sub>2</sub> emissions in billions of tones.**

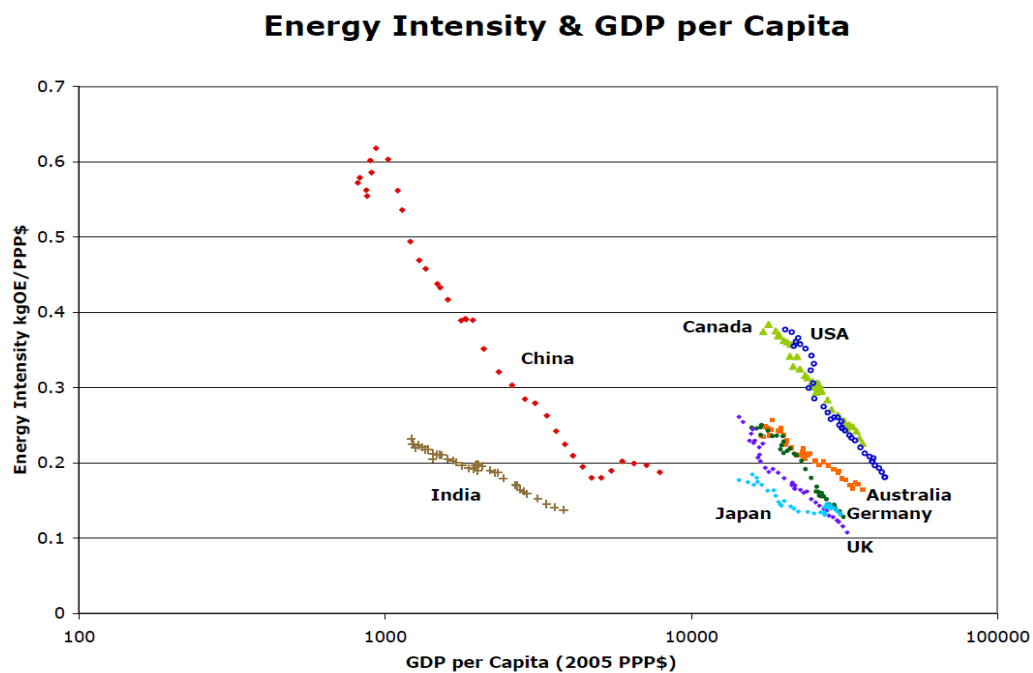
However, there has been an ongoing trend since the beginning of 1970 that services, instead of products, getting a larger share of the world economy. This could further on lead to a weaker correlation between GDP and CO<sub>2</sub> emissions. (United Nations, 2010)

#### 2.1.1.4.6 Material and energy intensity

The worlds primary energy consumption has had a continuously growth since 1987 and oil is today the largest energy source. However, the market share for oil has decreased for 13 years

in a row. The environmental friendly energy sources only add up to 8, 6% but are at an all-time record. Further on, there is a large difference between the patterns of energy consumption between different regional areas. Asia in specific is a very coal heavy area and coal constitutes of over 50% of the Asian total energy consumption whereas South & Central America barely uses any coal but instead have the world's largest hydroelectricity production. Further, when a nation becomes richer the total energy consumed of its society will increase (World Bank, 2014).

However, the energy intensity, which is calculated as units of energy per unit of GDP and hence measures the energy efficiency of a nation's economy (Peck and Chipman, 2007), is decreasing on a global level (Liddle, 2012) and do have a negative correlation with wealth (Stem, 2012). Energy intensity is however not perfectly accurate since countries that experience a colder climate or have a large mining sector will naturally use more energy, even though having a high level of energy efficiency.



**Figure 14: The relation between Energy Intensity and GDP per capita (Stern, 2012)**

As mentioned earlier in the resources chapter there is a growing need of materials. Material intensity can be described as the amount of material needed to produce a certain product and material intensity seems to have a negative correlation with wealth, just as energy intensity, and does decrease while GDP goes up. (Allwood et al, 2011) Further, one factor that has impact on the material inefficiency is that people prefer to own rather than share products via e.g. pooling with the purpose to raise the operating hours. (United Nations, 2007)

#### **2.1.1.5 Envision future solutions**

The sustainable future must be aligned with the fundamental conditions that constitute the framework identified in the first step. Envisioning future solutions is a precondition in order to

be able to find strategies that will create a sustainable future. However, it is neither desirable nor possible to specify the future in too much detail. Further, the broad thinking can reveal new options while opening up the mind. (Holmberg, 1998)

According to this the C-Lab participants together formulated two visions based on different boundaries. Vision number one has the whole world as such boundary and takes a long-term perspective while vision number two instead has Gothenburg as a boundary and is a vision for the transportation sector. During our process of work towards the visions the definition of sustainable development by the Brundtland commission (Brundtland, 1987) was used as inspiration and vision number one was finally expressed as: "A sustainable future where the population, 10 billion people, is able to meet their own needs, within the planetary boundaries, without compromising the ability of future generations to meet their own."

The second vision, for a sustainable transport sector in Gothenburg, was expressed as: "The transport system should satisfy the needs of the population as whole where all the individual parts of the system as well as the complete system i) is efficient, ii) the materials used are enclosed within the techno-sphere and iii) the source of energy is renewable produced with minimum impact to the environment e.g. zero fossil carbon emissions to the atmosphere."

#### ***2.1.1.6 Step-by-step strategies towards sustainability***

This last step works as a bridge between the current situation and the future sustainable situation in such way that strategies are identified that can move the society towards sustainability. In order to be able to identify these strategies four points have to be considered (Holmberg, 1998):

- Will each measure bring society closer to sustainability?
- Can each measure work as a flexible platform for the next step towards sustainability?
- Is the payoff time horizon short enough?
- Will the measures taken together be able to help society to make changes in an adequate scale and speed in order to achieve sustainability without too big losses for the species on earth during the transition?

Further, when identified strategies are put into effect it is important that they are consistent with the socio-economic reality (Robért, et al, 2002).

Strategies that can lead towards a sustainable society were identified in two different ways by the C-Lab team. Firstly, a literature study was conducted in order to find strategies such as goals, policies and governing documents connected to the transportation sector at different levels: Västra Götaland region, Sweden and the Europe Union. Secondly, by taking use of VINNOVA, the stakeholders met during phase 1 and additionally through a document analysis the team searched for projects and business models connected to sustainable transportation within the Västra Götaland Region. The findings were then analyzed by the four steps of backcasting earlier described and lastly put up at the C-Lab wall as can be seen in figure 5.



At the Swedish level, strategies were found in the Fossil Free fleet investigation (Näringsdepartementet, 2013) and included reduction of the need of transportation, higher energy efficiency as well as a more widely usage of biofuels. Further, at the Europe Union level strategies consisted of more environmental friendly types of transport such as cycling, walking and public transport as well the use of low or zero emission vehicles (European Commission, 2011). Lastly, some of the projects and business models which were found to be able to move the society towards sustainability were GoBiGas, ElectriCity, Ubigo and DriveMe.

## **2.2 Inside-out perspective**

Inside-out has its starting point within an individual and provides methods and knowledge to understand one's own values, visions and strengths. This can, additionally to personal improvement and understanding, improve the stakeholder interaction by enabling the extraction of hidden agendas and values. Additionally it also helped the students to gain an understanding of each other despite the group's ethical and cultural diversity. This is important for the effectiveness of an organization or group (Kwantes & Boglarsky, 2006).

The inside-out block consists of three interconnected subjects: leadership, self-leadership and dialogues. Self-leadership was introduced to the C-Lab team by Dominic von Maartens from the organization SelfLeaders by two full day sessions. Dialogues was introduced by Martin Sandé from the management consulting company PREERA and consisted of a total of four dialogue sessions. Lastly, leadership was introduced to the group by Göran Carstedt, former president of IKEA North America and Europe.

### **2.2.1 Leadership and self-leadership**

Current large global problems such as climate change; poverty and biodiversity loss can be addressed as challenges that are "bigger-than-self"-problems. This is due to that they distinguish themselves in that it is not clearly in an individual's immediate self-interest to invest energy and resources in tackling the problem. The personal effort needed to address the problem is unlikely to justify the individual's expenditure of resources. Therefore it is necessary with bolder leadership from both political and business leaders. (Crompton, 2010) There are two main challenges in today's leadership and these are a sustainable future and organizational change (Carstedt, 2014).

Further, the main function of leadership is to produce or cope with change. Leaders do this by working with: i) setting the direction of change through visions and strategies, ii) gather people that are aligned to the vision through communication skills as well as iii) inspiring people to work towards the vision. Conventionally the qualities associated with leadership are intelligence, toughness, determination and vision. (Kotter, 2001)

However, Goleman (1998) identified leader's qualities within three groups: emotional intelligence, cognitive abilities and technical skills. Cognitive skills such as analytical reasoning and high IQ were considered as threshold capabilities useful for a leader to have a systems perspective and a long-term vision. In the study it was found that the most effective leaders are alike in one way, they all have a high degree of emotional intelligence which is the "quanon" of leadership. Further, it was found that 90% of the difference between star performers in senior leadership compared to the average performer was attributable to emotional intelligence factors. (Goleman, 1998)

The factors that emotional intelligence consists of are i) self-awareness, ii) self-regulation, iii) motivation, iv) empathy, v) social skills. Self-awareness is the ability to understand and recognize your own emotions, drives and moods as well as their impact on others (Goleman, 1998). Additionally there is a high correlation between self-awareness and high efficiency (Tamm, & Luyet, 2004). Self-regulation is the ability to redirect and control disruptive impulses,

thus think before acting. Motivation is the passion to work for other reasons than money or status and be able to pursue goals with persistence and energy. Empathy is to have the ability to understand emotions of other people and treating them thereafter. Lastly, social skill is the proficiency in managing relationships and building networks as well as building common grounds. (Goleman, 1998)

Moreover, a great leader gets others to move in such direction that it is sensible for themselves, the business and the community. Great leaders often have characteristics of humility, vulnerability and a lack of arrogance. Furthermore, people only change their behaviors' when they are motivated to do so, which happens when speaking to their feelings. Great leaders tell stories that create pictures in our minds, attached to an emotion. Thus, people change when they can visualize something that touches their emotions and their incentives of action. (Kotter, 2001)

Motivation consists of both extrinsic motivation and intrinsic motivation and is associated with better performance, more engagement, higher quality learning and achievements beyond expectations. Extrinsic motivation refers to the performance of an activity in order to attain some separable outcome and contrasts with intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself. (Ryan and Deci, 2000)

There are four levels of depth in the extrinsic motivation and engagement and each level constitutes of a higher degree of motivation. These are external regulation, interjected regulation, identified regulation and integrated regulation. At the first level, external motivation, an individual do something "if-so", hence something is done to get something else. At the interjected regulation level an individual feel that something should be done, in order to feel good and avoid guilt feelings. Further, at the third identified regulation level an individual do something because there is an expressed wish to do it, thus something is done because the individual feel it is important. Finally, at the integrated regulation level, which is the strongest level of motivation, an individual do something because it expresses who she/he is and her/his deepest values and beliefs. (Ryan and Deci, 2000) Additionally, in order to be able to transform a complex system it is beneficial to reach this last level of integrated regulation (Holmberg, 2014).

Further on, people's decisions are driven by the values they hold and thus behavior is intimately connected to people's values. Moreover, individuals are predisposed to reject information when it would challenge their identity and values. Hence, information and facts about a problem will have greatest positive effect on those already believing in it while strengthening their identity. However, it will likely leave many people unmoved, or even more resistant to change. Instead appealing to values that contradicts the problematic behavior is more likely to contribute to the incorporation of the values culturally and lead to real change. (Crompton, 2010) Additionally, people might realize the need for change but lack the passion to be able to break out of habit, patterns and routines. (Kotter, 2001)

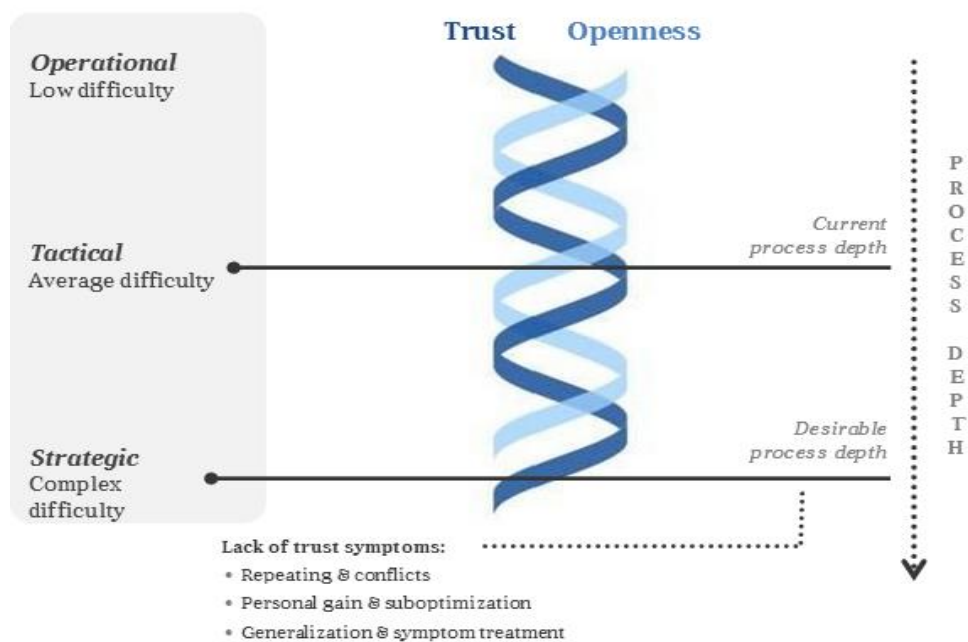
There exist both personal and organizational values, which influence decision-making. It is necessary to examine the interplay between these two different value perspectives. (Liedtka,

1989) Decisions within an organization are often made by assessing the fit between organizational values (the proposed course of action) and personal values (the individual's self-image) (O, Reilly et al, 1991). It has also been shown how values impact both personal and organizational effectiveness and that clarity of personal values is shown to have a more positive impact than clarity in organizational values. Further on, values are the core of one's personality and influences both choices and which people that are considered trustworthy. (Posner & Schmidt, 1996)

Self-leadership can be described as a self-influence process by which individuals achieve self-direction and self-motivation, which is necessary in order to perform and enhance personal effectiveness. This self-influence process is carried out by behavioral and cognitive strategies, which more specifically consists of behavior focused strategies, natural reward strategies and constructive thought pattern strategies. Behavior focused strategies aims to increase the individual's self-awareness by understanding the underlying reason to the behavior. Examples of techniques used to achieve self-awareness are self-observation, self-goal setting and self-reward. (Neck, 2006)

The natural reward strategies aim to create a feeling of competence and self-determination, which increases the intrinsic motivation. Constructive thought pattern strategies, on the other hand, intend to change the way an individual is thinking in order to increase its performance. Self-leaderships thus focus to a great extent on the underlying reasons for behavior, which in many ways depends on the inner values an individual holds. It has further be shown that that the most effective leaders in self-managing are those that engage in behaviors that facilitates self-leadership strategies such as self-reward, self-goal setting and self-observation. (Neck, 2006)

There is also a positive causal relationship between self-leadership and the level of innovation due to a higher level of creativity. Additionally, self-leadership increases the belief that other will be honest, which means that the trust between individuals within a team will be enhanced. (Neck, 2006) According to Wendelheim (1997) trust and openness is interconnected in a spiral and the tighter this spiral is the more complex problems can be solved by a team as illustrated in figure 15.



**Figure 15: The trust and openness spiral (Wendelheim, 1997)**

### **2.2.1.1 Value mapping**

Value mapping is a self-leadership method designed to help individuals to retrieve and understand their values. It is based on more than 46 theories of human development and 125 universally standardized definitions of values. These values can be distributed across a value-map, distributed into four phases of human development: i) Surviving ii) Belonging iii) Self-initiating iv) Interdependence. Through answering questions about which values are preferred an individual values profile can be obtained. The profile includes means and goals values, which are the foundation values, but is also including focus and vision values. (Hall et al. 1994)

Foundation values provide the basic support for daily living, which may take priority over higher ideals such as the vision. However, vision values are values that give motivation and meaning; forming the individual's vision for the future. The focus values act as a bridge between foundation and vision. These values represent the highest priorities in daily life and indicate where most of our energy is put. This value profile can allow individuals to plot a relationship between their own value patterns and a range of leadership styles. (Hall et al. 1994)

When the personal value priorities are clear to an individual, the desire to develop appropriate skills becomes more focused and purposeful. Thus, values can be regarded as preceding skills and therefore does value analysis provide an efficient and reliable data source to be used prior to development activity. Moreover, the individual values and personal motivation can be transformed into group values, consisting of values held in common. These values can work as a foundation of norms, policies, goals, roles and business practices, which in turn can be converted into behaviors. (Hall et al. 1994)

### **2.2.1.2 Our process and takeaways**

As stated earlier, Dominik Van Maartens introduced the self-leadership for the C-Lab team through a two-day session. The whole group worked together in order to understand self-leadership, exploring one's own values and motivations with the aim to understand what drives our behavior as well as others. Additionally, the aim was to create more openness and trust within the group, which succeeded. Several different tools were used and some of them were active listening, issue tree, storytelling and value mapping. The participant's strengths and weaknesses were also identified with focus on strengths and each participant got to hear three of her/his strengths from three other participants.

The leadership session, which was introduced to the team by Göran Carstedt had a more traditional layout and consisted of a one-day lecture about leadership towards sustainable development. The overall message was the need for the world to change its focus from consumption of things to ideas and knowledge and the biggest challenges today's leaders face is to transform societies and organizations for this shift of focus to take place.

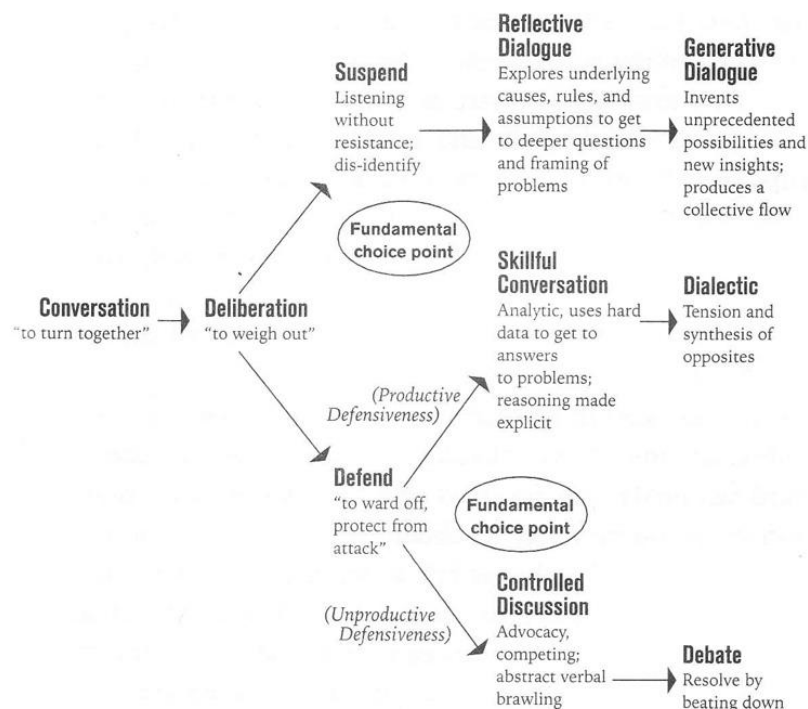
Among others, the takeaways from this part are the importance of leaders and the role they play in the transformation to more sustainable systems as well as the importance of values both in oneself and in others due to its impact on behavior. Connected to this, the importance of trying to understand stakeholder's values, with full attention listening, and realizing that there are something deeper beyond the surface. This understanding helped us to extract more valuable information from stakeholders in phase 2.

### **2.2.2 Dialogues**

Today's problems are often too complicated and complex to be solved and managed by a single person. A group is both smarter and more aware than a single individual, which means that it is possible to perceive new opportunities and directions thinking together. Dialogues can be used as a mean to harness this collective intelligence. (Isaacs, 1999, pp. 11)

Isaacs (1999) defines dialogues as a "special type of conversation that builds upon listening without resistance to explore underlying causes, rules and assumptions to deeper questions and framing of problems". Additionally, dialogues are the key to creating a reflexive learning culture and are encounters between persons that exchange experiences, ideas and opinions. (Päsilä et al., 2012) Dialogues are something you do with another person and are about shifting our attitudes around relationships. Instead of put effort into making others understand us the focus is shifted towards a greater understanding of ourselves as well as each other. (Isaacs, 1999, pp 9)

Dialogues can resolve conflicts, discover undiscussed thinking, make people get along, solve problems more effective and without external control make people work in a highly coordinated and creative fashion. (Isaacs, 1999, pp.10-11). Furthermore, dialogues also have the property of being able to invest into unprecedented possibilities and new insights, which produces a collective flow. Hence a dialogue could be said to be the art of thinking and reflecting together. (Isaacs, 1999) The main differences between different conversations can be seen in figure 17.



**Figure 16: The difference between different types of conversations (Isaacs, 1999. pp. 41)**

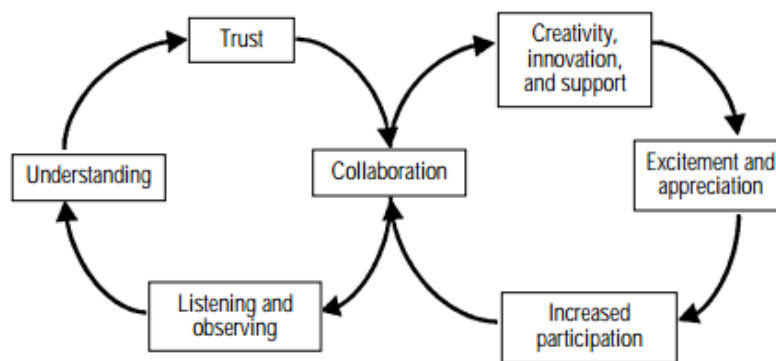
However, for dialogues to work there are three fundamental levels of human interactions that need to be addressed: i) Production of coherent action ii) Creation of fluid structures of interaction iii) Providing a wholesome space for dialogues.

- Produce coherent action refers to that we often do things we do not intend to, thus is learning capacity needed for new behavior so this contradiction disappear and we instead produce the intended effects. The skills needed to learn for coherent action are listening, respecting, suspending and voicing.
- Create fluid structures of interaction. Often people do not see what forces that operate under the surface of a conversation. This leads to that individuals misunderstand what others are doing as well as what impact themselves have on others. Moreover, this could lead to that well-intentioned persons with other ways of seeing the world can neutralize changes within groups or organizations. To create these fluid structures of interaction is it important for an individual to be aware of patterns of actions and how to overcome structural traps.
- Provide wholesome space for dialogue refers to that often when people are trying to induce a dialogue it often take place in an atmosphere of envelope that have a large impact on how to think and act. This atmosphere consists of habits of thought and the quality of attention that are brought to an interaction. Thus, one needs to become more conscious about the architecture of invisible atmosphere that affects our conversations.

(Isaacs, 1999, pp. 29-32)

Collaboration can be defined as the social coordination of actions where everyone in this specific social system is accepted as a contributor to a common purpose (Sandow & Allen, 2005). To improve a social network the relations between the individuals must be improved, which can be done through personal improvement (Jewell-Larsen & Sandow, 1999). Collaboration increases the social capital (Sandow & Allen, 2005) and is further often needed in order to solve problems rapidly and to create new breakthrough knowledge (Jewell-Larsen & Sandow, 1999).

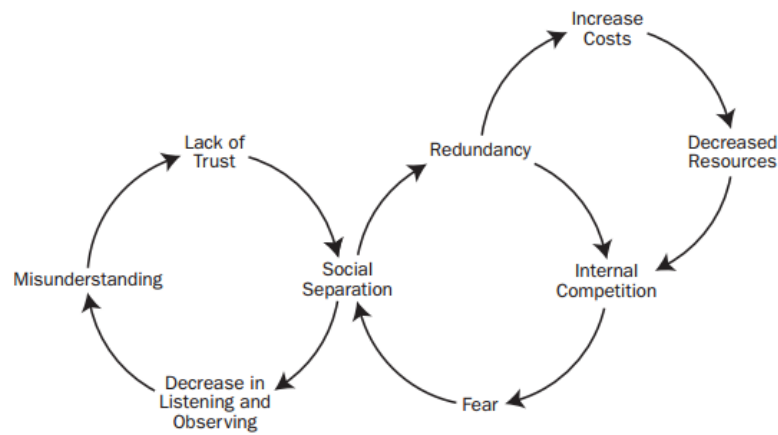
Moreover, organizations are complex structures that interweave people and their emotions, meanings, interpretations and actions. The innovation potential of an organization is based on these people and their capability of interacting and creating knowledge. (Päsilä et al., 2012) The level of collaboration is connected to the level of listening, understanding and trusting in an interconnected reinforcing loop, which can be seen in figure 17 (Sandow & Allen, 2005). It can also be seen that the creativity, excitement and participation is leveraged through this process. Onwards, the more complex a task is the more important is it to have a high level of trust and openness within a team. A low level of trust and openness can lead to sub-optimization, conflicts and generalization. (Wenderheim et al, 1997)



**Figure 17: The collaborative process (Jewell-Larsen & Sandow, 1999)**

However, if there instead is a decrease in the level of listening and observing it will eventually lead to a social separation, redundancy and increased costs and finally resource depletion as can be seen in figure 18. This will then feed back into the first loop and decrease the listening and the trust even more. Dialogues can enhance this double loop by increasing the listening, understanding and trust. (Sandow & Allen, 2005) Further, dialogues can foster learning by its ability to collectively reflect on experiences related to practices and enhance listening and construct shared understanding (Päsilä et al., 2012).





**Figure 18: Resource depletion (Sandow & Allen, 2005)**

Dialogues can be a useful tool when it comes to enhance learning and trust and therefore fits very well in a process before a decision is made. However, when a decision is supposed to be taken dialogues is not very useful. Therefore daily work can be divided into circle and triangle time. Circle time consists of dialogues that deals with questions that contain high energy as well as creating alternative solutions that otherwise are outside the box. Moreover circle time includes a diversity of people and thoughts. Triangle time however, is when decisions have to be made by choosing paths and priorities. Further, triangle time demands that the participants have clear roles and accept the decision made; hence all are taking their responsibilities. (Sande, 2014)

### **2.2.2.1 Our process and takeaways**

As been described earlier dialogues were introduced to the C-Lab team by Martin Sandé in five dialogue sessions. One of these sessions included a traditional lecture where the rest were dialogue sessions with Sandé as a facilitator. Each of the sessions started with a dialogue around how the morning had been, in order to create openness and build trust. Several different dialogue tools were used in these sessions including circle and triangle time, green and red zone as well as the six thinking hats methodology.

The dialogue sessions were very useful in order to come closer within the group as well getting to know oneself. It opened our eyes to how important it is to listen with intention to understand and not to answer, which was rather hard in the beginning, and how this can enhance collaboration and thus the end result. Further, it was very interesting to learn a technique of how it actually is possible to harness the collective intelligence. In other work outside the dialogue sessions we used the circle and triangle technique at several occasions as well as listening without intentions to answer but to understand.

## 2.3 The socio-technical system

Previously the two major parts of phase 1 has been described; the outside-in and the inside-out. The purpose has been to give understanding and tools to be able to intervene both on a system level linked to the outside-in perspective but also on a personal and interpersonal level through the inside-out related theories and methods. From previous parts the knowledge that the system is complex and that people are very much driven by values are takeaways that should be considered when the system is examined from a socio-technical approach.

A socio-technical system analysis considers the technology as well as social aspects such as behavior. It includes a model to help understand the forces that drives technological and social development and how these two factors merge, affect and shapes the whole system in a certain direction. The socio-technical theory also includes suggestions on how to achieve transformation of the system in a desirable direction.

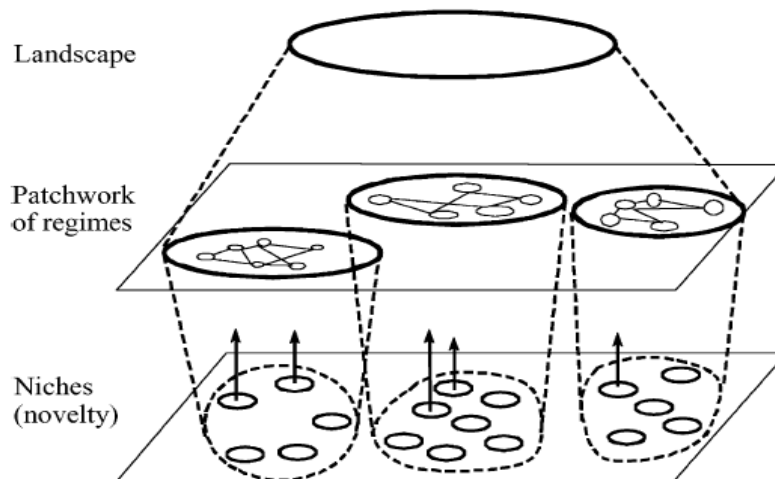
In this chapter will the socio-technical system first be explained on a general level and then be treated in relation to the system connected to transportation, more specifically the fossil fueled automobile, based on Geels (2012) analysis.

A socio-technical system according to Geels consists of three levels: landscape, regime and niches. These three levels will be described in more detail below, see figure 19. The socio-technical system applies a multi-level perspective and at its basics it is a model for describing technological transformation. It has four different characteristics:

1. Technological transformation is co-evolutionary, meaning that the whole system is taken into account and not just single factors such as technological or economic changes.
2. Technological transformation is actor-based. The perceptions, strategies and interactions between different actors within the system should be taken into account.
3. Technological transformation is a result of the dynamics between stability and change. The system strives for stability, which leads to lock-in effects. Yet there is also an ever-present instability within the system that at some points leads to radical changes.
4. Technological transformation is complex, there is no simple cause-and-effect relationships as the system consist of too many factors affecting its development.

(Geels, 2012)

The socio-technical system is a result of alignment of existing technologies, user patterns, regulations, culture, and infrastructure (Geels, 2002).



*Figure 19: The socio-technical system (Geels, 2002)*

### 2.3.1 The regime

The theory is based on evolutionary economics and argues that technologies are path-dependent and result in the emergence of a regime. The first one to launch the concept of the technological regime was Nelson and Winter (1982) in the book *An Evolutionary Theory of Economic Change*. What is referred to as the regime is in most aspects the same as to what Dosi (1982) refer to as a technological paradigm.

The regime according to Geels (2002) constitutes of seven dimensions; technology, user practices and markets, symbolic meaning of technology, infrastructure, industry structure, policy, and techno-scientific knowledge (Geels, 2002). Dosi (1982) is also referring to the emergence of a technological regime as contextual. That implies that only the existence of an alternative and eventually better suited technology is not enough to change the regime or paradigm as it is affected by several other factors and where some factors are deeply rooted in the culture and values of the system. (Geels, 2002)

### 2.3.2 The landscape

At the most abstract level of the socio-technical system is the landscape that constitutes the context in which both the regime and the niches are active within (Geels, 2012). It is in the socio-technical landscape where the structural factors affecting the technological trajectories are situated. These factors are very diverse such as economic growth, legislation, cultural and normative values, and environmental issues etcetera. What the factors have in common is that they are all technology-external and hard to affect or change. (Geels, 2002) The landscape impacts the rate of technological transformation through the level of pressure it puts on the regime. If enough pressure from the landscape is put on the regime it will create opportunities for alternative technologies to evolve. These alternative technologies will in most cases have its origin within the level of the niches. (Geels, 2012)

### 2.3.3 The niche

In the socio-technical system there are niches from which most radical innovations are generated. The niches are not as dominated by the logic of the technological trajectory as the

regime, which leads to more room for radical thinking (Nelson & Winter, 1982). However, alternative technologies come at the price of less efficiency and the new technologies have often lower performance than the technology that dominates the regime. The niches have the function of a protected market where the selection criteria are different from the regimes. (Geels, 2002)

In the niches the customers are so called early adopters who are enthusiastic about new technology and willing to try it out despite lack in performance and ability to compete on price (Moore, 2008). The niches offers time and space for new technologies to build up network, learn and gain some economics of scale (Geels, 2002). However, the niche is in general not considered a market for the bigger established firms as the returns from these markets are too small and most niche actors is therefore smaller and more entrepreneurial firms. (Christensen, 2013) These small firms are mostly driven by the expectation of Schumpeterian rents whenever there is a shift in the regime (Dosi, 1982).

For the niche technologies to be incorporated in the regime there are certain conditions that have to be met. When the landscape put pressure on the regime, for example through high prices on raw material or through legislation that creates instability within the regime, it opens up for niche technologies to take place within or substitute the dominant design of the regime. (Geels, 2002; Geels, 2012) Additionally, the niche-innovations that have the most support among actors and receive the most resources have the highest likelihood of success (Geels, 2012).

In conclusion could it be argued that technological transformation is dependent on the landscape to put pressure on the regime creating the right circumstances for change as well as availability of multiple niche actors willing to grasp opportunities to change the regime (Geels, 2002; Geels, 2014; Dosi, 1982). It is however important to notice that the system is always gradually evolving but what is described here as technological transformation is rather the cases of more radical change where the technological trajectories are broken and new ones are created (Nelson & Winter, 2002).

The takeaways from the socio-technical perspective of technological transformation is that in order for change to take place the whole system is affected, meaning that technology does not evolve in vacuum. That leads to the assumption that a superior new technology is in most cases not enough to transform the socio-technical system and challenge the regime. Taking this further the implications of the regime and technological trajectories will be described further on industry level and more specifically in relation to the transport industry.

#### **2.3.4 A socio-technical analysis of the transportation system**

According to Geels (2012) is the transportation system dominated by a rather significant fossil driven automobile regime. In addition there are also subaltern regimes such as public transport. By applying the socio-technical framework on the transport industry some conclusions has been made about the niches ability to change the automobile regime. Six niche-innovations has been defined and analyzed in relation to its contribution towards a low-carbon transport system, see table 1.

Niche-innovations	Sub- categories	Pros and cons
1. Inter-modal travelling	Bus Train Bike Walking	- Time consuming - Lack of regime support - Collective adoption problem
2. Cultural and social activities	Urban planning Home zones Car sharing Public bike sharing	-/+ Impact on a local scale
3. Behavioral change through transport initiatives	Travel plans (school, work) Awareness campaigns Public transport information	- Slow diffusion - Dependent on policy makers
4. Change in subaltern regimes	Public transport system	+ Good testing ground - Lack of user friendliness - Dependent on regulation and taxes
5. Information and communication technology (ICT)	Intelligent transport system ICT in general	+ Industry support + Changed behaviors
6. Green technology	Battery electric vehicles (BEV) Fuel-cell vehicles (FCV)	+ CO2 regulations + Subsidies and government support + Specialized new entrants + Collaboration - Uncertainties in adoption - Dependent on subsidies - Expensive

**Table 1: The six niche-innovations together with sub-categories and their respective pros and cons (Geels, 2012)**

1. *Inter-modal travelling* as a concept has been around for a long time. Although there has been plenty projects have most of them remained small or failed. The reason for the failures of the inter-modal niche is the following:

- i) Time losses when transferring.
- ii) Lack of support from actors within the regime who is not considering this there core business.
- iii) The collective action problem, there is no powerful enough coalition lobbying for the niche.

According to Parkhurst et al (2012) there has to be restraining policies towards cars for the inter-modal travelling niche to gain ground within the regime.

2. *Cultural and social activities* that create niches that derivative from the normative automobile regime such as:

- i) Sustainable urban planning through densification and clustering around transportation hubs.
- ii) Home zones, where the urban environment is designed for pedestrians.
- iii) Car sharing.
- iv) Public bike sharing.

These activities have been forming new patterns in mobility but have still limited impact on the automobile regime due to its limited ability to diffuse since the activities are rather local.

3. *Behavioral change through transport initiatives* with the aim to reduce car use. Could be workplace and school travel plans, awareness campaigns, public transport information etcetera. According to Goodwin (2012) there is a chance that these initiatives could lead to about 10-20 % reduction of car usage. However, this strategy to decrease car use has not yet reached momentum and is also dependent on policy makers, which make its diffusion less efficient.

4. *Changes in subaltern regimes* such as the public transport system. Public transport is a good testing ground for new technologies and through public policy there has been some increase in usage. There are on the other hand problems in user friendliness when it comes to price and comfort, which makes it fall short in relation to cars. For this niche to grow there has to be more regulations and taxes making car travels less favorable.

5. *Information and Communication Technologies (ICT's)* has led to the development of two new niches within the transport system.

i) Intelligent Transportation Systems (ITS) is when ICT is integrated within the transportation system to gather and mediate information in order to control the traffic flow. With the assistance of ITS is the prediction that more intelligent cars will be built in the future, minimizing emissions. The ITS technology has gained lots of support from both public and industry actors and has therefore gained momentum.

ii) In addition it is expected that ICT in general will lead to the need for travels will decrease when more activities can be performed from a distance.

6. *Green technology* such as battery-electric vehicles (BEV) and fuel-cell vehicles (FCV) has recently been successful within its niches. The success could be explained through the following factors:

i) CO<sub>2</sub> regulations and government subsidies for R&D programs and adoption.

ii) New entrants that are specialized within the BEV and FCV technologies.

iii) Collaboration between established car companies and suppliers of

components. iv) Support from government and electric utilities for the BEV technology.

Although BEV and FCV technologies have gained some momentum the development has not been straightforward and other technologies could also be alternatives. Uncertainties connected to which technology the system will adapt to, adaption to infrastructure, technical barriers and unexpected costs has made the forecasts less optimistic. The BEV technology in combination with the electrical hybrid is currently seen as the most promising technology. It is however too early in the process of settling down on a new dominant design to be sure and alternative technologies such as fuel cells or hydrogen are still in the race.

The diffusion of the green car is also dependent on subsidies and regulations as the market of today is too small and the technology is still more expensive than the traditional fossil fueled car.

In addition the analyzing the current niches within the transportation system, Geels (2012) also assessed the level of pressure the landscape puts on the automobile regime. Factors that put pressure on and destabilizing the automobile regime and factors that are stabilizing the regime is listed in table 2.

Destabilizing factors	Stabilizing factors
Environmental concerns	Owning property norm
Peak oil	Speed and time saving
ICT and information society	Infrastructure and physical landscape
	Cultural values
	Macro-economic growth
	Globalization

**Table 2: Destabilizing and stabilizing factors of the automobile regime (Geels, 2012)**

Factors that destabilize the automobile regime are explained below.

- *Environmental concerns* are discussed more frequently and have begun to catch the attention of policy makers on higher levels. There is an increasing realization that just incremental improvement of the existing technology might not be enough to cope with the challenges ahead but more radical innovations are needed.
- *Peak oil*, meaning the point in time where the maximum rate of oil extracted from the earth is reached. Although it is unclear what will happen after peak oil is reached the oil prices is assumed to rise.
- *ICT and the development* towards an information society, which will change traveling patterns and possibly decrease the need for transportation.

Factors that stabilize the automobile regime are explained below.

- *Owning property is preferred* within the current cultural context, which contradicts any sharing initiatives.
- *Speed and time saving* is factors that are highly valued within the current cultural context.
- *Infrastructure and physical landscape* is customized to the automobile regime.
- *Cultural values* such as freedom and exposure of wealth has led to the car being a status symbol that is hard to replace.
- *Macro-economic growth* enables an increasing number of people in the world to buy a car or even buy several.
- *Globalization* increases the need for transportation of people and goods.

### **2.3.5 Conclusion from the socio-technical analysis**

The conclusion made from Geels (2012) analysis of the transportation system is that there is a fairly strong automobile regime. There are niche-innovations but whether there is any who can challenge the automobile regime is still uncertain where the highest hope right now is put on the BEV technology. However, there are more factors connected to the landscape that are actually stabilizing the regime instead of putting pressure on it. Most of the stabilizing factors are related to culture and values.

From Geels (2012) socio-technical analysis of the transport system there is also the assumption that changes will most likely come from the niches but also that one of the strongest niche-candidates currently is the BEV. That assumption had a major impact on the formation of the research question for phase 2 as it was decided that a case study should be conducted on a small niche company producing small electrical vehicles; Clean Motion. The next phase of this paper will focus on the reasons why this technology has gained momentum right now and what barriers there are still to overcome. However, the formation of the research area and the research questions for phase 2 will firstly be described in detail.



## 2.4 Research question formation

As stated earlier one important feature of phase 1 was that it eventually should lead to a research topic and a research questions that the students, in pair, should further investigate in phase 2. In order to find this research topic the students had a high level of freedom with the only limitations that it should emanate from the learning's and findings from phase 1 and should be connected to the transportation sector in Västra Götaland with a focus on sustainability. When choosing the research topic were the students' academic background and interests also taken into account. Being students for an MSc in Management and Economics of Innovation had a major impact on the choice of research question where the subject of how to enable innovation and system transformation were of great interest.

From the outside-in part it was made clear for us that some radical changes need to happen in order to be able to go from all negative trends of today to a sustainable society. More specifically our focus and interest were on how to deal with the diminishing resources and the accelerating cost of those resources by an increase in the resource and material efficiency from new innovations. The inside-out part caught our interest in behavioral change and its strong connection to motivation, values and leadership. Further, the socio-technical analysis had a large impact on the choice of topic due its focus on that there are niches from which most radical innovations are generated. More specifically six niches were pointed out with the potential to compete with today's fossil fuel automobile regime and the niche "green technology", including BEV and FCV, caught our interest and we decided to find a research topic within this niche.

Additionally, inspiration was also found from the stakeholder meetings we had and in particular from Johansson (2014), Grahn, (2014) and Edh (2014). According to Johansson (2014) there are two ways of achieving the goals stated in the Fossil Free fleet report (Näringslivsdepartmentet, 2013) and these are to increase the use of biofuels or the use of electricity. Additionally, both Edh (2014) and Grahn (2014) highlighted the need of alternative vehicle fuels. This encouraged us to investigate a research topic in connection to either biofuel or electricity. However, due to the knowledge gained during our education (Management and economics if innovation) it seemed to us that biofuel is just a sailing effect of the internal combustion engine and that electricity is the "fuel of the future".

Moreover, biofuel requires a lot of extra transportation that do put more stress on the transportation infrastructure as well as leading to local emissions. Our supervisor then gave us a tip about the manufacturer Clean Motion and their product Zbee, which made it clear for us that we wanted a research topic about Small Electrical Vehicles (SEV). An SEV has several advantages over normal electric cars such as higher energy efficiency, which connects well with phase 1, and take up less space, which is important in an urban area. Additionally, SEV's are a product that in a high degree is connected to the knowledge gained from the inside-out part since it requires changes in individuals' values and thus behavioral change.

Finally our topic turned out to be:

- A pre-study of the diffusion of small electric vehicles within the Gothenburg Area with the below research questions.
- *What possibilities and barriers are linked to the diffusion of SEV within the Gothenburg Area?*
- *How could the chances of a successful diffusion and the speed of adoption be increased?*

### **3 A prestudy of the diffusion of small electric vehicles within the Gothenburg area**

Within the individual project previously referred to as phase 2, a study of the diffusion of SEV's in the Gothenburg area will be conducted. To gather knowledge and understanding of the subject a small start-up company was selected (Clean Motion) to represent a niche player challenging the existing order within the transport system. It is also investigated further the different role the incumbent and the new firm has in a system transition, both to explain the niche players' role challenging the system regime but also the implications for the diffusion of innovation that the regime and technological trajectories bring. This should give a background to the choice of study and the challenges on a system level that has to be considered.

Our aim is to identify possibilities and barriers for the SEV as well as strategies to overcome the barriers and speed up the diffusion in the Gothenburg area. This will be done both by relating from the findings in the case study of Clean Motion, a survey addressing specifically the transportation behaviors and preferences of Gothenburg citizens, and additional interviews with researchers. Additionally, a literature study has been done to explain the diffusion of new technology both on a general level and also how to apply the general knowledge in models applicable for the single firm. The results from the findings will then be accounted for and discussed.

Starting with the theoretical framework that first connects back to and deepens the reasoning from the socio-technical system theory from phase 1 by further investigating the role of the regime, technological trajectories and the role of the niche actor. Then theory about diffusion theory and business models will follow where diffusion of new technology will be explained both in more abstract terms but also in terms of how the firm can influence diffusion. The outcome of the theoretical framework will then be applied on the findings from the Clean Motion case study.

#### **3.1 Theoretical framework**

The main take away from the socio-technical approach is that for technology to function within the system its dependent on the involvement of human agency, organizations and social structures. When technological transformation takes place the whole system is affected. (Geels, 2002) This chapter will start by building on this statement by further going to investigate the theory of technological trajectories and implications they have for niche innovations and why niche innovations are important.

Starting off in the basics of economic growth theory two perspectives will be swiftly presented: the neo-classical and the evolutionary. The Neo-classical approach to economic growth builds upon the assumption that there is always an economic equilibrium due to self-correcting market powers. Through a natural selection will the most profitable actors survive and grow and thereby drive the economic growth (Friedman, 1957). That would imply that such a system is rather static and does not take into account any need for actors to adapt to changes (Nelson & Winter, 2002). Evolutionary economics on the other hand argues that there is a natural selection in line with neo-classical theory but that the selection not necessarily leads to

economic equilibrium. Instead the evolutionary approach implies that the natural selection induces disequilibrium as technological trajectories are created. (Nelson & Winter, 1982) In this thesis the evolutionary approach will be the theoretical starting point as certain technological trajectories in society could be argued for as assumed by Geels (2012).

### **3.1.1 Technological trajectories**

Technological trajectories are a result of all experiences of past technological solutions and past attempts together with all accumulated knowledge and institutional influences (Dosi, 2002). The trajectories are influenced by several actors within the system, such as users, policymakers, scientist, suppliers, and capital banks etcetera (Geels, 2002). Technological trajectories could be described as the perception of that there is only a limited set of possible technological solutions and could be seen as a lock-in of the mind (Dosi, 1982).

This lock-in is also described by Nelson and Winter (2002) as social technologies, which are defined as "widely used procedures for collective choice and action" (Nelson & Nelson, 2002, p.4). These procedures can in turn be broken down into set of routines that are unconsciously shaped by the organization over time to make decisions more efficient as the system is too complex to exactly assess. As the routines has to make sense within its context they are often based on the understandings or values coherent with those of the context, meaning they are to a great extent embedded in the culture and therefore hard to change. (Nelson & Winter, 2002)

When technology follows trajectories it is incrementally developed and the organization with the most efficient routines are the one that survive. This is in line with the behavioral continuity assumption that firms learn from previous experiences. This short-term feedback through the market-mechanism makes the whole industry evolve in the same direction and thereby reinforcing the technological trajectory, much in line with the neo-classical perspective. However, it is also assumed that the behavioral continuity could be a disadvantage if the circumstances within the system are changed. (Nelson & Winter, 2002)

Moreover, Christensen (2013) builds a case around the fact that many successful firms fails to adapt to change as a result of having built up and refined strategies and competencies around their current business environment. This could also be linked to the implication of core competencies, whereas these competencies are crucial for firm success and survival they can pose a threat in times of rapid change outside the firms control (Prahalad & Hamel, 1990). Although organizational routines are more or less impossible to evade and even is an important factor for the firm to function efficiently they limit the organizations ability to change its action patterns or do complex analysis of the future (Nelson and Winter, 2002).

In conclusion, technological trajectories result in cognitive lock-ins both inside the firm (Christensen & Rosenbloom, 1995; Dosi, 1982) and throughout the whole system (Dosi, 1982; Nelson & Winter, 2002), which constitutes a barrier for new technologies to challenge the current trajectories.

### 3.1.2 Disruptive innovation

There are different views on which actor, the incumbent firm or the new entrant, that have the most potential to drive the change in the system. Starting off in the theory of evolutionary economics the role of the firm in relation to its maturity will be assessed for new technology. Inspired by Schumpeter's logic of the existence of potential economical disequilibrium there is two perspectives of radical innovation and creative destruction to be assessed (Tripsas, 1997). The first perspective is based on Schumpeter's (1934) early work where the new firm is the one bringing the radical innovation into the industry. In the second perspective, based on Schumpeter's (1950) later work, it is on the contrary the big established firms that are the driver of radical innovation.

The later perspective is supported by Teece (1986) and partly by Tripsas (1997) as these researchers particularly highlights complementary assets as a key factor for enabling new technology in the system. However, another perspective is focusing more on the incumbent firms inability to properly assess the threat and opportunities of new technologies due to mechanisms in the system that guides industries in the trajectories defined by the incumbent technology (Nelson & Winter, 2002; Christensen, 2013). As Christensen and Rosenbloom (1995) argue it is in many cases not the technological knowledge that hinders the incumbent firm but rather its ability to change strategy.

Most successful firms do act on the logic that the customers is right and eventually firms which are not successfully satisfying their customers' needs won't survive. However, according to that logic it is somewhat an illusion that the firm is in real control of its investments. (Christensen & Bower, 1995) Established firms do most often go for the big mainstream segment of customers as the niche market is too small to cover for overhead costs and investments stuck in technology specific equipment and knowledge (Christensen & Bower, 1995). Changing the organizational routines will ultimately create a less efficient system as complementary routines has to be reengineered to fit such change and is therefore time consuming, costly and risky (Nelson & Nelson, 2002). However, the mainstream segment can only appropriate its current needs and not the future needs and new technology does seldom attract these customers before it has reached certain maturity in terms of utility and economics of scale (Christensen, 2013).

Two main lines of arguments have been reviewed. The one where the incumbent firm has an advantage due to its possession of complementary assets (Tripsas, 1997; Teece, 1986) and one where the incumbent has a disadvantage due to resource dependencies and being stuck in organizational routines (Christensen & Bower, 1995; Christensen, 2013; Christensen & Rosenbloom, 1995).

Even though both these perspectives are legit will this thesis focus on the perspective that it's new entrants and within the niche most disruptive technologies will have its origin, as it's more likely that these actors can be truly innovative for reasons mentioned above. It also connects back to the socio-technical theory by Geels (2002), where the established firms to a greater extent are part of the regime and therefore less likely to have the ability or motivation to change it. It is also in line with the theory around technological trajectories that creates

cognitive lock-ins, which also could be related back to the logic behind the socio-technical regime.

Previously some theoretical understanding of the implications with technological trajectories and the point of view that niche actors are most likely the ones having the potential to switch these technological trajectories has been accounted for. Going further a theoretical framework explaining how a new technology is spread and accepted throughout the system will be presented. The framework will primarily build on diffusion theory and business model theory. Diffusion theory gives an understanding of the general prerequisites for diffusion, which could then be applied in a business model and though incorporated in the single firms organization.

### **3.1.3 Techno-economic analysis**

Apart from the socio-technical aspect there is also a techno-economic perspective. A techno-economic analysis (TEA) has the purpose to link technical and economical aspect of a product or service with the intent to get an understanding of which value, or utility, it has. This is done through mapping different variables and performance attributes. The utility will in turn affect the diffusion of this product or service. (Lindmark, 2006)

A product is characterized by its function or set of functions, where the function itself is specified by its technical performance attributes. It is through the function as well as the performance and attributes whereby a product render its value, or utility. However, it is important to remember that the value or utility is always dependent on subjective opinion of the user and though hard to measure. Different utility functions attract different users, which then can be clustered into market segments with respect to value ranking and technical performance attributes. It is through the perceived utility together with price and cost variables that a product diffuses within a population and penetrates different segments of buyers. (Lindmark, 2006)

#### **3.1.3.1 Static analysis**

TEA is divided into one static and one dynamic part where the basic variables and concepts of the technology involved are identified as well as the relations between them are mapped out. In the dynamic analysis it is the development over time that is taken into consideration.

##### **3.1.3.1.1 Technical systems**

According to Lindmark (2006) can every product and service be perceived as a technical system. A technical system should not be viewed in isolation since it has to be consumed or interacted with other products or services in a user system in order to provide any utility. Further, a technical system is mostly applied to a larger context where it interacts with other technical systems. This is called applications and a technical system is never stronger than its weakest link, thus all parts need to hold the same quality. (Lindmark, 2006)

As Adner (2006) illustrates, if the success of a product is dependent on for example four other applications that each has a success factor of 90 % the likelihood that the product will manage to be competitive on the market is  $0.9 \cdot 0.9 \cdot 0.9 \cdot 0.9$  which equals 66 %. Thus it is important to

get an understanding of the actor system as well as complementary systems when trying to assess the diffusion of a product.

By taking mobile phones as an example the mobile phone in itself has a technical system but for it to function and generate value for a user it has to be connected to complementary technical systems for example technology in infrastructure (Lindmark, 2006)

When the technical system is synchronized with a complementary technical system it is referred to as couplings. It means that the output of one system instantly creates value in another system, which only happens if the two systems are technically compatible. If the same or overlapping functions of a technical system can be delivered from another technical system these systems are termed as substitutes or competing technical systems. When identifying competing systems, function or set of functions has to be considered. (Lindmark, 2006)

#### 3.1.3.1.2 Utility analysis

As mentioned above does the performance attributes of a product or service result in a certain utility, which in turn could vary dependent on who is using it or for what purpose. Utility could also be described as the pleasure or satisfaction that is derived by an individual from a technical system. To reach the highest possible utility is the main goal of any product or service. (Lindmark, 2006)

One way to break down utility into different dimensions is to develop a buyer utility map, illustrated in figure 20. This buyer utility map consists of six utility levels as well as a six-stage buyer experience cycle. The utility levels consist of customer productivity, simplicity, convenience, risk, fun and image as well as environmental friendliness. Further the user's experience cycle consist of purchase, delivery, use, supplements, maintenance and finally disposal. Within each stage an innovation can improve the utility of the product. (Lindmark, 2006)

**The Six Stages of Buyer Experience Cycle**

	Purchase	Delivery	Use	Supplements	Maintenance	Disposal
Customer Productivity						
Simplicity						
Convenience						
Risk						
Fun and Image						
Environmental Friendliness						

**The Six Utility Levers**

**Figure 20: Buyer utility map (Lindmark, 2006)**

Consumers are assumed to be utility maximizers within neo-classical economy theory and the marginal utility for a product or service is decreasing with each improvement. A consumer will thus choose a good that will yield the highest marginal utility. Thus, the total number sold of a good will depend on the perceived yielded marginal utility as well the cost of this good together with the cost of substitutes and complements. (Lindmark, 2006)

However, according to Swann (2002) is consumer behavior utility maximization only applicable in hard-core neoclassic modern economics and consumption is more likely undertaken to transmit a signal rather than to satisfy a need. Swann's argument is strengthened by both Gabriel and Lang's (1995) and Warde (2002) that questions the individual choice in consumption. Warde (2002) further argues that consumption behavior is collective while Gabriel and Lang's (1995) argues that it is about belonging into groups as well as the relationship both inside the groups and between the different groups. According to Warde (2002) there has been too much focus on the conspicuous consumption and the more important unconscious consumption has been neglected, which constitutes into belonging. Further, a consumer's choice depends very much on one owns earlier decisions in the past (Gabriel and Lang's, 1995; Swann, 2002) as well as expected future choice of others (Swann, 2002). Researcher should therefore stop spending too much effort on utility optimization algorithms (Swann, 2002).

In addition to Lindmark's utility mapping does Shilling (2005) present three dimensions of value: standalone value, complementary goods availability, and installed base. The standalone value is the products value in its own right and could be linked to the utility mapping above. The installed base value refers to amount of existing users and the complementary value depends on the amount and quality of the complementary assets. Normally there are a positive feedback loop between complementary assets and the installed base. (Shilling, 2005) Further, several technologies only become valuable to a wide range of user after a set of complementary resources have been developed (Schilling, 2010. p57). Additionally, one important aspect of subsidiary consumption is the complementariness, which might be needed before a purchase can be done. This subsidiary may be what actually announces the social meanings involved and not the product itself. (Gabriel and Lang's, 1995)

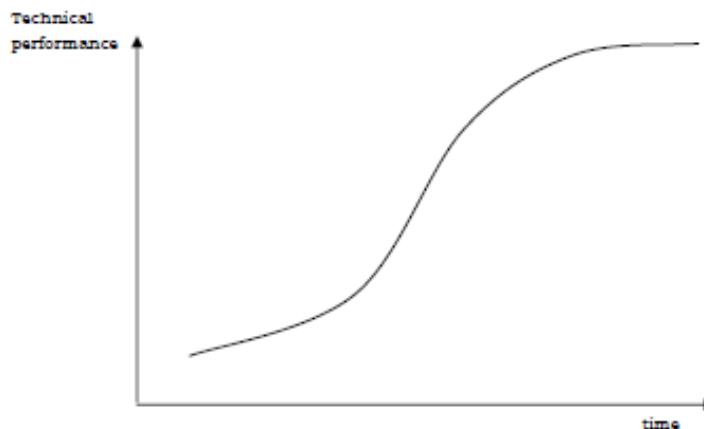
#### 3.1.3.1.3 Market segments

By using different utility dimensions as well as price sensitivity that has been identified by doing the TEA market segmentation is done, which gives result performance and cost characteristic. This means that the market is segmented within sub-groups that have homogenous users that values the same utility dimensions as figure 26 shows. (Lindmark, 2006) Finding the right market segment is of special importance in the diffusion of new technology as the first users, or the so called early adopters, values other performance attributes then the mainstream customers and is therefore willing to accept a lower overall performance, which creates a niche to grow in. (Moore, 1998)



### 3.1.3.2 Dynamic analysis

The above areas of analysis within the TEA are in common for both the static and dynamic TEA. Taking it further the attributes specific for dynamic TEA will be described. Typically in a dynamic analysis is the performance of the technical system measured over time. It is the resources devoted to the technical change and the marginal return on those efforts that influence the rate of change. In turn is the marginal return dependent on the technological opportunities available. This ongoing change for many technical systems will follow an S-shaped curve, illustrated in figure 21, where technical performance is on the x-axis and time, or cumulative effort on the y-axis. (Lindmark, 2006)



**Figure 21: Performance of a technical system over time (Lindmark, 2006)**

The logic behind this shape is that major innovations can open up technological opportunities that will increase the marginal return of the technological effort in an early phase. Further, the rate of progress is higher when a technological system is far from reaching its limits. When it is getting closer to the limit the rate of progress will decline since the marginal return is lowered. As a result have investments in R&D typically its highest returns and lowest cost after a barrier has been overcome by a breakthrough innovation, where the S-curve turns up. After the big breakthrough will most innovations be incremental or process oriented, which will increase the utility of the technical system as mentioned above. However, cumulative incremental improvements for a specific technology cannot go on forever since the unexplored opportunities that a major innovation opens up will decrease and eventually be exhausted when the limit is being approached. (Lindmark, 2006)

A technology that is approaching its limits often experiences strong trade-offs between different technical properties, such as size and operating time. Thus, often when it is no longer rational to improve performance in one dimension another dimension will be improved, if customers still value improvements in that dimension. Additionally, when a technical system improves its performance over time it will exceed different threshold values for attracting various applications and reach applications diversification. (Lindmark, 2006)

#### 3.1.3.2.1 Technological transitions

In order for a new technology to be disruptive and though have a chance to challenge an incumbent technology there are two criteria to be met. Firstly the new technology has to offer a new set of performance attributes. Secondly the performance attributes of the incumbent has to improve at such pace that those attributes loses importance for most customers due to decreasing marginal utility and the new technology can take over the incumbent market. (Christensen & Bower, 1995) A typical example is the camera industry where incumbent firms such as Kodak underestimated the digital technology for a long time due to its substandard quality. Over time did quality and general performance of the digital camera increased to the point where the perceived value of a digital camera was higher than that of traditional camera and it was then too late for a company like Kodak to adapt to the new technology. (Lucas & Goh, 2009)

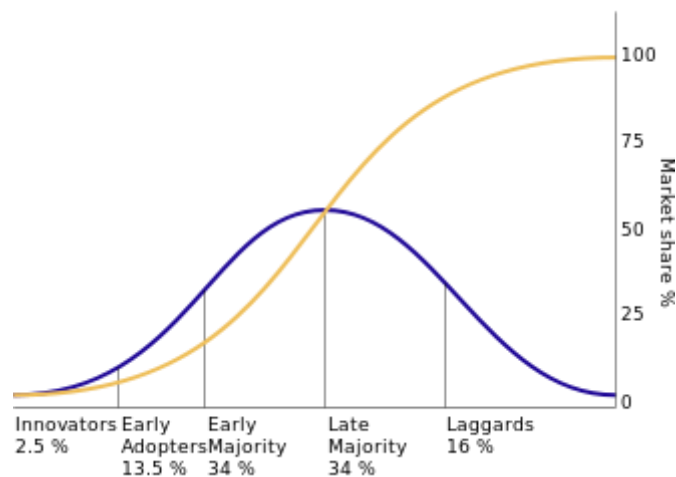
When systems undergo change the state of the system is altered. If a system undergoes a large change in form of e.g. discontinuous innovation it will be labeled transition. A technological transition is defined as “the process by which the technology base of a product area is changed involving an addition and/or deletion of one or more technologies and just not advancements of knowledge within a given field”. (Granstrand 1999, p 418)

Technological transitions usually have disruptive effects on the industry structure, e.g. market share of firms and numbers of firms within the industry are affected. This is due to that incumbent firms often have problems managing transitions and hence lose market shares or disappear from the market for several reasons treated above.

#### 3.1.3.2.2 Diffusion analysis

Diffusion can be referred to as a kind of social change, a process by which the function and structure of a social setting is transformed. It is when new ideas are invented, diffused and adopted or rejected that this transformation takes place and social change happens. (Lindmark, 2006) Further, It is only when an invention is adopted and used that it will have a sustained economic importance and therefore diffusion is one of the key processes to link technology and economics. (Lindmark, 2006)

Diffusion can be defined as “the process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1995, p. 5). Further, the communication is a process whereby participants share and create information with each other to reach a mutual understanding, thus a two-way process. The message communicated contains a new idea, which gives diffusion a special character as the novelty of the idea result in new possible direction of development and thus does diffusion involve a high level of uncertainty. As there is a high level of uncertainty in diffusion there is a lack of predictability, structure and information. (Lindmark, 2006)



**Figure 22: S-shaped diffusion and the different buyer categories (Moore, 2008)**

The diffusion of a technology can in its simplest form, just as technology development, be described with an S-curve. However, the S-curve is then obtained by plotting the cumulative number adopters of the technology against time. The reason for the S-shape is due to an epidemic pattern, the adoption is initially slow but accelerates when the technology behind is better understood and reaches mass market. Eventually the saturation is so high that the adoption declines. (Schilling, 2010, p56) The S-shape is also due to learning curves and economics of scale, resulting in a lower price and an accelerated adoption by users (Schilling, 2010, p57). It can further also be said that the S-curve of diffusion is a function of the S-curve of technology improvements since better technologies are developed, which becomes more useful and certain for customers and though facilitating the adoption (Schilling, 2010, p62).

Throughout the diffusion there are different types of customers that adapt to the new technology, which are categorized by Rogers (1995). The first customer category appreciates the new architecture of an innovative product and thus sees the competitive advantages of it are called innovators (Moore, 2008. pp28-29). The innovators possess typically an adventurous purchasing behavior and are comfortable with a high degree of uncertainty and complexity. However, they are not always well integrated in the social system but do often play an important role in the diffusion since they are the ones in a first phase bringing out new ideas into the social system. (Schilling, 2010, p60)

The second category of customers are called early adopters and are unlike innovators very well integrated in the social system and make more sound adoption decisions in order to retain the systems respect. This category of customer has the greatest likelihood for opinion leadership. The third category, early majority, consists of 34% of the individuals within a social system. These customers are usually not seen as opinion leaders but do often communicate with their peers and are an important category to win to gain scalability. (Schilling, 2010, p60)

The fourth and fifth customer categories are late majority and laggards but those are out of the scope of this thesis and will therefore not be dealt with. The two first categories of customers, innovators and early adopters, will rarely result in a lot of money for a company

but rather work as gatekeepers for the early majority. Long-term relationships with the first two categories are necessary in order to reach the more mainstream category, early majority, which is essential to reach full diffusion of the innovation. (Moore, 2008, pp 63)

Additionally, in order to reach this mass market it is important to limit the focus to one or two niche markets in the beginning in order to not spread the resources too thin. The first niche market works as a reference group consisting of innovators and early adopters. Further, to be able to create this reference group it is important to not be too sales-driven but rather have a strong customer focus within the niche. It is essential that the reference group is pleased as the key of succeeding within a new market segment is to reach a strong word-to-mouth reputation among users. (Moore, 2008, pp 63-70)

Lastly, one of the problems with reaching the main stream customers is that those customers generally are comfortable and do not question the existing regime since it provides a certain type of safety, lowers the total costs of ownership as well as making their buying process more simplified (Moore, 2008, pp 69).

#### 3.1.3.2.3 The rate of adaption

The rate of adoption can be defined as "the relative speed with which an innovation is adopted by members of a social system" (Rogers, 1995, s.206). Thus, the rate of adoption can be viewed as a numerical indicator of the steepness for the adoption curve of an innovation. The perceived attributes of the innovation can explain between 49-87% of the variance in rate of adoption. In figure 23 can all important variables for the rate of adoption be seen as well as the perceived attributes of an innovation, which consists of:

1. **Relative advantage**, the perceived degree of how much better the innovation is compared to the idea it supersedes. It can be measured in social prestige, convenience, satisfaction, and in economic terms. The greater the perceived, not the objective, advantage is the faster the rate of adoption will be.
2. **Compatibility**, the perceived degree of how an innovation fits with existing values, past experiences and potential adopters. The greater the perceived fit is the faster the rate of adoption will be. For an innovation that is incompatible there is often a need for a prior adoption of a new value system, which is a relatively slow process.
3. **Complexity**, the perceived degree of the difficulties that is associated with the innovation, such as understanding and use. The greater the perceived difficulty is the slower the rate of adoption will be.
4. **Trialability**, the degree to which an innovation can be experimented before the adoption decision. Trialability reduces the uncertainty to the individual whom experiences it, due to learning by doing, and therefore will a high trialability increase the rate of adoption.
5. **Observability**, to which degree the results of an innovation are visible to others. Visibility results in discussions about the new idea and adopters of requests innovation-evaluation

information from others. Further, adopters of a new idea can often be seen in clusters, such as neighborhood clusters of solar panels in California.

(Rogers, 1995 pp. 200-207)

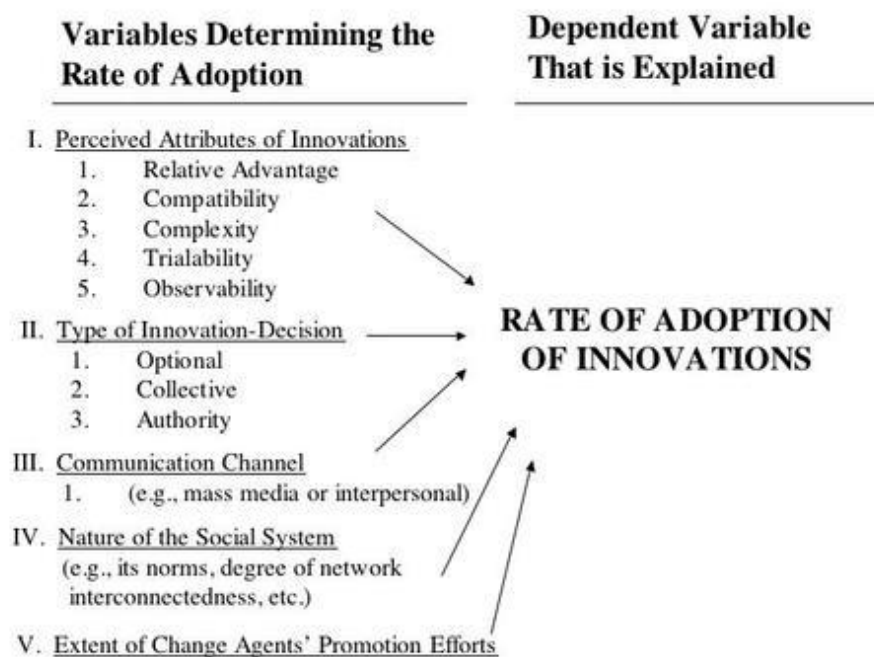
Additionally, there are other factors that affect the rate of adoption and according to Rogers (1995 pp. 206) these factors are i) The type of innovation decision, ii) Communication channels, iii) Nature of the social system, iv) Extent of change agents promotion efforts.

i) Innovations are normally adopted more rapidly the less persons that are involved in the innovation decision. Thus one attempt of speeding the rate of adoption up is alter the unit of decision so fewer persons are involved.

ii) The rate of adoption will be increased if the communication channels make use of interpersonal channels, rather than mass-media channels. It was found by Petrini et al (1968) that interpersonal communication is important for innovations that are perceived as more complex and that mass media channels is satisfactory for less complex innovations. Additionally, as described earlier by Moore (2008) word-to-mouth is critical in order to reach mass market.

iii) The rate of adoption also depends on the structure of the social system, where the norms of the system as well as how much the communication network structure are interconnected. (Rogers, 1995 p.208)

iv) The rate of adoption also depends on the effort of change agents. However, this relationship is neither linear nor direct. The impact from change agents differs in different phases of diffusion as well as if opinion leaders adopt the new idea. Opinion leaders are important and they can constitute up to 16% of the rate of adoption. Moreover, when a critical mass has been reached the spreading will continue with just a small amount of promotion by change agents.

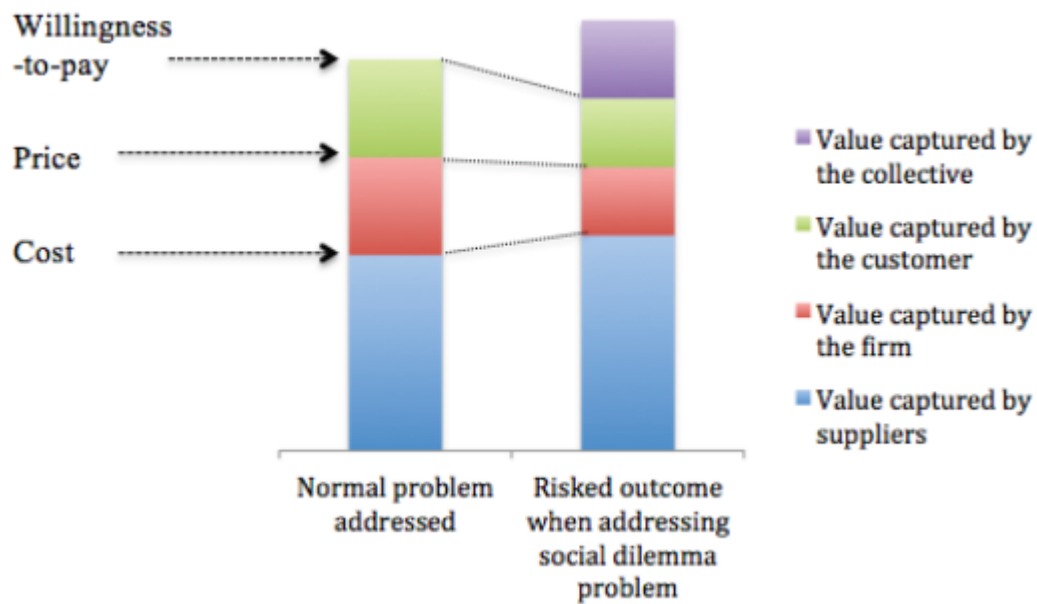


**Figure 23: Variables determining the rate of adoption (Rogers, 1995)**

#### 3.1.3.2.4 Preventive innovations

Innovations that can prevent an unwanted future condition, and thus requires action before that future condition happens, are called preventive innovations. Preventive innovations mostly have a peculiar slow rate of adoption even though a promising strategy for the diffusion is utilized (Rogers, 1995). This is due to that they have a relatively low perceived relative advantage compared to non-preventive innovations. Anything that can be done to raise the perceived relative advantage is of importance since relative advantage is the most important factor in the rate of adoption. (Rogers, 1995) The low perceived relative advantage is due to that the consequences are distant in time, which means that the reward is delayed. Moreover, the rewards for adopting are not only delayed but there is as well an uncertainty if they actually will be needed in the future. (Rogers, 1995, p 217)

Further on, Linder (2013) describes a social dilemma as when “individuals in interdependent situations face choices in which the maximization of short term interests yields outcomes leaving all participants worse off than feasible alternatives.” One type of social dilemmas could be said to be environmental problems and it can be hard for a firm to get appropriation of the created value. Thus it is likely that a firm in this case creates more value with its environmental friendly offer but capture less of it than it would do with another offer. (Linder, 2013)



**Figure 24: How a social dilemma can decrease the possibility of capturing value for a firm (Linder, 2013)**

Environmental differentiation results in private costs and common goods and this can have a negative impact on economic competitiveness. However, it could be argued that environmental friendly products often even decrease costs and increase efficiency, which possibly can result in both differentiation and cost-advantage. It can also develop valuable alternative capabilities and reduce risk. (Linder, 2013)

Further, it is possible to receive a benefit for firms by using environmental differentiation to leverage and influence social norms and regulation (Pacheco et al, 2010). There is an increased demand of environmental friendly products from consumers (World values survey association, 2008). This in turn could lead to new opportunities for environmental products to access new markets (Linder, 2013).

Rogers (1995) mentions five different strategies that could speed up the diffusion of a preventive innovation:

1. Change the perceived attributes of preventive innovations. As mentioned previously, the relative advantage of a preventive innovation needs to be stressed.
2. Utilize champions to promote preventive innovations. A champion is an individual who devotes his/her personal influence to encourage adoption of an innovation.
3. Change the norms of the system regarding preventive innovations through peer support. Changing norms on prevention is a gradual process over time, but can be accomplished.
4. Use entertainment–education to promote preventive innovations. Entertainment–education is the process of placing educational ideas (such as on prevention) in entertainment messages.

5. Activate peer networks to diffuse preventive innovations. Previously, it was mentioned that diffusion is a social process of people talking about the new idea, giving it a personal meaning before adopting the idea. To encourage peer communications will increase the speed of adoption as communication creates the most impact.

So far the theory has been treating diffusion in general terms but for the firm to address these different factors that affects diffusion on its firm-specific offering a business model could be a tool. Aspects like communication channels, market segments, value proposition and value systems that has been described in the techno-economic analysis is also part of a business model for a product or service. In the following chapter will business model theory be treated in some more detail.

### **3.1.4 Business models**

For the firm to realize the utility and get the best relative advantage of their offering the aspects brought up in the techno-economic analysis will be brought in to the process of developing a business model. This chapter will treat what a business model (BM) is, why it is important, the process of making a BM and potential barriers in the process.

Starting off with describing what a BM is. "The essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit." (Teece, 2010 p.1) Magretta (2002) argues that a BM could be referred back to the simple question of "Who is the customer and what does the customer value".

Shafer et al (2005) on the other hand means that an exact definition of a BM that is generally accepted is hard to find but that there are some identified components of a BM; (1) strategic choice, (2) create value, (3) capture value, and (4) value network. The first component, strategic planning, leads to the conclusion that a BM should help the firm to reach its strategic goal and be competitive. Both creating and capturing value is closely interlinked and a logical result of most firms aims to earn revenue, which is connected to the strategy. However, neither creating nor capturing value could be done without considering the value network and therefore are all these four components of Shafer et al's (2005) BM interlinked.

Furthermore, according to Chesbrough and Rosenbloom (2003) should a business model include:

- Value proposition
- Market segment, who are using it and why
- Value chain for produce and distribute as well as map the complementary assets needed.
- Revenue mechanism
- Estimate cost structure and profit potential
- Map of the firms position within its value network (distributors, suppliers, complementary and competitors)
- A strategy

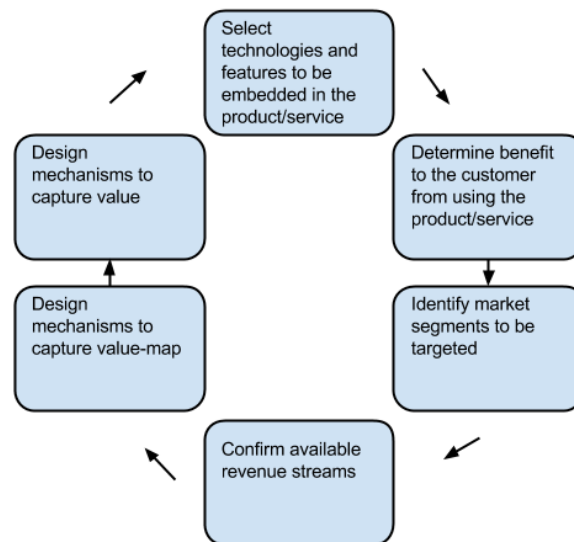


The logic for the firm to put effort into the design of their BM, and not just developing new technologies, is that a new technology has no real value in itself before it is commercialized.

*"...a company has at least as much value gain from developing an innovative new business model as from developing an innovative new technology"* (Chesbrough, 2010 p.3)

BM's are the mean for companies to make new products and technologies commercially viable. There are several BM's for the same product but each of them will result in a different economic outcome and it is therefore important for the success of a firm to identify the best possible BM for its business. A firm that has discovered a great new technology but lack the right BM to exploit it risk that the revenues of the innovation will pass to a competitor instead. (Chesbrough, 2010) In addition, BM's has become increasingly important as the new globalized information society makes it easier for customers to get information and compare different products and services, which forces the companies to be more customer focused and re-evaluate their value proposition (Teece, 2010).

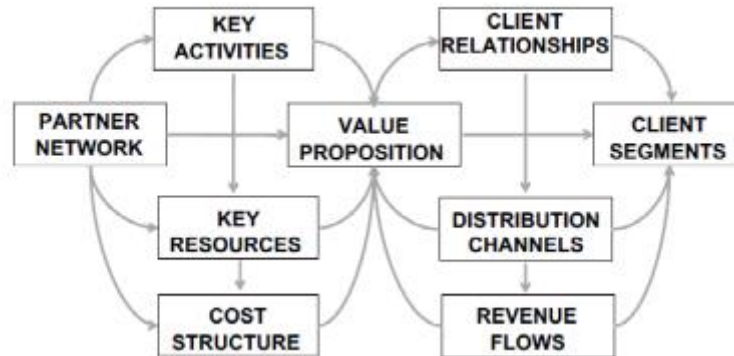
An example of how an alternative BM could create new value is when the group Radiohead launched their album Rainbow on their homepage where fans could download it for an optional fee. Not only did Radiohead earn more money on the launch then they would have done by doing it the traditional way but also did they sell more physical albums then ever due to the publicity the unorthodox launch created. As the music industry is a typical example of having a BM that no longer creates much value, Radiohead's initiative is a proof of that there is still revenue to earn within the music industry with the right BM. (Chesbrough, 2010)



**Figure 25: The process of designing a business model (Teece, 2010)**

As to identify the perfect fit between offering and market there is a process of designing the BM. The process by which a BM is designed, according to Teece (2010), is described as a six stepped iterative process, see figure 25. Chesbrough (2010) on the other hand highlights three processes that should operate simultaneously in order to identify the best BM: (1) mapping, (2) experimenting, and (3) create a changing organization.

By constructing BM maps the alternatives are made more concrete, which helps experimenting on a theoretical level before trying it out on the market. A known example of this is Osterwald's (2004) business model map as is shown in figure 26.



*Figure 26: Osterwald's business model canvas (Osterwald, 2004)*

The mapping could help unlocking barriers on a cognitive level but for real experimentation the processes within the firms organization needs to be changed. In the end it is when the revenue comes in that the actual conclusion could be made. However, it is important to differ between failure and mistakes as each try out generates information to the firm even though it failed, a mistake is that the try out was designed in such way that no conclusions or faulty ones could be made from it. Chesbrough (2010) suggest that firms should develop processes to try out alternative business models in a quick and efficient way even if it leads to some failed trails in the process. Also Magretta (2002) argues for the important of trial and error and means that a BM always starts with a hypothesis that needs to be tested.

The third of Chesbrough's (2010) processes, creating a changing organization, is much connected to the actions and attitude of the leaders within the organization. Chesbrough points out CEO's of small businesses as most suitable for leading such change and even more so if the CEO also is an owner in the company. However, generally it comes back to the issue of the CEO often has risen through the ranks within the firm and is therefore very much a product of the existing way of doing business. It's important to build a strong organizational culture that embraces change. (Chesbrough, 2010)

Key factors for a new business model are novelty, to lock-in complementariness and efficiency. However, these objectives are often not in line with the firms existing value creation and is therefore not considered as the new business model threatens the firm's current business. This connects back to Christensen's (2013) theory about incumbent firms that are often reluctant to exploit disruptive innovation as it may challenge the value of the firm's assets, making them obsolete. Also the fact that the revenues of the current business model are more or less known whereas a new business model brings a higher risk.

The success or failures of a business model often result a so-called dominant logic within the firm making it hard to exploit different ways of acting. As information is limited it is logical for the firm to act in order with past experience of success. This could be connected back to the

cognitive lock-in effect that both Nelson and Winter (1982) and Dosi (1982) refers to as a big barrier in the adaption process of a new technology, i.e. when changing technological trajectory.

Regardless whether the firm is aware of alternative business models but ignoring them as they interfere with current models or is unaware due to inability to identify alternatives due to cognitive lock-ins Chesbrough (2010) highlights experimentation as the main factor for successfully identifying a new business model.

To conclude the theoretical framework it contains mainly of diffusion theory and business model theory as well as some basic understanding of system transition and the niche firms part in that process. The theoretical framework will be applied on the case study of Clean Motion, where the findings from the case study will be discussed in relation to the theory. As to further describe the process of the individual project, the following chapter is treating the methodologies used to then continue with the empirical part of the project.

### 3.2 Method

Methodology refers to how problems are approached and how answers are sought for (Taylor & Bogdan, 1984). Within researching there are two main methodologies, quantitative and qualitative research (Eriksson & Wiedersheim, 2008). The basic differences between these two methodologies lie in how data is expressed and how it is analyzed (Lekvall et al., 2001). Further, they differ in a fundamental way and that is that quantitative research takes on a deductive approach whereas qualitative takes an inductive approach.

Additionally, the epistemological orientation between them differs; qualitative research is interpretivistic while quantitative research in particular is positivistic. Quantitative method can be said to be concerned with numbers at a macro level whereas qualitative method can be said to be concerned with words at micro level. (Bryman & Bell, 2011) Qualitative methodology refers to research that produces descriptive data. Further, its inductive approach makes it possible to develop concepts, insights and understanding from patterns in the data. (Taylor & Bogdan, 1984)

Further on, qualitative research enables the researcher to stay close to the empirical world and ensure a close fit between the data and what people actually say and do. The knowledge obtained by observing people in their everyday life; talking to them and looking at the documents they produce is first hand data unfiltered from rating scales, concepts and operational definitions. (Bryman & Bell, 2011) Moreover, the methods used when studying people affect how we view them. When reducing words and acts to statistical equations the aspects of the human side of social life are lost. The inner life of a person, his moral struggles and his failures and success, hopes and ideals can be collected with qualitative research.

Qualitative research sees the points of view of participants and their meaning whereas quantitative research instead sees the point of view of the researcher and the participants' behavior. (Bryman & Bell, 2011) Quantitative research further tends to paint up a static picture of what is being investigated (Bryman & Bell, 2011. Taylor & Bogdan, 1984), which can be seen as negative but is often positive and useful due to the possibility of uncovering regularities. This discovery of regularities may in turn lead to that a qualitative research can be allowed to proceed. (Bryman & Bell, 2011)

Additionally, qualitative research tries to understand people from their own reference frame, thus experience reality as other experience it. (Taylor & Bogdan, 1984) Further on, qualitative research can give rise to a broader range of perspectives using a confined number of empirical "entities" (Denzin, 2000) as well as deeper analysis (Bibik et al., 2003) and allowing for a flexible research design (Taylor & Bogdan, 1984). Quantitative research instead depends on a very large amount of data where the survey is ensured by the large selection (Eriksson & Wiedersheim 2008). However, the practical differences might not always be that large and often, particular more comprehensive research, use elements of both types of methods. (Lekvall et al, 2001)

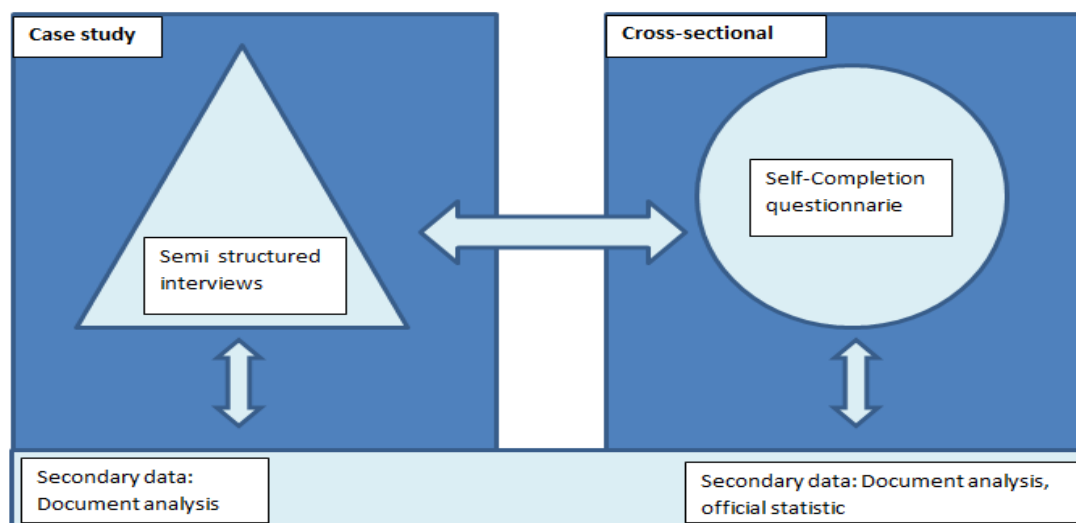
### **3.2.1 Research design**

The research design of this part will consist of an exploratory survey research. This type of research is used during early stages of research to provide a basis for more in-depth surveys as well as gaining preliminary insight on a topic and provide ideas and means of action. (Forza, 2002, Lekvall et al, 2001) Further it can be used to determine the concepts to be measured in relation to the phenomena of interest and how to measure them (Forza, 2002). Moreover, it often builds upon an inductive view, theory building, and has a qualitative research approach (Bryman and Bell, 2011).

However, in this study the exploratory survey will also involve a quantitative approach. According to Hinds (1989) can a combination of quantitative and qualitative methods increase the capability of ruling out rival explanations of observed change as well as reducing skepticism of change-related findings. Additionally both Denzin (1970) and Floyd (1993) used a successful combination of qualitative interviews and self-completion questionnaires in the same study and adding quantitative data to a qualitative approach can enhance understanding (Thurmon, 2001). Adding quantitative data from self-completion questionnaires could strengthen the results from the qualitative field work (Thurmon, 2001).

The qualitative part of the exploratory survey consists of a case study involving six interviews conducted with a semi-structured technique as well as qualitative document analysis. The reason for using a case-study design is its nature of concerning the complexity and particular nature of a case in question. Further it allows for an intensive examination of the settings of a particular question and an individual, at one specific location. (Bryman & Bell, 2011) Additionally, a case study is useful for answering how and why questions (Bryman & Bell, 2011; Yin, 2002). Within the case study interviewees from all parts of the triple-helix were interviewed, consisting of a total of five interviewees, in order to get a deeper understanding as well as possibly induce collaboration over the triple helix borders. A full list of all interviewees can be found in Appendix 2.

The quantitative part consists of a cross-sectional design and includes a self-completion questionnaire as well as quantitative document analysis and official statistic. This part can be described as a descriptive survey research with the aim to understand the relevance of a certain phenomenon as well as describing the distribution of this specific phenomenon within the population. (Forza, 2002) The self-completion questionnaire was answered by 202 respondents in the Gothenburg area and can be found in Appendix 3. The full design of this exploratory survey research can be seen in figure 27.



**Figure 27: Illustration of the research design used**

Due to the earlier description of the research design it is given that this research constitutes of both within-method triangulation as well as across-method triangulation, thus it meets the criteria of a multiple triangulation study (Thurmon, 2001). The within-method triangulation consists of data triangulation in both the qualitative part as well as in the quantitative part and the across-method triangulation consists of methodological triangulation (Thurmon, 2001), also called multi-strategy research (Bryman & Bell, 2011). This however presupposes a technical version about the nature of qualitative and quantitative method, meaning that it is possible to use one of those two methods into the service of the other (Bryman & Bell, 2011).

In this study the multi-strategy research approach is attained by facilitation, thus using quantitative research in order to aid the qualitative research (Bryman & Bell, 2011). This leads to an enhanced internal validity (Scandura & Williams, 2000). Further, triangulation can lead to increased confidence in research data, creating innovative ways of understanding a phenomenon, providing a better understanding of the problem as well as revealing unique findings. (Thurmon, 2001) Triangulation can also reduce the impact of potential biases that can exist in a single study (Bowen, 2009; Thurmon, 2001).

### **3.2.2 Sample**

For the quantitative part, including the self-completion questionnaire, the population is defined as all citizens and regular travellers within the Västra Götaland region. For the qualitative part including the semi structured interviews the sample is instead defined as all individuals that have a high knowledge base within the interesting areas as well as persons that potentially have a high impact on the diffusion process in the Gothenburg area as such. Thus this thesis will only deal with stakeholders and projects, which somehow are interesting for the transportation area in the geographical region of Västra Götaland, Sweden. For this a convenience sample was firstly used, convenience sampling is suitable to use in qualitative research due to representativeness is less important than the in depth-analysis (Bryman and

Bell, 2011). After the first convenience sample snowballing was used as a method to find additional interviewees.

### **3.2.2.1 Sampling error**

The sampling error in the qualitative part with semi-structured interviews is considered to be low in this study. However, due to the use of a non-probability sampling, e.g. convenience sample, human judgment could have impact and affecting the way elements have been chosen (Bryman and Bell, 2011). Further, for the quantitative part with self-completion questions is it very hard to know how many respondents that fall outside the sample definition since it was spread through social media and more or less anyone could have answered it.

### **3.2.2.2 Non-respondents**

Non-respondents is a type of error that can occur due to that elements within the population do not give a response, either because they refuse to collaborate or because they can't be contacted (Bryman & Bell, 2011). In this study there was one rather important stakeholder, a SEV-producer that refused to collaborate and thus important information, data and points of view was not possible to collect.

Additionally, associated to the self-completion questionnaire it is hard to estimate the non-respondents but it is a problem that individuals that do not have access to the internet forum that the questionnaire was spread through cannot participate, since they might have different opinions. Also individuals that have had access to the questionnaire but refused to participate might be a problem due to the same reason; they might have different opinions compared to the individuals that did respond.

### **3.2.3 Case study**

There are two main interview based research methods when conducting a research with a qualitative approach, semi-structured interview and unstructured interview. Overall these methods are much less structured than methods within quantitative research and the questions can be of an open-ended character to enable more detailed answers (Bryman and Bell, 2011). Due to increased possibilities of ensuring comparability in a multiple-case-study (Bryman and Bell, 2011) this section will use semi-structured interviews and not unstructured.

Further the semi-structured interviews will consist of purely open-ended questions due to its attribute of enabling unusual and unexpected answers. Moreover open-ended questions are useful for exploring new areas of study and can therefore be used later on for generating fixed choice format answer with a quantitative character. (Bryman and Bell, 2011) However, there are some negative aspects with using open-ended questions, including that the demands on the interviewer is high and therefore a greater likelihood of error. Further, different interviewers can behave differently and therefore affect the answers of the interviewees and complicate the comparability. The interviewees can also interpret the answers differently and hence lowering the internal reliability (Bryman and Bell, 2011).

Qualitative document analysis makes use of secondary data. Secondary data has several advantages over first hand data such as it requires less cost and time as well as often yields

higher quality data (Bryman & Bell, 2011). Document analysis with a qualitative approach is often used together with other research methods and works best within a case study (Bowen, 2009). A document analysis with a qualitative approach can provide supplementary research data and expand the knowledge base. Further on, it can be used in order to track change and development as well as to verify findings from other sources. The biggest advantages with this method are that it is a very efficient method in addition to a high availability and being one of the cheapest methods possible to use. (Bowen, 2009) For this study has several different documents been used mostly from McKinsey, MIT, The Economics and such.

### **3.2.4 Cross-sectional design**

A cross-sectional design holds the characteristics of being able to include a huge amount of cases at one point in time collecting quantitative data, where the data points do have a meaning but the ordering of them don't. (Bryman & Bell, 2009) Further, the methods used within this cross-sectional design are secondary data from official statistics as well as a self-completion questionnaire. The advantages of using secondary data have been revealed in the case-study section. These advantages hold true when extracting data from official statistics and the use of official statistics fits well into a cross-sectional design. (Bryman & Bell, 2009)

A self-completion questionnaire has a quantitative approach, which means that the research method has to be more structured than research methods within the qualitative approach to maximize reliability and validity, thus there need to be a clear set of questions to be investigated. Self-completion questionnaires consist mostly of closed ended questions, which result in that the responses can be aggregated due to identical questions and therefore enhance the comparability of the answers. Additionally close-ended questions lower the likelihood of error. However, close-ended questions might possibly lower the validity if there is a variation among the interviewees in the interpretation of the inflexible choice answers. Additionally can closed-ended questions be seen as irritating for the respondent. (Bryman and Bell, 2011)

Onwards, self-completion questionnaires are often rather short and should have an easy to follow design in order to avoid respondent fatigue (Bryman & Bell, 2011). There are several advantages connected to the use of self-completion questionnaires compared to other quantitative approaches such as structured interviews. Firstly, the administration cost is lower, especially when the geographical area is dispersed. The distribution can be done through internet, which significantly reduces the administration time. Further on, it results in an absence of the interviewer, which in turn reduces the tendency to display social-desirability.

However, there are also disadvantages linked to self-completion questionnaire such as that the respondents cannot ask the interviewer in order to elaborate and get aid when answering the questions. (Bryman & Bell, 2011) The questionnaire was designed in such way that the questions were logically ordered, from general to specific, to not confuse the respondent and therefore lower the risk that the respondents deter from answering.



#### ***3.2.4.1 Pre-testing***

Before the self-completion questionnaire was sent out a pre-test was conducted in order to assure that the questions were formulated correctly and unambiguously, thus operating well. (Bryman & Bell, 2011) Additionally this help assuring that the study objective can be accomplished (Forza, 2002). To avoid affecting the representativeness of the final questionnaire the population used for pre-testing cannot overlap with the real population. However, it should be comparable. Therefore five persons living in other parts of Sweden were used. Moreover, the construct validity was also tested in the pre-test by receiving opinions from the pre-testers. Thus the construct validity was enhanced (Scandura & Williams, 2000).

Due to the feedback achieved from the pre-test several changes to the self-completion questionnaire was conducted. In short the introduction letter was changed in order to become more interesting, a few questions were removed, some were added and some were changed.

## 4 Findings: SEV prestudy

The empirical part is first and foremost based on a case study of a start-up company in the Gothenburg region called Clean Motion, developer of the electric vehicle Zbee. This chapter will start with a description of Clean Motion and their small electric vehicle (SEV), Zbee, as well as some background information about the product segment. Thereafter will the opportunities and barriers for the diffusion of SEV's be treated as well as potential customer segments and business models that could induce diffusion. This text is based on the case, additional interviews, the results from a self-completion questionnaire and literature. The intent is to use the Zbee as a representative for a new type of vehicle that aims at being a sustainable alternative to the fossil fueled regime but not yet represented on the mainstream market in Sweden.

*"Four years ago no one could see the need of having an Ipad, but today almost everyone have one" (Folkesson, 2014)*

---

### 4.1 Clean Motion

Clean Motion was founded in 2009 and has developed and is currently producing an electric vehicle, the Zbee, which is shown in figure 28. A Zbee is three wheeled, with no doors and with room for one driver and two passengers. It has a maximum range of 50 km and a charging time of an hour. Further, its maximum speed is 45 km/h and it has today an L2e classification in Sweden, meaning that it is considered as a EU-moped and therefore is just a EU-driver's license needed. Three point belts in all seats and patented safety solutions for the chassis should make the Zbee safer than a moped (Hans, 2014). (Clean Motion, 2014)



Figure 28: A Zbee (CleanMotion, 2013)

#### Properties

Weight: 230 kg  
Range: 50 km  
Max speed: 45 km/h  
Price: 95 000 - 70 000 SEK  
Cost per 10 km: 0.06 \$  
Class 1 EU moped

Table 3: Properties of a Zbee  
(CleanMotion, 2013)

The chassis is made in carbonate, which results in a weight as low as 230 kg. (Clean Motion, 2014) Also the number of components has been kept to a minimum, only around 300 compared to 10 000 in a normal car, in order to keep the weight and complexity down as the weight correlates with the energy consumption. Also the fact that the Zbee consist of few components makes it easier to produce in smaller batches and henceforth being more local, leading to less cost and emissions related to transportation (Folkesson, 2014).

The Zbee is currently stated as the most energy efficient vehicle on the global market and did receive the WWF Climate Solver Award 2013 (Clean Motion, 2013). The prize is awarded to innovations that have the potential to considerably lower the amount of greenhouse gases and be an important brick in the transition to a fossil free society (WWF, 2013). A Zbee only uses 7% of the energy of a fossil fuel driven car in a city and do not emit pollution or contribute to noise pollution. Per 100 km is 4 kWh consumed, which equals to a charging cost of 0,6 ¢/km. (Clean Motion, 2014)

Similar vehicles to the Zbee that also could be classified as SEV's are the Norwegian Buddy or Renault's Twizy that Clean Motion right now is considering as their greatest competitor. As both these SEV's have a higher allowed speed limit the Zbee stands out in terms of its energy efficiency and choice of material, as Zbee is the only vehicle within its segment that is made of carbonate. (Folkesson, 2014)

## 4.2 Opportunities and barriers

According to Folkesson (2014), one of the founders, is Clean Motion a reaction to the increasing awareness of the environmental problems that is connected to the fossil fuelled car. They have identified four problem areas; congestion, emission affecting air quality on a local level, lack of parking, and the greenhouse effect. He also mentions that Zbee will address all those problems even though the electricity is based on fossil fuel, which is not the case with i.e. a normal electric car and that a Zbee actually can drive where a normal car is not allowed.

The aim for Clean Motion was to create an alternative product that would decrease the impact in all these problem areas, as there is an increasing demand according to Folkesson (2014). Many big cities in the world, such as Paris and Delhi, have increasing problems with congestion and air pollution and Folkesson (2014) states that: "*The more visible the problems of car usage are the keener are people and politicians to find a solution*". The solution according to Clean Motion is the Zbee and through being first on this market they hope to secure a competitive market position (Folkesson, 2014).

Although the classification of an EU moped Folkesson states that Clean Motion wants the Zbee to be perceived as a vehicle in between a bike and a car, a product segment that has been lagging for a long time in the western world but flourished in other parts of the world (Folkesson, 2014). Further, there are researcher that means that the traditional car manufacturers will keep on standing strong throughout changes in technology due to the great complexity of a modern car, connecting millions of mechanical, electric and software components. (MacDuffie & Fujimoto, 2010)

Clean Motion is going in the opposite direction and is very clear about that their aim is not to become a "car manufacturer" but instead creating a much simpler product. "*I'm much more comfortable in my car then in my own living room sofa, the car industry has gone to the extreme with adding more and more features.*" says Folkesson (2014) who believes the market soon will get tired and a counter reaction will come. However, Kampmann (2014) mentions that customers take for granted and want a very comfortable vehicle since they invest so much money in it. Additionally, according to our questionnaire the comfort of a transportation mode

was the second most important reason, after *“the fastest way of going from point a to point b”*, for choosing that specific mode.

That Clean Motions business model focuses on simplicity instead of complexity, which makes Clean Motion rather agile with local factories with the investment cost of 3 million SEK that has the capabilities to produce up to 1000 vehicles each year. Folkesson(2014) means that it is important to be able to produce locally since it not economically viable to transport Zbee's that are sold for about 30-35 thousand SEK all around the globe. What enables this business model is the low complexity of the product and the relatively cheap and easy to produce tools. Both the Zbee and the tools are made in a composite material, which is also one of the things that make the Zbee special according to Folkesson. He argues that due to the lightness of the composite the Zbee out conquer the competitors when it comes to energy efficiency.

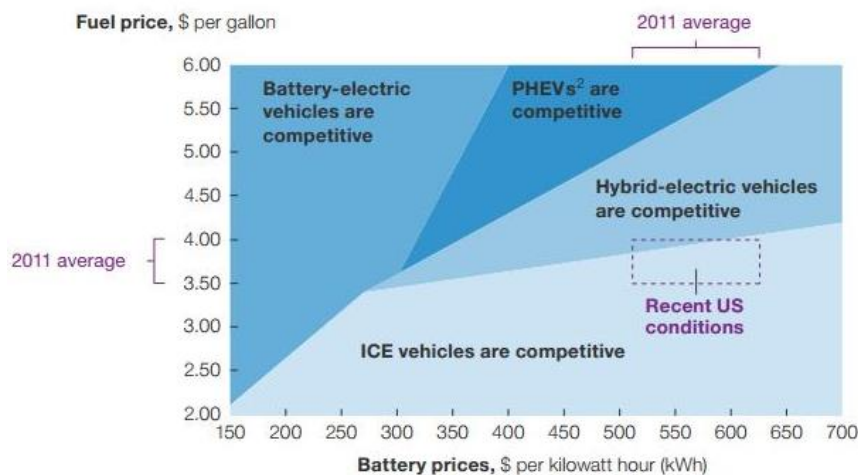
Clean Motions business model is to offer a premium product, in first and foremost the markets India and Indonesia that is cleaner, energy efficient and safer. The Zbee will still be more expensive than most vehicles within the three-wheeled segment. However, the aim is to take a market share of 1 % in India and Indonesia and though remain within a premium segment there.

When asking Folkesson (2014) what he believes is the greatest hinder for the Zbee to start selling in Sweden he suggests lack of political incentives and regulations and argues that both Norway and Denmark would be better markets for Clean Motion in that sense. However Gothenburg City has recently implemented a congestion tax (Transportstyrelsen, 2014). Additionally, Johan (Nyhus, 2014), politician in the municipality of Gothenburg, agrees that politicians both on state and municipality level has great potential to affect the diffusion of alternative vehicles as well that they should do whatever they can using both *“whip and carrots”*. However, even though Nyhus sees electricity as the fuel of tomorrow he states *“to implement changes for the tax payer's money that is not rooted among the voters is politically impossible in the long run”*.

Research on what actually affects the adoption of electrical vehicle has on the other hand concluded that purely monetary means such as tax reduction was less efficient than expected while other perks such as special roads or parking were surprisingly successful means for stimulating the market (Hensley, Newman & Roger, 2012). It was further also shown in the results from our questionnaire that over 50% of the responders thought it was very important to easily find parking spots as well as easily park with the vehicle when buying a new vehicle (Questionnaire, 2014)

Magnus Johansson, researcher at Lund University, argues that the cost and performance of the electric battery is a key factor for the diffusion of SEV's. "If the batteries are good and cheap enough the overall cost of ownership will be low enough and no subventions will be needed"(Johansson, 2014). According to McKinseys report on the subject is it clear that batteries will have better performance and lower price in the future. However, there is still much uncertainty in terms of how fast this development will be. Dependent on the development in price for batteries and also the price development for fossil fuels, different

types of vehicles will be economically viable to buy as figure 29 shows. (Hensley, Newman & Roger, 2012) Additionally, there are recent breakthroughs in the battery science and both Dual Carbon Batteries and Lithium Sulphur Grapheme batteries would be able to greatly improve the driving range and the charging time of electric vehicles (Gizmag, 2014; The Guradian, 2014)



**Figure 29: The relationship between battery prices and fossil fuel prices effect on vehicle technology competitiveness (Hensley, Newman & Roger, 2012)**

All of the interviewees agreed on that there is a strong car owning tradition in Sweden and as Johansson (2014) puts it *"the car has for many represented more than a mode of transport but also reflects on who you are in terms of status and identity as well as provides a feeling of freedom"* and that a Zbee probably won't be seen as status symbol in any country in a near future. Johansson further mentions a pilot project at IKEA Älmhult where one of the bosses used a two-seater car in order to commute 30km to work and during the day let the employees use it for business-related things. This failed due to the lack of status driving such car. Folkesson (2014) is also aware that this is a problem with attitudes and consumer awareness as he states *"It's a completely new market and a completely new product for the developed countries"*. Another McKinsey report suggests that consumer education and awareness will be an important factor to make consumers adapt to the new technology (Hensley, Newman & Roger, 2012).

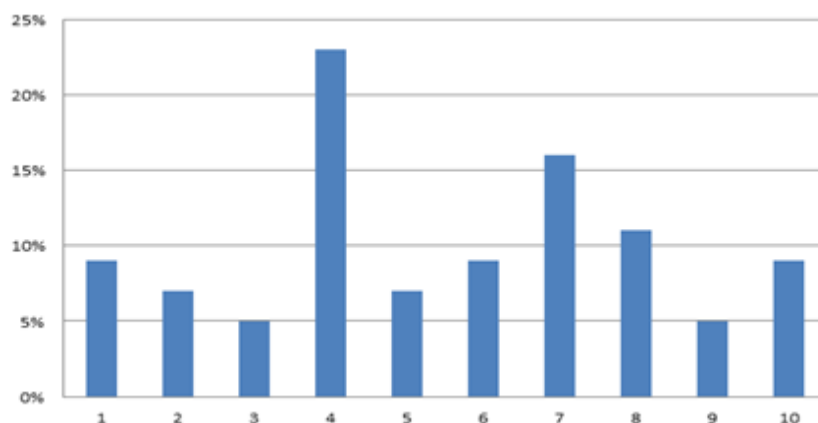
### 4.3 Market segment

The difficulty to communicate what kind of vehicle and the area of usage to the Swedish market is one of the reasons why Clean Motion is foremost going for the Indian and the Indonesian markets as those places already has a tradition of small, three-wheeled vehicles as the tuck-tucks or rickshaws. (Folkesson, 2014) Clean Motion aims for taking the premium segment of the small vehicle in these countries by being a safer and cleaner option. Folkesson is quoting one of their sales personnel in India saying he is selling *"the BMW of tuck-tucks"*. The Zbee has according to Folkesson attracted a lot of attention in India and Indonesia and he believes that as soon as Clean Motion managed to lower the cost of production through

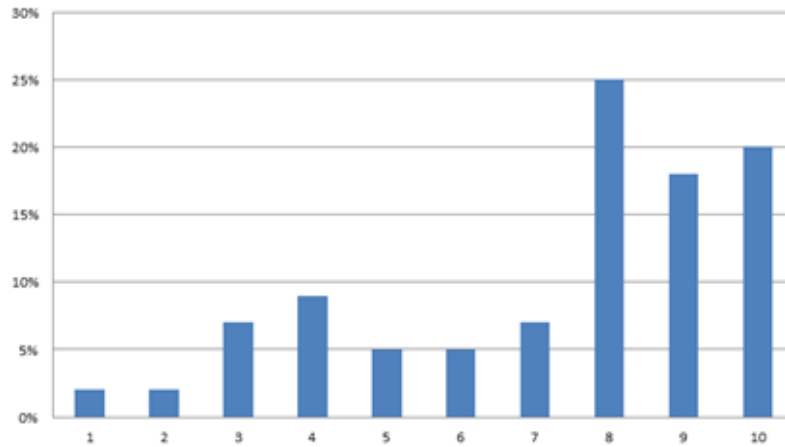
economics of scale there are lots of potential. *"Are the mega cities expanding, this will be the vehicle requested there"*.

Folkesson also sees a lot of potential areas of usage here in Sweden today but believes that these niches are not enough to reach an economically sustainable scale in production. Some of the future usage areas that Folkesson believes in are among others replacing the second car, safer alternative for teenager, vehicle for transportation connecting to public transport, home care services or janitorial services in cities etcetera. Folkesson believes that in a city environment the car could be replaced by SEV's such as the Zbee others are more skeptical. Johansson means that there might be a market but it is probably quite limited: *"Young people living in the city that are environmentally aware and has some money could possibly be interested in buying."* As Johansson states that this is a growing group it is still very limited

That young people generally are more environmentally aware than the average in Sweden could be supported by the SCB report on voters sympathies where the green party clearly has more sympathizers in the age group 18-29 (Pejl på partierna, 2014). There are also statistics showing that the number of young people that chooses to take a driver's license is decreasing, today three out of five people in the age 18-24 owns a driver's license compared to four out of five in 1985 (Sydsvenskan, 2013). When asking people in Gothenburg how important it is for a vehicle to be environmentally friendly the answers are rather shattered where the requested ranked quite equally between one to ten on the scale, see figure 30. Additionally, the green party became the largest party in Gothenburg in the European Parliament election 2014 with over 18% of the total votes (Val, 2014)

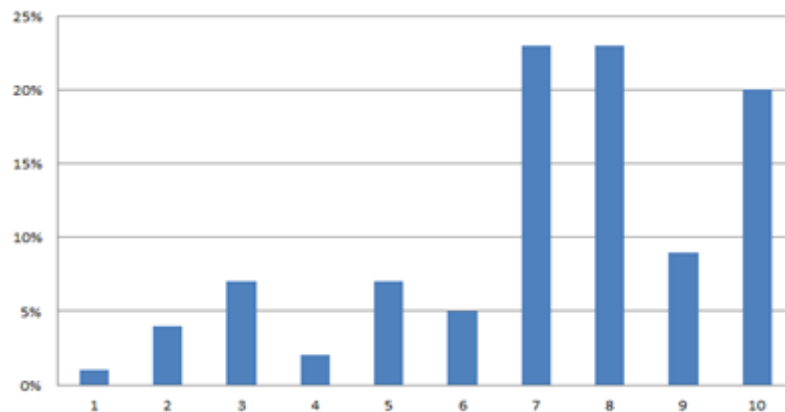


**Figure 30: The importance of a vehicle being environmentally friendly**



**Figure 31: Importance of low cost per km when buying a vehicle**

On the other hand did a clear majority think that having a low cost of driving per kilometer were an important or very important factor, ranked 8 or higher, when buying a vehicle as can be seen in figure 31. Another factor that was important for the survey participants was safety and also being easy to park while signaling social prestige had somewhat mixed result but over half of the respondent scored a four or lower, see figure 32 and 33. Marcus Linder (Linder, 2014), researcher at the Victoria institute, suggested based on his research on business models for sustainable products and services, that in the case of Clean Motion it would be wise to highlight the energy efficiency of the Zbee more than just being an environmentally friendly product.



**Figure 32: Importance of vehicle safety**

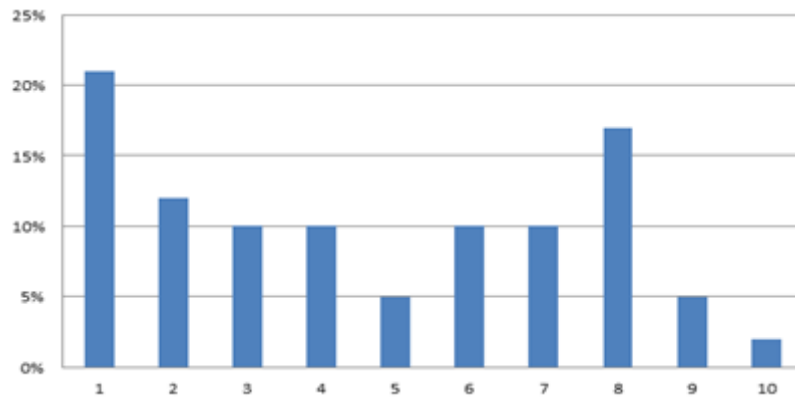


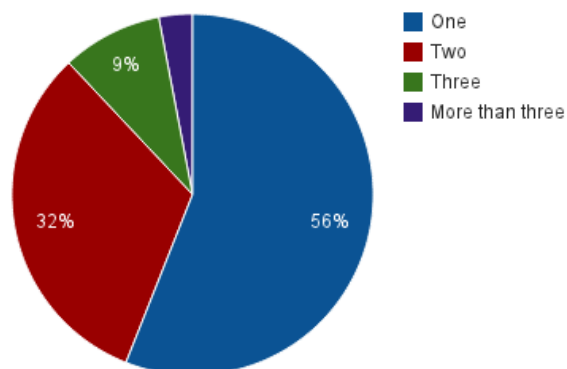
Figure 33: Importance of vehicle signaling social prestige

#### 4.4 Alternative business models

Christian Erik Kampmann (Kampmann, 2014), associate professor at CBS, is positive that our transportation behavior will change due to the fact that the current system includes a lot of waste. As the entrepreneur and vehicle builder Robert Q Riley (2003, p.45) writes: *“Overweight and oversize cars and chronic underutilization of vehicles”* are the two most wasteful habits affecting the world’s consumption of transportation energy, of which about 95 percent comes from petroleum. Using vehicles that fit driving patterns would greatly improve vehicle utilization and significantly reduce the energy intensity of personal transportation.

The degree of utilization for a car is in average very low since it is only used about 4 % of each day and loses value so fast there are reasons to believe that changes will come especially in the cities as congestion and lack of parking makes it inconvenient to own a car according to Kampmann (2014). Also in the questionnaire that was conducted in the city of Gothenburg implied that most people used their car for only a small percentage of the day and that the average daily travel was under 5 km for about half of the persons participating in the survey and only 5 % had an average length of their daily travel that was over 50 km. Also in a clear majority of the travels there were maximum two persons in the vehicle. See figure 34.

Number of persons per vehicle



Average length of daily travel

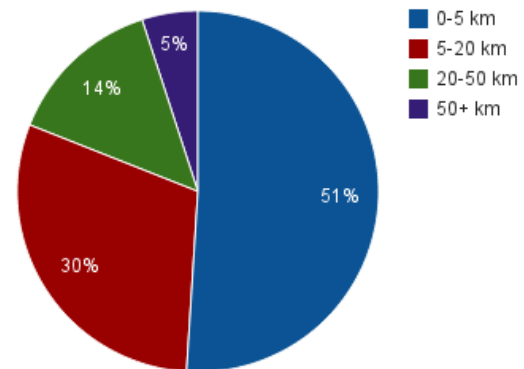


Figure 34: Numbers of persons per vehicle and the average length of a daily travel



In the future Kampmann (2014) imagined that fleets of different vehicles will be at the disposal for customers and that transportation is sold as a service and not a product. In that case could all vehicles be utilized to a much greater extent. The politician Nyhus (2014) is also arguing for the need for more complementary modes of transport to public transport in order to create a complete transport system stating, *"we cannot think that buses and trams will be enough to replace the car"*

Johansson (2014) agrees that *"there is much in the concept but there is still limitations"* and means that there is still a strong tradition of owning in the western countries. He further mentions that *"A traditional business model that focuses on that the end users owns an SEV will never work"* and the companies should think about if they are a transportation company or a car manufacturer. Additionally, Kampmann (2014) argues that *"owning your own car is going to be a thing of the past since it is so much more value that could be utilized with other business models"*.

Both Johansson (2014) and Linder (2014) is quite positive that there is at least some niche markets for the SEV and Linder(2014) further mentions that it is all about matching the value proposition with the right customer, i.e. finding the business model and the early adopters. However, both Linder (2014) and Kampmann (2014) emphasizes that there will be a process of trial and error before the system has adapted fully to the new business models in transportation. As Kampmann (2014) puts it: *"It is a hard process for people to change behavior but it's all about the time, it takes a few to start and when your neighbor take the carpool you might feel more inclined to try it as well"*.

## 5 Discussions and recommendations C-Lab

Taking part of this first pilot of the C-Lab has been an interesting and positive experience reaching beyond the traditional education at Chalmers in aspects such as personal development and sustainable development. C-Lab is further connected with a lot of new knowledge as well as laughs and good times for us but also to a lot of frustration and uncertainty. In this chapter the experiences and findings from the whole C-Lab process will be discussed. This text is not representative for the whole group but rather just the authors of this thesis own thoughts and opinions. For the other C-Lab participant's thoughts and opinions we refer to their theses.

### 5.1 Aims and objectives of C-Lab

Here it will be discussed whereby the aims and objectives of C-Lab, for the whole project as well as for phase 1, have been fulfilled or not and thereafter why so and what could have been done better. As stated in the beginning of phase 1 the aims of C-Lab are: i) to create an arena where transformative solutions can be derived in collaboration between multiple stakeholders in order to drive the change needed for a sustainable society ii) facilitate meetings and dialogues with different stakeholders throughout the society as well as extract and manage knowledge in a complex context.

In Holmberg (2014) this is broken down into four objectives i) strengthen the educational dimension in the triple helix, ii) provide a natural hub as a neutral meeting place where all parties of the triple helix are drawn to iii) build trust in the system by students with non-threatening and challenging characteristics iv) give the participating students the opportunity to develop unique skills in working from a challenge-driven perspective and across disciplines. Most of the aims are rather long term and naturally not fully fulfilled from just one pilot project. However, some were more fulfilled than others or have a larger probability of getting fulfilled if the concept remains the same the coming years.

**For the first aim** to strengthen the educational dimension in the triple helix, it is rather obvious that it is fulfilled to some degree. However, the question is to what degree, which we think depends on the quantity as well as quality of the interactions with stakeholders as well the results from this process and how it is spread through the triple helix. During phase 1 we had a high quantity of stakeholder interactions, which is positive but the quality and the results from them are questionable.

The interactions were mostly one-way where the participating students extracted information from the visiting stakeholders either through questions or through a lecture. This one-way interaction is seen as a problem by us since it probably means that both parties gain less than they otherwise would have done. The more a stakeholder gains the more likely it is that the word about C-Lab is spread and thus attracts more stakeholders. However, it wasn't really meant to be only one-way interactions with the stakeholders but rather dialogues and this is something we really think C-Lab would benefit from the upcoming years. Further, there were more room for improvements with the stakeholder interactions, which will be discussed later on in tools and frameworks-External stakeholders. Lastly, regardless of the problems discussed

we know that several stakeholders were very happy with the C-Lab visit and that the mouth-to-mouth communication about C-Lab started rather early, which must be seen as a success. Even though some stakeholder meetings did not always result in the intended dialogue or applicable knowledge it is believed that it brought some different perspective helping us to understand the system.

**The second aim** to provide a natural hub, as a neutral meeting place where all parties of the triple helix are drawn to must be seen as rather far from a fulfilled aim mostly due to practical reasons. The intention, which was to invite several stakeholders, from all parts of the triple helix, at the same time and through dialogue sessions create trust and later collaboration as well as letting them interact with each other freely was hard to achieve. Almost all of the invited stakeholders from phase 2 preferred to meet at their respective offices instead of meeting at the C-Lab. Additionally; the stakeholders that were invited in phase 1 as well as the stakeholders that actually arrived to C-Lab in phase 2 almost always were alone with the students and did not interact with other stakeholders.

As the interest shown for C-lab was already big this first year we believe that it will be easier to convince stakeholders to come to the C-lab office and participate in dialogues with other stakeholders as the concept gets increasingly known. Thus it is important for C-lab to build a stronger brand as well as communicating the benefits of participating in the Lab, making it more interesting for stakeholders to take their time and visit the Lab.

Another issue limiting the fulfilling of the second aim is that the students worked on very different projects in phase 2. This resulted in that everyone wanted to talk to different stakeholders extracting different kinds of information, which that made it even harder to succeed in holding a dialogue session about a common subject.

**The third aim** to build trust in the system by students' non-threatening and challenging characteristics is a bit tricky. Having the stakeholder meetings in mind it really felt that they were both honest and open with us, which would indicate that trust between the students and the stakeholders were built. However, one stakeholder even wanted to see the stakeholder meeting notes afterwards because he felt that he had been too open and might have revealed information that he was not supposed/allowed to reveal. Thus, it seems like the non-threatening and challenging characteristics of students indeed helped building trust. However, the potential trust that has been built is between the students and the stakeholders and did probably not spill over in trust between stakeholders. This is of course an issue that is connected to the lack of interactions between the stakeholders as previously discussed.

**The fourth aim**, or correctly described as the objective, iv) give the participating students the opportunity to develop unique skills in working from a challenge-driven perspective and across disciplines is the aim that we think is fulfilled to the highest degree. We have without a doubt gained skills participating in the C-Lab that we would never have learned from the traditional education at Chalmers. For both of us was interacting with the divers group of students and share experiences the most positive experience on a personal level.

However, we think that the different ethical and educational backgrounds of the participants could be exploited even more. Exchange of knowledge and experiences could have been enhanced by even more teamwork, increasing the collaboration and the knowledge transfer. For example could the participants' keep on working as a team in phase 2 on a larger project instead of being divided into pairs. Working on a larger common project would also have made the project management session more useful and could be a useful experience for students to gain project management experience. Another interesting way of increasing the skill set would be to include participants that do not have an engineering background but instead e.g. law and psychology students.

## **5.2 The C-Lab approach**

The C-Lab was split into two separate, but connected, parts: Phase 1 and Phase 2. Phase 1 was further also divided into one outside-in section and one inside-out section. When it comes to the division of phase 1 we think that it was very helpful, due to the different starting points they take and the different mindset they require. Further, the outside-in and inside-out was also very well connected by Holmberg (2014) and the theory U. However, dividing it into phase 1 and phase 2 is a bit more questionably since it basically became two different master thesis, which led to time restraint and the feeling that some of the tools and exercises were not given the time needed to get the most out of it.

Additionally, the first 1, 5 months was almost fully booked with stakeholder meetings. This could have been a good idea and the aim was to quickly get us up to date with the subject and gain knowledge from all parts of the system as well as acting as change agents from the very start. However, since the knowledge of the students about what C-Lab was about were quite low in the beginning the general feeling was that it was hard to ask the right questions at these meetings and the information gained was thus very general.

Further, we believe that it would be more motivating to get a high degree of freedom even early in the project. The first time in the C-Lab project created a feeling a bit similar of being back to high school and could have impacted the motivation and creativity for a while. We think it is very important that the students in the upcoming C-Labs feel like they are more in charge from day one and thus being able to spend time on things that makes them feel that they are moving closer to the objectives and aims.

Furthermore, it is suggested that less focus should be put on writing the report in favor of the more creative activities that makes C-lab differentiate from traditional master theses. Currently, the end result from a C-lab thesis is not that different from a normal master thesis, apart from our personal development and knowledge gained. In order to achieve the aims and actually produce different results than a normal master thesis we think it is a necessity to focus less on the written report and more on what actually matters. For example could Chalmers consider other ways of examining C-Lab students in order to maximize the C-Lab experience as well as fulfilling the aims better.

### **5.2.1 Tools and frameworks**

Throughout phase 1 a wide variety of different tools and frameworks were used, which did create a unique possibility of cross-disciplinary learning. This additionally helped to create a unique atmosphere between the participants as the tools included group exercises and required teamwork. However, even if some of the tools were both useful and essential for the progress there were also tools and frameworks that did not add any particular value for all participants.

Additionally, some tools and frameworks were not fully completed and some were not entirely understood by the group, both in terms of how they were supposed to be done and how they were connected to the process. This unfortunately resulted in that precious time wasn't used as efficient as would have been preferred. It also led to unnecessary uncertainty within the group about the purpose of the exercises. However, it could also be seen as positive that as the process and the outcome was not planned in detail the students got the challenge and opportunity to incorporate the outcome of the exercises in a unique way.

#### **5.2.1.1 Backcasting**

Backcasting is one of the most essential tools in the C-Lab process and is what creates the frames of phase 1. It is overall a really good tool all though the connection between backcasting and the phase 2 project could have been made more clear. Additionally, it would have been good with more time for exploring this tool.

#### **5.2.1.2 The compass methodology**

The compass methodology is part of the second step of backcasting but the reasons of doing it were not fully clear at the time we did it, which could have had negative impact on the group motivation of executing it thoroughly. Yet, it did help us to increase the understanding of where it is most important to intervene in the system. Lastly, this is an interesting exercise, which could be very useful if given the time needed.

#### **5.2.1.3 The funnel framework**

This is also part of the second step of the backcasting methodology and one of the most straightforward and better-communicated tools. This method was interesting and important in order to understand today's trends. However, initially pairs of students were in charge of one part each, which did not work satisfying. Reasons for this were the really tight time frame for doing this, only a couple of hours, which led to poor results and that it later had to be redone individually. Even if the tight time frame was due to the objective of quickly getting an overview we still suggest that this step is worked through more thoroughly to avoid extra work later.

#### **5.2.1.4 Self-leadership and leadership**

The self-leadership and the leadership module were very inspiring as well as very important and useful for our personal development. This together with the dialogue session is one of the main takeaways from C-Lab. Additionally, it created knowledge about how important values, motivation and behavior is for a sustainable transition as well as how important leaders role in this transition is. It also taught us how important it is to look beyond the organizational value

when extracting information from stakeholders and also look deeper into individual values. This is one module that worked really well and was very appreciated by us and also by the whole group.

#### **5.2.1.5 *Design thinking***

Design thinking is a very interesting topic in itself but for our project and us it felt mostly as a waste of time since we had to spend time on hand-ins and lectures that couldn't be used at all. This was because it focused too heavily on product development and the prototyping of results did not fit very well with our end result. However, for other projects with a focus on real product as end results it was probably useful. For following years of C-Lab, if they have a similar set up, we think that this part should not be mandatory.

#### **5.2.1.6 *Multi-level perspective***

The multi-level perspective was very useful in order to understand transitions of socio-technical systems and did play a rather large part in our decision process of finding a research topic.

#### **5.2.1.7 *Casual loop diagram***

Casual loop diagram was initially thought of being a very important tool in order to find the hot spots in the system where we could intervene with our research in phase 2. However, due to time limits the casual loop diagram exercise were discarded half way through and thus made the whole exercise more or less useless for our report. The participating students played a large role in the discard of this tool since there was a lot of worry in the group that it wouldn't be possible to finish phase 2 unless started as fast as possible. Ironically the discard of casual loop diagram probably instead prolonged the search for a research question as well making the connection between the phases a bit weaker. Additionally, it might have been possible to find a more urgent hot spot for our research topic using casual loop diagram. With this information at hand now the casual loop diagram tool should probably be given more time in future C-Labs.

#### **5.2.1.8 *External stakeholder meetings***

In phase 1 we had meetings with external stakeholders almost from day one and spent large amount of time on this. In theory this sounds really good since it's included in the C-lab aim to connect stakeholders and work as change agents. However, since the stakeholder meetings started so early it meant that we as students didn't really know about what information to extract and most stakeholder meetings mainly included very general information. An example of this is that only three external stakeholders (apart from the main ones which were main elements in one of the parts) are used in this thesis.

Of course the other stakeholder meetings did result in an increased knowledge of sustainability problems in the transportation sector in Västra Götaland but it was not efficient and that knowledge could have been gained quicker using other methods. For the external stakeholder meetings to be the way they are meant to be we think it is important to start with the meetings later in process when the students have a better idea of what information they need. Additionally we think it would be beneficial if the students themselves could decide on

which external stakeholders that should be invited. A later introduction of the stakeholder meetings could also mean that it would be easier to invite some of them at the same time and make use of the knowledge gained from the dialogue tools.

## 6 Recommendations C-Lab

This section is built upon the earlier discussion and is meant to give recommendations for future C-Lab projects in order to improve the process, results as well as the experience for the students. The recommendations will be given in a rather short manner since the underlying discussion is thoroughly.

- Instead of dividing the process in phase 1 and phase 2 it could be connected in such way it becomes more like one master thesis instead of two and therefore create a stronger common thread as well as possible improving the end result.
- Keep both the outside-in and the inside-out perspective since this structure enabled the students to gain inter-disciplinary knowledge as well personal development.
- Use less exercises and methods in order to assure that the ones that actually are executed are executed in such way that they are fully completed, understood and useful.
- Instead of letting the students work in pairs on their respective research question it would be better and more meaningful to work as one team on one project. Enhancing the learning and the experience for the students as and possible increasing the satisfaction of all connected stakeholders.
- Explain the process and the expected outcome better in the beginning instead of starting off with stakeholder meetings directly. Students that don't know what they are doing or why they are doing will struggle with delivering as good results as they want to.
- Let the students be in charge earlier in the process. Once the overall process and structure is understood it should be the students that drive the project forward by inviting stakeholders etcetera. This would most likely increase the creativity and motivation and lead to more innovative results.
- Provide a different way of examining C-Lab students. A normal thesis produces very little value but it does take a large amount of time writing it academically correct. This time could be spent on actual value creating activities.



## 7 Discussion: SEV prestudy

In this section a discussion about the findings from the collected data in relation to the theory will be held. The discussion will further revolve around the research questions i) What possibilities and barriers are linked to the diffusion of SEV within the Västra Götaland Region and ii) How could the chances of a successful diffusion and the speed of adoption be increased?

Geels (2012) pointed out the EV and plug-in hybrids as the strongest niche trends right now with potential ability to challenge the regime. This conclusion by Geels (2012) was one of the takeaways from the first phase that formed the research question and the choice to make a case study on Clean Motion. When starting the project the realization of the importance to separate the SEV from the more general EV segment was not yet found. However, during the work process it was evident that a SEV such as the Zbee has not the same market segment as the traditional car and it's therefore not applicable to just replace one for the other or make simple comparisons.

### 7.1 Opportunities and barriers

According to Lindmark (2006) utility is a key word for the success of the diffusion of a product and customers strives after utility maximization. Further, Rogers (1995) stated that the diffusion of a product very much depends on the perceived attributes of the innovation and that the relative advantage, which is closely linked to the perceived utility, is of particular importance. Clean Motion (2014) and Folkesson (2014) mentioned that Zbee has several unique characteristics such as being small, easy to park, the most energy efficient vehicle on the global market and contributes with no local emissions.

These features would further solve the problems for at least some of the congested, polluted and noisy cities of the world (Folkesson, 2014) and as the funnel in phase 1 shows there are indeed threatening trends that needs to be resolved, partly by changing the transportation sector. Further, a product such as Zbee could help fight the chronic underutilization mentioned by O Riley (2003, pp. 45) and Kampmann (2014). However, Zbee lacks features that normal cars have such as long driving range, a high degree of safety, comfort and speed. The results from our questionnaire did point out safety as one of the most important utilities of a vehicle, see figure 36, however Folkesson (2014) upholds that a Zbee actually is very safe with three point seatbelts and a safety patent and thus that it is only the perceived degree of safety that is low.

That Zbee's utilities in reality could be more advantageous in an urban area was detected in our questionnaire since peoples driving patterns seems to include 1-2 persons and a very short distance at most times, see figure 38 and figure 39, which fits well with the properties of Zbee. Additionally, Zbee has extremely low driving costs (Folkesson, 2014), which the respondents in our survey valued highly, see figure 35. Additionally, in order to illustrate of how valuable the easy to park utility is Kampmann (2014) said that *"a large amount of the distance driven in Copenhagen is done in order to find a parking space and this add up to a large total cost for the city"*.

Swann (2002) argued that customers do not strive after utility maximization but rather wants to transmit a signal and Gabriel and Lang's (1995) and Warde (2002) argued that the buying behavior is more collective and about belonging into groups.

Additionally, the buying behavior is also strongly affected by earlier decisions (Gabriel and Lang's, 1995; Swann, 2002) as well as expected future choices of others (Swann, 2002). That the buying behavior is strongly affected by earlier decisions suggests that there is a collective cognitive lock in accordance with Nelson & Winter (1982) and according to Moore (1995) mainstream customers like to be "owned" by the regime. This is obviously not positive for a future diffusion of Zbee since this type of vehicle represents a new segment and product in the western world (Folkesson, 2014). Further, all interviewees agreed on that there is a strong car owning tradition in Sweden. However, that customers buying behavior is affected by belonging into groups and by others future decisions could be positive for the diffusion of Zbee in some aspects since Linder (2013) mentioned the demand of environmental friendly products is increasing and more and more people vote for green parties, resulting in that the green party was the most popular party in Gothenburg in the European parliament election 2014 (Val, 2014). This high degree of environmental thinking in Gothenburg should also be seen as positive for the compatibility, even though it could not be strengthened by our questionnaire, figure 34.

The earlier described car owning tradition in Sweden, together with that a car is seen as a freedom symbol in the western world (Kampmann, 2014) would in contrast be seen as negative to the compatibility. According to Geels (2012) were most of the factors identified that supported a continued dominance of the fossil fueled automobile regime connected to values and behaviors. As it is stated that there is a fossil fuel automobile regime currently it could also be assumed that surrounding infrastructure and institutions are adapted to the car, which also is a hinder for diffusion.

Social prestige is another important component that constitutes to the relative advantage (Rogers, 1995). According to Johansson (2014) will the Zbee not be seen as a status symbol in any country in the near future. However, our questionnaire showed that over 20% of the respondents didn't care at all about status when buying a vehicle in the Gothenburg area for daily travelling. What is perceived as high status or a normal vehicle is hard to change as stated in the theory referring to evolutionary economics where the system and the actors within it are not completely rational as acting under influence of the regime (Nelson & Winter, 1982; Nelson 2002).

A new technology could be superior but not be able to beat the competition due to technological trajectories and cognitive lock-ins described by among others Nelson & Winter (1982). The cognitive lock-ins make people less inclined to try new things as that would break the pattern created by earlier decision, experiences and action, which makes most customers as well as firms and industries path dependent. In that sense has Clean Motion an advantage as it's a startup company that is not as affected by customer expectations or organizational behavioral structures and though more likely than the incumbent firms to make disruptive innovation that changes the regime.

Onwards, several of the characteristics of the Zbee leads to utilities connected to a more sustainable society in the future. However, Rogers (1995) mentions that innovations with such utilities can be proclaimed as preventive innovations and holds a rather low overall relative advantage and thus a slow rate of adoption. Additionally it fits within what Linder (2013) describes as a social dilemma, meaning it is hard to capture the value of a more sustainable product but could occasionally lead to decreased costs and a higher efficiency and thus differentiation and new opportunities. Also Pacheco et al (2010) argues that it could lead to a positive environmental differentiation. However, Linder (2014) mentioned that environmental friendliness generally does not create motivation for adaption and that energy efficiency often is a better selling point even though it's just a byproduct feature.

The relative advantages is lower in Gothenburg compared to larger cities in other parts of the world where the problems that Zbee can solve; congestion, local emissions and parking problem in particular. As Johansson (2014) stated, *"the more visible the problems of car usage are the keener are people and politicians to find a solution considered"*. However, the high degree of environmental thinking as well as the user's wish to have a very low driving cost does of course affect the relative advantage positively and lay a foundation for a possible diffusion. Further, traditional aspects create a problem, where vehicles similar to the SEV do not really exist on the Swedish market yet. By focusing on India and Indonesia Clean Motion is dodging some of the new segment problems described above as these markets already have that kind of transportation tradition. Further, this allows the product to be seen as a status symbol (Folkesson, 2014) which would be very unlikely to happen in the Swedish market (Kampmann, 2014)

## **7.2 Accelerating the diffusion**

This section will discuss how to speed up the diffusion process by mainly focusing on market segments and business models but also other alternatives.

### **7.2.1 Market segments and Business models**

According to Moore (2008) is it essential to find the right market segment in order to diffuse a new technology and Lindmark (2006) mentioned that for this diffusion to be successful the new product must have a different set of utilities than the preceding products. As mentioned earlier Zbee does have a completely different set of utilities than e.g. a normal car or a normal EV and therefore fulfills this criterion. Additionally, for diffusion to happen it is important to find a niche market where it is possible to get innovators and early adopters that can act as a recommendation group and work as a bridge over to the mass market (Moore, 2008).

Folkesson (2014) mentioned niche markets such as craftsman operating in an environment where they are not allowed to drive and the home car service. However, Nyhus (2014) said that the safety regulations of the municipality would probably not allow them to use Zbee's in such manner, which would imply a decrease in the total number of potential market segments. All researchers, Kampmann (2014), Johansson (2014) and Linder (2014), mentioned that they believe there are niche markets where a product like Zbee has the potential to grow. Which these niche markets are is not yet identified but they all agree about the necessity of using an

alternative business model in order to reach these niche markets and that a correct business model is just as important as the actual product.

This goes well with Chesbrough's (2010) statement that a new product or technology has no real value before the right business model has been identified. Kampmann (2014) suggested that one type of business model could be that Zbee would be part in a larger pooling fleet including all other sorts of vehicles where Zbee will be used where it has its largest advantages, urban areas and short distances. Thus, the Zbee should not be sold as a product to end customer but instead as a service. Another business model idea that Kampmann (2014) gave was that a product such as Zbee could be connected to the public transportation network and again be sold as a service to the end customers. This also connects well with that Nyhus (2014) said about the need of creating a more complete transportation system.

Both Kampmann (2014) and Johansson (2014) suggested a specific customer segment focusing on people that are young, environmentally aware, living in cities, earn some money and don't want to own a car. Additionally, young people more often vote on green parties than other individuals in the society (Pejl på partierna, 2014) and the trend shows that the number of young people owning a driver license has decreased (Sydsvenskan, 2013). These two circumstances hint that this is a growing group in society with alternative values. Kampmann (2014) also mentioned that a large amount of young people today do not want to bind up capital in a car or similar.

### **7.2.2 Other alternatives**

One way of accelerating the adoption rate according to Moore (2008) and Rogers & Petrini et al (1986) is to make use of interpersonal channels, i.e. word-to-mouth. Kampmann (2014) also highlights the importance of interpersonal communication in order to change behaviors although he does mention that this process could be slow and unpredictable in the start.

Lindmark (2006) states that complementary systems can be essential for the diffusion of a product and Schilling (2005) argues for that several technologies become valuable for many users due to complementary resources. Additionally, Gabriel and Lang (1995) mentioned that complementary resources could give social meaning to a product. What a complementary system or resource could be for a Zbee is unclear but one could argue that roads built specific for SEVs or other subsidies such as possibility to drive in the bus lane or specific and free parking spaces could be examples.

Nyhus (2014) specifically expressed that he believed that the electric fuel is the future and that he thinks politicians have a great potential affecting the diffusion of such products and should therefore do whatever they can. However, he also mentioned that politicians in the long run couldn't do things that are not rooted among the voters, which suggests that subsidies and projects that could add complementary resources probably are far away. McKinsey (2012) suggests it is not always most efficient with big monetary savings, like tax reductions, for the consumer to adapt to a more sustainable vehicle but it could be other initiatives like special roads or parking spots that are valued higher. This can be also be seen from the questionnaire that the possibility of easy parking was perceived as a great advantage.

Further on, in McKinsey quarterlies report from 2012 investigating the market for EV's are education and communication brought up as important factors to make more consumers interested. As the SEV segment is not only representing a new technology but also a new usage area will the need for communication and education probably be even more important to make people overcome their cognitive lock-ins.

Lastly, another thing that could speed up the diffusion would be if some radical innovation greatly increased the performance and price of batteries, which would lower the total cost of ownership as well as adding utility leading to that no subventions at all would be needed (Johansson, 2014). As Gizmag (2014) and The Guardian 2014 mentions new batteries with way better performance are being developed.

## 8 Results: SEV prestudy

In order to analyze the diffusion of small electrical vehicles in the Gothenburg area a literature study as well as a case study and a self-completion questionnaire have been conducted. The findings from the study were presented and then discussed in relation to the theory in the previous chapters. The main points of interest are described here in a concise form.

- A successful diffusion of Zbee or similar SEV's would most likely be a step in the right direction, if it substitutes cars on short distances and not e.g. walking and cycling, to reverse the negative trends in phase 1 and work as a brick to a transition to a more sustainable society. This is due to the very high energy efficiency and a higher utilization per vehicle.
- The Zbee is a vehicle that not only represents a different technology but also in many aspects addresses a *new market segment*, which implies higher barriers than for a "normal" EV. The SEV does not replace the car in all use cases; other vehicles could also be substitutes as well as complements.
- *The relative advantage* is the single most important factor whether a product/service/technology will diffuse or not. It is further subjective and thus the perceived relative advantage that is relevant. This creates both opportunities and barriers for Zbee. It has been shown that Zbee holds a completely different set of utilities compared to other vehicles. However, in Gothenburg problems such as congestion and pollution are almost not prominent making some utilities of the Zbee insignificant relative to the car. Additionally, behavioral aspects and cognitive lock-ins such as the strong car dependency and that the car is seen as a freedom symbol in the western world do most likely have a negative impact on the overall perceived relative advantage. The Zbee is also perceived as being less safe than e.g. a car which could be a rather big drawback since safety is rated so highly in Gothenburg. However, the high environmental awareness in Gothenburg could eventually lead to a changed buying behavior and thus a higher overall perceived relative advantage. Additionally, the travelling pattern of the inhabitants fit well with the properties of the Zbee and easy parking is highly valued.
- *Behavioral aspects and values* are more important in the short run than technical improvement, unless something radical happens.
- *Complementary systems and resources* can be essential for the diffusion of a product and give meaning to it. Special roads, parking spots and possibilities to drive in bus lanes are example that could help the diffusion of the Zbee.
- *Finding the correct business model* in order to add value and thus increase the relative advantage and finding innovators and early adopters in a niche market is a key feature for a successful diffusion of the Zbee. It has been suggested that the Zbee probably

should not be sold as a good but rather use an alternative business model and e.g. be sold as a service in a larger pooling fleet where the Zbee can be used for urban areas and short distances. The Zbee could also be connected to the public transportation system and thus creating a more complete transportation system where it is sold as a service to the end customer.

- *The customer segmentation* could focus on young environmental townspeople with no driver's license since it is a growing group that probably would be able to perceive more of the relative advantages of the Zbee. Additionally, the compatibility would possibly be higher as well. Another niche market has been suggested to be craftsmen operating in an environment where there are not allowed to drive, however policies and laws might make the Zbee redundant from safety aspects.
- Since the Zbee is *a preventive innovation* it is likely that it holds a low overall relative advantage and will suffer from a slow rate of adoption. Additionally, this type of innovation normally has a hard time capturing value but could lead to positive environmental effects as well. However, it is probably a better idea to use energy efficiency and the low costs as selling points. In order to speed up the diffusion of a preventive innovation Rogers (1995) five strategies could be used.

## 9 Conclusion: SEV prestudy

As shown in the discussion there are both barriers and opportunities for the SEV diffusion in the Gothenburg area. Among the opportunities are the increasing environmental awareness and new vehicle features that is valuable in especially urban environment but also the aspect of favorable driving habits. These factors create the opportunity for SEV's to start growing within niche markets. The barriers on the other hand are among others a strong tradition of car driving and cognitive lock-ins limiting people's tendency to try new modes of transport. The behavioral aspect has been identified as important and is currently seen to act mostly as a barrier. Also the SEV's new alternative features could be a disadvantage since it is harder to communicate the utility due to problems such as congestion and local emissions are not demonstrated in the Gothenburg area at the same degree as in other parts of the world. Additionally, the infrastructure in the Gothenburg area favors other types of transportation and policies such as safety regulations also act as a barrier in some potential niches.

For the SEV to diffuse it is essential to create a higher perceived relative advantage than other transport alternatives. One mean of achieving a higher perceived value is to find the right business model to approach early adopters and innovators in order to build up a customer reference base. Additionally, a focus on other factors than positive environmental effects, such as cost savings and higher energy efficiency, would be preferable due to the nature of preventive innovations. However, there are theories on how to speed up the diffusion of preventive innovations, where Rogers five points theory could be useful. To overcome the barriers of habit and values are communication and education important tools. Other suggestions for speeding up the diffusion process are to implement some perks for SEV consumers' consisting of complementary systems and resources such as free parking and specific roads. Adapting the infrastructure for this new type of vehicle will expand the value network for the SEV.

Despite many barriers at the moment there are most likely potential niche markets in the Gothenburg area. However, they are so far limited and a further diffusion is likely to be more dependent on behavioral aspects and values rather than technological advances. However, if the battery development radically advances vehicles such as the Zbee will greatly increase its utilities and the relative advantages making diffusion less troublesome.

This thesis has the potential of being used as a prestudy for companies as well as for politicians and organizations that are interested in fostering the SEV diffusion and want to dig deeper down than this report that just have scratched on the surface. The reason for this report just scratching on the surface is due to the very general approach on both theory and empirical findings. However this fit the purpose of being a prestudy, but it could be argued that the findings might had been more interesting if one specific area was chosen instead.

One drawback with this investigation would be the rather low amount of interviewees compared to the theory and more interesting facts would most likely have been revealed with more interviews. This would have improved the quality of the report. It would have been



especially interesting to interview potential customers in the potential niche markets that were identified in order to see if the ideas had any bearing.

For further studies in this subject it would be valuable to dig deeper down into alternative business models using an iterative business model canvas approach. This would more likely reveal if there really are niche markets in the Gothenburg area as well. Additionally it would be beneficial to compare this case study of CleanMotion with case studies of similar companies and products. This would also reveal what properties that are viable for an SEV and together with an iterative business model canvas viable properties for different niche markets could be revealed. Studies digging deeper into the complexity, trialability, observability, compatibility as well as value networks and complement resources and systems would also be interesting since this report mostly had the relative advantage in focus.

## 10 References

- Allwood, J., Ashby, M., Gutowski, T. & Worrell, E. 2011 Material efficiency: a white paper. Resources, Conservation, and Recycling, 55, 362–381.
- Asian Development Bank, 2009. The Economics of Climate Change in Southeast Asia : A Regional Review,
- Adner, Ron. "Match your innovation strategy to your innovation ecosystem."Harvard business review 84.4 (2006): 98.
- Atkisson, A. 2011, The sustainability transformation: how to accelerate positive change in challenging times, Earthscan, Washington, DC; London.
- Bowen, G.A. 2009, "Document Analysis as a Qualitative Research Method", Quality Research Journal, vol. 9, no. 2, pp. 27-40.
- Christensen, C. & Bower, J (1995) "Disruptive Technologies: Catching the Wave", Harvard Business Review, Jan-Feb.
- Brundtland, Gro Harlem. 1987. Report of the World Commission on Environment and Development: Our Common Future. Technical report. New York.
- Bryman, A., & Bell, E. (2011). Business Research Methods 3e. Oxford university press.
- Cairns, John. 1999. "Assimilative capacity – the key to sustainable use of the planet." Journal of Aquatic Ecosystem Stress and Recovery 6:259–263.
- Chesbrough, Henry. "Business model innovation: opportunities and barriers."Long range planning 43.2 (2010): 354-363.
- Chesbrough, Henry, and Richard S. Rosenbloom. "The dual-edged role of the business model in leveraging corporate technology investments." Taking Technical Risks: How Innovators, Managers, and Investors Manage Risk in High-Tech Innovations 57 (2003).
- Christensen, Clayton. The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business Review Press, 2013.
- Christensen, C. & Rosenbloom, R. 1995, "Explaining the attackers advantage: Technological paradigms, organizational dynamics, and the value network", Research Policy, Vol. 24, no. 2, pp.233-257.
- Climate Change 2013: The Physical Science Basis", Climate Change 2013: The Physical Science Basis
- Clean Motion (2013) <http://cleanmotion.se/2013/11/zbee-wwf-climate-solver-award-winner-2013> (2014-04-20)
- Crompton, T., 2010. Common Cause: The Case for Working with our Cultural Values,

- Dean, T. 2014, "Replacing GDP with a measure that matters", *Charter*, vol. 85, no. 4, pp. 24.
- Denzin, N. K., & Lincoln, Y. S. (2000). *The discipline and practice of qualitative research. Handbook of qualitative research*, 2, 1-28.
- Dosi, Giovanni. "Technological paradigms and technological trajectories: a suggested interpretation of the determinants and directions of technical change." *Research policy* 11.3 (1982): 147-162.
- Dreborg, K. H., 1996. *Essence of Backcasting*, *Futures*, 28, 813-828
- Eriksson, L.T. & Wiedersheim-Paul, F. (2008). *Rapportboken: hur man skriver uppsatser, artiklar och examensarbeten*. (1. uppl.) Malmö: Liber.
- Floyd, J.A. (1993). The use of across-method triangulation in the study of sleep concerns in healthy older adults. *Advances in Nursing Science*, 16(2),70-80
- Döös, B.R., 2002. Population growth and loss of arable land. *Global Environmental Change*, 12(4), pp.303–311.
- European Commission. 2001. *White paper: European transport policy for 2010*. Brussels.
- Fischer, G., van Velthuisen, H. & Nachtergaele, F.O., 2000. *Global agro-ecological zones assessment: Methodology and results*,
- Forza, C. (2002) *Survey research in operations management: a process-based perspective*. *International Journal of Operations & Production Management*, Vol. 22, No. 2, pp. 152-194.
- Friedman, Milton. "Introduction to" *A Theory of the Consumption Function*." *A theory of the consumption function*. princeton university press, 1957. 1-6.
- Geels, F. 2012, "A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies", *Journal of Transport Geography*, vol. 24, pp. 471-482.
- Geels, F.W. 2002, "Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study", *Research Policy*, vol. 31, no. 8, pp. 1257-1274.
- Geels, Frank W. 2014 "Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective." *Theory, Culture & Society*
- Gizmag, (2014) <http://www.gizmag.com/dual-carbon-fast-charging-battery/32121/>
- Goodwin, P. (2012) *Providing road capacity for automobility: the continuing transition*. In: Geels, F.W., Kemp, R., Dudley, G., Lyons, G. (Eds.), *Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport*. Routledge, New York, pp. 140–159.
- Goleman, D., 1998. *What Makes a Great Leader?* *Harvard Business Review*.

Granados Tapia, J. a., Ionides, E.L. & Carpintero, Ó., 2012. Climate change and the world economy: short-run determinants of atmospheric CO<sub>2</sub>. *Environmental Science & Policy*, 21, pp.50–62.

Granstrand, O. 1999, *The economics and management of intellectual property: towards intellectual capitalism*, E. Elgar, Northampton, Mass; Cheltenham, UK.

Hall, B.P. et al., 1994. *The Hall-Tonna Inventory of Values*, Behaviordyne, Inc.

Hensley, Newman & Roger (2012) Battery technology charges ahead. *McKinsey Quarterly*, July

Hinds, P.S. (1989). Method triangulation to index change in clinical phenomena. *Western Journal of Nursing Research*, 11(4), 440-447.

Hooke, R.L., Martin-Duque, J.F. & Pedraza, J., 2012. *Land transformation by humans: A review* 22nd ed., GSA Today.

Holmberg, J. 2014. Challenge Lab at Chalmers — Transformative learning and leadership for a sustainable future. To be published in: Corcoran, Peter Blaze and Brandon Hollingshead (Eds.). *Intergenerational Learning and Transformative Leadership for Sustainable Futures*. Wageningen, The Netherlands: Wageningen Academic Publishers, 2014.

Holmberg, J. 2014. Challenge Lab at Chalmers — Transformative learning and leadership for a sustainable future. To be published in: Blaze Corcoran P. & Wals A. (Eds.) (2004). *Intergenerational Learning and Transformative Leadership for Sustainable*. Wageningen Academic Publishers. 2014.

Holmberg, J. and Robèrt, K.-H. 2000. Backcasting — a framework for Strategic Planning. *Int. J. Sustain. Dev. World Ecol.* 7, 291-308

Holmberg, J. 1998. Backcasting — a natural step when operationalising sustainable development. *Greener Management International*. — the *Journal of Corporate Environmental Strategy and Practice*. Issue 23: 30-51. (Autumn 1998)

Holmberg, J., Robèrt, K.-H. and Eriksson, K.-E., 1996. Socio-ecological principles for sustainability. In: Costanza, R., Olan, S., and Martinez-Alier, J. (ed.), *Getting Down to Earth — Practical Applications of Ecological Economics*, International Society of Ecological Economics, Island Press. Washington DC.

Holmberg, J., 1995. *Socio-Ecological Principles and Indicators for Sustainability*, Ph.D. Thesis, Institute of Physical Resource Theory, Chalmers University of Technology and Göteborg University, Göteborg, Sweden.

Issacs, W. (1999). *Dialogue and the Art of Thinking Together: A pioneering approach to communicating in business and in life*. Doubleday.

Jewell-Larsen, S., & Sandow, D. (1999). *Personal Development: The Key to Change Acceleration in Global Operations*. Association for Manufacturing Excellence, 15-19.

Kotter, John P. 2001. "What leaders really do.(Managers promote stability while leaders press for change)(A reprint of a 1990 article)." Harvard Business Review 79 (11): 85–98.

Kwantes, C. T., & Boglarsky, C. A. (2006). Organizational cultures across national boundaries: Results of a cluster analysis. *Applied Multivariate Research*, 12, 107-124

Lekvall, P, Wahlbin, C, Frankelius, P & Institutet för högre marknadsföringsutbildning (2001). Information för marknadsföringsbeslut, IHM Publ, Göteborg.

Liedtka, J. M.: 1989, 'Value Congruence: The Interplay of Individual and Organizational Value Systems', *Journal of Business Ethics* 8, pp. 805-815.

Le Quéré, G. et al., 2013. Global Carbon Budget 2013. *Earth System Science Data Discussion*, (November).

Liddle, Brantley. 2012. "OECD Energy Intensity: Measures, Trends, and Convergence." *Energy Efficiency (Melbourne)* 5 (4): 583–597.

Linder, M. (2013) *Capturing Value from Green Offers – An Examination of Environmental Differentiation and Economic Performance*. Göteborg : Chalmers University of Technology

Lucas Jr, Henry C., and Jie Mein Goh. "Disruptive technology: How Kodak missed the digital photography revolution." *The Journal of Strategic Information Systems* 18.1 (2009): 46-55.

MacDuffie & Fujimoto (2010) Why dinosaurs will keep ruling the auto industry. *Harvard Business Review*, June

Magretta, J. 2002, *Why business models matter*, HARVARD BUSINESS SCHOOL PUBLISHING CORPORATION, United States

McKinsey Global Institute, 2013. *Resource Revolution: Tracking global commodity markets*,

Moore, G.A. 2008, *Crossing the chasm: marketing and selling technology products to mainstream customers*, Capstone, Chichester.

Neck, C.P. & ebrary (e-book collection) 2006, *Self-leadership*, Emerald Group Publishing Ltd, Bradford, England

Nelson, K. & Nelson, R.R. 2002, "Technology, institutions, and innovation systems", *Research Policy*, vol. 31, no. 2, pp. 265-272.

Nelson, Richard R., and Sidney G. Winter. "Evolutionary theorizing in economics." *Journal of Economic Perspectives* (2002): 23-46.

Näringsdepartementet. 2013. *Fossilfrihet på väg (Statens offentliga utredningar,2013:84)*. Technical report. Stockholm: Government Official Reports (SOU).

O' Reilly, C.A., J. Chatman and D. F. Caldwell (1991) People and organizational culture: A profile comparison approach to assessing person-organization fit, *Academy of Management Journal* 34(3), pp. 487-516.

Oldeman, L.R., Hakkeling, R.T.A. & Sombroek, W.G., 1991. World Map of the Status of Human-Induced Soil Degradation: An Explanatory Note,

Osterwalder, Alexander. "The business model ontology: A proposition in a design science approach." Institut d'Informatique et Organisation. Lausanne, Switzerland, University of Lausanne, Ecole des Hautes Etudes Commerciales HEC 173 (2004).

Pacheco D F, Dean T J and Payne D S. 2010. Escaping the green prison: Entrepreneurship and the creation of opportunities for sustainable development. *Journal of Business Venturing*. Vol. 25, No. 5: 464-480.

Peck, M., & Chipman, R. (2008). Industrial energy and material efficiency: What role for policies?. *asdf*, 333.

Pejl på partierna (2014) [http://pejl.svt.se/visualisering/politik/partisymptier-over-tid/#party=mp&indicator=\\_1829](http://pejl.svt.se/visualisering/politik/partisymptier-over-tid/#party=mp&indicator=_1829) (2014-06-26)

Posner, B.Z. & Schmidt, W.H. 1996, "The values of business and federal government executives: More different than alike", *Public Personnel Management*, vol. 25, no. 3, pp. 277

Prahalad, C. K., and Gary Hamel. "The core competence of the corporation." *Boston (MA)* (1990): 235-256.

REKACEWICZ, P. (2002): Degraded soils. UNEP/GRID-Arendal Maps and Graphics Library. 20.05.2010

Pässilä, A., Oikarinen, T. & Kallio, A. 2013, "Creating dialogue by storytelling", *Journal of Workplace Learning*, vol. 25, no. 3, pp.159-177.

Radtke et al (2012) Profiling Japans early EV adopters. *McKinsey Quarterly*, August

Ramankutty, N. et al., 2008. 1. Geographic distribution of global agricultural lands in the year 2000. *Global Biogeochemical Cycles*, 22, pp.1–19.

Riley, R.Q. & Chee, W. 2004, *Alternative cars in the 21st century: a new personal transportation paradigm*, SAE International, Warrendale, Pa.

Robèrt, K.-H. et al., 1997. A compass for sustainable development. *International Journal of Sustainable Development & World Ecology*, 4(2), pp.79–92.

Robèrt, Karl-Henrik, B. Schmidt-Bleek, J. Aloisi de Lardere, G. Basile, J.L. Jansen, R. Kuehr, P. Price Thomas, M. Suzuki, P. Hawken, and M. Wackernagel. 2002. "Strategic sustainable development — selection, design and synergies of applied tools." *Journal of Cleaner Production* 10, no. 3 (June):197–214.

- Rogers Everett, M. (1995). Diffusion of innovations. New York.
- Ryan, RM, and EL Deci. 2000. "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions." Contemporary educational psychology 25, no. 1 (January): 54–67.
- Sahin, K. & ebrary (e-book collection) 2009, Measuring the economy: GDP and NIPAs, Nova Science Publishers, Inc, Hauppauge, N.Y.
- Sandow, D. & Allen, A.M., 2005. The Nature of Social Collaboration: How Work Really Gets Done. The SoL Journal, 6(2), pp.1–13.
- Scandura, T. A., & Williams, E. A. (2000). Research methodology in management: Current practices, trends, and implications for future research. Academy of Management Journal, 43, 1248–1264.
- Shafer, Scott M., H. Jeff Smith, and Jane C. Linder. "The power of business models." Business horizons 48.3 (2005):
- Scharmer, C.O. & Books24x7, I. 2009, Theory U: leading from the future as it emerges : the social technology of presencing, Berrett-Koehler, San Francisco, Calif; London
- Schilling, M. A. (2005). Strategic management of technological innovation. Tata McGraw-Hill Education.
- Schilling, M.A. 2010, Strategic management of technological innovation, McGraw-Hill/Irwin, Boston.
- Schumpeter, Joseph Alois. The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle. Vol. 55. Transaction Publishers, 1934.
- Shergold, Ian, Graham Parkhurst, and Charles Musselwhite. "Rural car dependence: an emerging barrier to community activity for older people." Transportation Planning and Technology 35.1 (2012): 69-85.
- Stern, D.I., 2012. Energy and Economic Growth : The “ Stylized Facts .” In 35th IAEE International Conference. Perth, Australia.
- Sydsvenskan (2013) <http://www.sydsvenskan.se/sverige/farre-unga-tar-korkort/> (2014-06-26)
- Tamm, J.W., Luyet, R., Books24x7 - BusinessPro (e-book collection) & Books24x7, I. 2004, Radical collaboration: five essential skills to overcome defensiveness and build successful relationships, HarperCollins, Pymble, N.S.W., Australia; New York, N.Y.
- The Guardian (2014) <http://www.theguardian.com/technology/2014/jan/22/sugar-battery-green-powered-gadgets-three-years>
- Teece, David J. "Business models, business strategy and innovation." Long range planning 43.2 (2010): 172-194..

- Teece, D.J. 1986, "Profiting from technological innovation: implications for integration, collaboration, licensing and public policy", *Research policy*, vol. 15, no. 6, pp. 285-305.
- Thurmond, V.A. 2001, "The point of triangulation", *Journal of nursing scholarship : an official publication of Sigma Theta Tau International Honor Society of Nursing / Sigma Theta Tau*, vol. 33, no. 3, pp. 253-258
- Tripsas, M. 1997, "Unraveling the Process of Creative Destruction: Complementary Assets and Incumbent Survival in the Typesetter Industry", *Strategic Management Journal*, vol. 18, no. S1, pp. 119-142.
- United Nations, 2001. World population monitoring 2001,
- United Nations, 2012. Probabilistic Population Projections
- US Census Bureau, 2011. International Data Base World Population Growth Rates: 1950-2050, Available at: <https://www.census.gov/population/international/data/idb/worldgrgraph.php>.
- Val (2014), <http://www.val.se/val/ep20al14/slutresultat/E/kommun/14/80/index.html>
- Wackernagel, M. et al., 2002. Tracking the ecological overshoot of the human economy. *Proceedings of the National Academy of Sciences*, 99(14), pp.9266–9271.
- Wendelheim, A. 1997, Effectiveness and process in experiential group learning: comparing a process-directive encounter group (PEG) and a self-directive study group (SSG) approach, Univ Stockholm, Stockholm.
- World Bank, 2014. World Development Indicators.
- WWF (2013) <http://www.wwf.se/press/pressrum/pressmeddelanden/1543317-ultraltt-elbil-och-smart-teknik-fr-solpaneler-och-geoenergi-prisas> (2014-04-20)

## **10.1 Short list of Interviewees**

- Hans Folkesson, Chairman and co-founder Clean Motion, 2014-05-13
- Christian Erik Kampmann, associate professor innovation and organization economics, CBS, 2014-06-02
- Johan Nyhus, politician in traffic committee, Gothenburg municipality, 2014-05- 23
- Magnus Johansson, postdoc at Lund Institute of Economic Research, Standardization Research Centre, 2014-05-20
- Marcus Linder, researcher at the Victoria Institute within circular business model, 2014-06-05



## 11 Appendix 1: List of the C-Lab student participants 2014

C-lab participants 2014		
Name	Education	Nationality
Per Härdfeldt	MSc. Managment & Economics of Innovation	Sweden
Daniella Mendoza	MSc. Industrial Ecology	Mexico
Burak Sen	MSc. Industrial Ecology	Turkey
Diana Valadez	MSc. Industrial Ecology	Mexico
Cecilia Hult	MSc. Complex Adaptive Systems	Sweden
Prashanth Sekhar	MSc. Managment & Economics of Innovation	India
Per Bergström	MSc. Managment & Economics of Innovation	Sweden
Johanna Hanson	MSc. Managment & Economics of Innovation	Sweden
Sebastian Ilves	MSc. Interaction Design & Technologies	Sweden
Benjamin Lillandt	MSc. Interaction Design & Technologies	Finland
Zhiyu Olivia Tang	MSc. Supply Chain Management	China
Andreas Lehner	MSc. Sustainable Energy Systems	Austria

## **12 Appendix 2: Full list of interviewees**

### **Hans Folkesson**

Is the co-founder and chairman of Clean Motion, the producer of the electrical vehicle Zbee. He is a strong believer in the future for electric vehicles although he has a long and solid background in the traditional vehicle industry where he worked within development in companies like Saab, Skoda, Volvo cars and Volvo trucks. Currently, apart from the work connected to Clean Motion, is Folkesson working as a consultant. He has been part of starting the project "Svenskt Hybridcentrum" and could also be linked to the project Test Site Sweden that is a testing ground for electrical vehicles and connected infrastructure.

### **Christian Erik Kampmann**

Is associate professor at the department of innovation and organizational economics at Copenhagen Business School. With an engineering degree from DTU and a Ph.D. in management from MIT is Kampmanns current research much focusing on the transition to clean energy within transportation. His areas of research are system dynamics, sustainable energy development, green urban mobility and electric mobility.

### **Magnus Johansson**

Currently postdoc at Lund Institute of Economic Research, Standardization Research Centre and has an educational background within economics and holds a Ph.D. in Business administration from the School of Economics and Management, Lund University. His research is mainly focusing on value creation, business models and knowledge management in relation to network effects and innovation. Has additional experience from industry where Johansson has been working in the telecom and automotive industries within the area of strategic analysis.

### **Marcus Linder**

Holds a Ph.D. from Chalmers University of technology where he is active within the institution of Management and Economics of Technology as well as Chalmers Centre for Business innovation. Linders area of research is business model and strategies for green innovations and his dissertation was on the subject of how to make profit of green products and services by creating environmental value. In addition is Linder also working on projects concerning circular business models at the Victoria Swedish ICT.

### **Johan Nyhus**

Is a social democrat and chairman for the Gothenburg municipalities traffic committee responsible for questions concerning traffic, infrastructure, land usage and buildings. Have also additional assignments as member of the municipality government, member of the board of Johanneberg Science Park and "Stiftelsen Chalmers teknikpark". He is also an advocate for Gothenburgs congestion tax in the ongoing debate.

### **Maria Grahn**

Grahn is currently head of division and project coordinator at the institution of Energy and

Environment at Chalmers University of Technology. Her main research area are energy system analysis, where her research aims at reducing CO2 emission through enable more cost efficient solutions for biomass usage. Grahn has extensive knowledge about alternative fuels and has anticipated different effects on the global energy system through modeling.

**Axel Edh**

Senior Strategic Advisor Environment at Volvo Car Cooperation with a solid background within the company. Holds an MSc in Energy and Fluid Dynamics from Chalmers University of Technology and has for many years within VCC held positions connected to environmental strategies.

**Thomas B Johansson**

Has on initiative from the Swedish government prepared strategies on how to reach a fossil free vehicle fleet in 2030. Is professor emeritus at Lund University, the International Environmental Institute, and has a background as nuclear scientist. Johansson is now known as an expert within environment and energy. Has been leader for the energy unit at UNs development program (UNDP.T) and is Co-Chairman in the Executive Committee of Global Energy Assessment.

**Göran Carstedt**

Has a Ph.D. in Economics and is known for his expertise within leadership and organizational learning. Carstedt has been active both within industry and academia. Currently he is working as consultant and advisor for organizations all over the world as well as being chairman or member of several boards. Previously has Carstedt held leading position within Volvo, IKEA and Clinton Climate Initiative and was one of the founders of SOL - the Society for Organizational Learning at MIT.

**Dominic von Martens**

Is the founder of the organization Selfleaders and is currently teaching in the areas of self-leadership, values, behavior management control and case solving at KTH. He holds both a MBA from Stockholm School of Economics and an MSc from KTH and has experience from industry in the companies McKinsey & Co and eBay.

**Martin Sande**

Is working as creative leader, management consultant and facilitator of dialogue at Preera. Has worked both within the public and private sector and is specialized within the areas of collective learning and development.

### 13 Appendix 3: Design of the self-completion questionnaire

#### Enkät angående transportsätt och preferenser vid vardagliga resor

Hej!

Tack för att Du vill hjälpa oss med vårt examensarbete! Vi kommer att lotta ut ett antal trisslotter till dem som svarar och vill vara med på utlottningen. Undersökningen tar bara några minuter och alla frågor besvaras med hjälp av flervalsalternativ.

Enkäten innehåller frågor om dina vardagliga resor samt vilka attribut som är viktiga för det transportsätt som Du gör dessa vardagliga resor med. Målet med den här enkäten är att den ska fungera som en del av underlaget till vår undersökning om en framtida spridning av mindre elfordon.

Inga frågor är obligatoriska att svara på, så är det någon du inte kan eller vill svara på går det att hoppa över dessa.

Vill du veta mer om vår undersökning eller har synpunkter så tveka inte att skicka ett mail till [diffusionsevr@outlook.com](mailto:diffusionsevr@outlook.com)

Kön

- ☐ Man
- ☐ Kvinna

Årsinkomst

- ☐ 0 - 100 000
- ☐ 100 000 - 250 000
- ☐ 250 000 - 400 000
- ☐ 400 000 - 600 000
- ☐ 600 000+
- ☐ Vill ej uppge

Bor du inne i en stad?

- ☐ Ja
- ☐ Nej

Ålder

- ☐ 16 - 25
- ☐ 26 - 35
- ☐ 36 - 45
- ☐ 46 - 55
- ☐ 56 - 65
- ☐ 66+

Vilka typer av transportmedel använder du dig framför allt av för dina vardagliga resor

- ☐ Bil
- ☐ Motocykel
- ☐ Cykel
- ☐ Kollektivtrafik
- ☐ Moped
- ☐ Övrigt

Vilka är anledningarna till varför du använder just dessa transportsätt?

Vid övrigt skriv gärna in ditt svar nedanför

- ☐ Billigt
- ☐ Bekvämt
- ☐ Snabbaste alternativet
- ☐ Miljövänligt
- ☐ Kräver inget körkort
- ☐ Övrigt

Övrigt

Hur lång är en genomsnittlig vardaglig resa?

Svaren är i Km

- ☐ 0-5
- ☐ 5-20
- ☐ 20-50
- ☐ 50+

Om du åker bil, hur många personer brukar befinna sig i bilen vid en genomsnittlig resa?  
inklusive förare

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4+

Om du idag skulle köpa ett fordon för att använda till dina vardagliga resor hur viktiga skulle nedanstående egenskaper vara då?

**Låg driftskostnad**

Kostnad per mil

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Viktigt

**Maxhastighet**

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Viktigt

**Lastningskapacitet**

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Viktigt

**Säkerhet**

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Viktigt

**Låg miljöpåverkan**

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Viktigt

**Lågt Inköpspris**

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ Viktigt

Tillverkarens anseende på marknaden

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ viktigt

Bekvämlighet

T.ex. Sköna sätet, AC, ljudsystem

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ viktigt

Enkel att parkera samt enkelt att hitta parkeringsplatser

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ viktigt

Förmåner såsom möjlighet att köra i bussfiler och slopad trängselskatt

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ viktigt

Är det viktigt för dig att ditt fordon matchar din personlighet?

☐ Ja

☐ Nej

Hur viktigt skulle det vara att ditt fordon för vardagliga resor utstrålar social prestige?

1 2 3 4 5 6 7 8 9 10

Oviktigt ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ viktigt

Vilket fordon skulle Du ranka som mest intressant med tanke på dina vardagliga resor

	Fordon 1	Fordon 2	Fordon 3
Inköpspris	350 000 Kr	70 000 Kr	170 000 Kr
Kostnad per mil	37 Kr	40 öre	20 Kr
Maxhastighet	250 Km/h	45 Km/h	200 Km/h
Kräver körkort	Ja	Nej	Ja
Koldioxutsläpp per mil	140g	0	115g
Räckvidd innan tankning/laddning	150 mil	5 mil	160 mil

☐ 1

☐ 2

☐ 3

Vill du vara med i utlottningen av trisslotterna?

Skriv ner din email så kontaktar vi dig ifall du hör till vinnarna