On the current drivers of Electric Vehicle adoption in Norway

A quantitative look at the impact of incentives

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Foreword

Renewable energies have always been a passion of mine. It is one of the main reasons I chose Norway as a location to study. Norway is on the forefront of the world in regards to clean energy production and use. I am constantly inspired by the success of initiatives aimed at reducing the carbon footprint and hope to bring much of this enthusiasm and drive forward with me in my career.

Electric vehicles have been particularly in my attention over the past few years as they have begun to appear everywhere around Oslo. Since the grid in Oslo in almost completely powered by renewable energies, the carbon footprint of these cars in almost zero. And the adoption of the technology here has been stellar compared to the rest of the globe. I have followed the growth of this industry for a few years now and am interested in doing my part in its success.

This project would not have been possible without the help of two very special supervisors. I would first like to extend my gratitude to Birthe Soppe for her hard work, her patience and for her inspiration. Without her guidance it is likely that none of these insights would have been possible. I would also like to thank Tommy Høyvard Clausen for his support and expertise, especially in the analysis of the data. I would finally like to say thank you to family, friends and especially my girlfriend who supported me through late nights and long days in delivering this on time. All of your support has been invaluable.

Table of Contents

Table of Figures

Table of Tables

Abstract

BACKGROUND: Many governments around the world have recognized the role that electric vehicles can play in creating a more sustainable transportation sector. For this reason, we have seen an explosion in sales of electric vehicles worldwide followed by a plethora of academic articles aiming to discover the major drivers behind this adoption. There have been very few quantitative studies on the effects of these drivers.

OBJECTIVE: Despite financial incentives being offered to EV owners in Norway since the late 1990's, adoption of electric vehicles was extremely sluggish until the year 2010 where sales spiked dramatically. Even then, there was significant variation between the municipalities regarding adoption. It is the goal of this project to determine quantitatively what factors contributed to this adoption rise and to what degree.

METHOD: This project uses panel data analysis with fixed effects and robust error terms to determine the relationship between the number of electric vehicles in each municipality and a number of possible independent/control variables. In this manner, we were able to determine not only which factors play a part in motivating citizens to adopt EVs, but also the degree to which they influence them. In addition, this method excludes the effects of time invariant factors.

RESULTS: It was found that in each municipality, the number of charging stations per person, the number of votes for the greens party, municipality spending on sports per capita, median income and the number of people employed in high tech jobs were all positively and significantly correlated with the dependent variable. The number of nearby EV's and the density of the population were not significant in explaining EV adoption.

CONCLUSION: The number of people employed in high tech jobs and the numbers of votes for the greens party were found to have the strongest impact on the dependent variable but are difficult factors for municipalities to control directly. Hence, cities that have high rates of both these factors are prime locations to incentivise EV's. Building charging infrastructure to reduce mental barriers blocking EV adoption was found to be the most efficient way to do this. It must be noted however that many of these factors should be implemented together in order to maximize the 'relative advantage' as stated by Rogers and hence receive the maximum benefit.

1.0 Introduction,

This current research project provides a quantitative analysis of the drivers for electric vehicle (EV) adoption in Norway. Several previous studies have looked into the motivations for purchasing EV's as well as the barriers standing in the way of their adoption in the past, yet very few have attempted to measure quantitatively the effectiveness of current incentives, financial or otherwise. The goal of this research project is to determine the different factors that cause variation in the adoption rates between the municipalities of Norway. In doing this, it is my hope that policy makers, as well as environmentally concerned organizations, will be better equipped to use their resources in the most efficient way possible when promoting EV adoption.

As I mentioned, this analysis focuses on the drivers behind the *variation* in EV adoption in the municipalities of Norway. It quickly becomes clear that the spike in adoption that occurs around 2009-2010 is most likely related to an increase in infrastructure, increases in efficiency/power/performance and selection of EV's on the market and an increase in legitimacy for the technology in the media. However, even though all of these factors are likely to affect all the municipalities in Norway, we still observe a large variation in adoption rates between the different municipalities. Determining what causes *this* variation will be the prime role of this investigation.

To measure the variation in datasets over a given time period and for many municipalities, OLS regression analysis using SPSS was inappropriate. This method is limited to cross sectional analysis and hence in unable to measure the variation across time of the variables as is required. In order to do this analysis correctly, an analysis of longitudinal data is required. This necessitated the use panel data using a statistical program called stata. This method of analysis allowed us to measure the effects of the independent variables across time, ignoring time invariant factors.

The introduction begins with some insights into my motivations for conducting this research. Next, some context is provided by offering some background on the EV industry, explaining the current situation as well as some detail about how the market in Norway has evolved into what we have today. Next is a discussion of some of the problems and questions that arise from inspecting the market and this is followed by stating the research question and the objectives of this analysis. The introduction is concluded with a brief overview of the rest of the paper.

1.1 Motivation

The overall motivation behind this research project is to increase the adoption rates of electric vehicles in Norway and hopefully in other countries. A transition from internal combustion engines (ICE's) towards electric vehicles is a vital step in reducing humanities carbon footprint, particularly in Norway where yet a large percentage of CO2 is emitted from regular cars. A switch to EV's would result in almost a 100% reduction in CO2 from those vehicles as the vast majority of electricity from the grid (96%) is generated from renewable sources. Literature on the topic of electric vehicles usually has the intent on helping make the process of EV adoption more efficient and hence speeding it up. This is also the motivation of this project.

From an academic point of view, the motivation behind this research project is to provide further support to the theory of diffusion of technology and institutional theory and the role they play in the adoption of new technologies. The test case for this project is the Electric vehicle industry in Norway which has been constantly reinforcing the legitimacy of the technology for the past two decades. In addition to this, the hope is that by quantifying the degree to which certain initiatives and social factors are successful in increasing adoption rates, policy makers will be able to better allocate their resources and maximize the diffusion of EV's into the market.

1.2 Background

Environmental issues have been a growing element of each nation's political discussion over the last century. Within this debate, the impact of vehicles is a particularly hot topic as, in major industrial countries, pollution generated by transportation generally averages more than 15% of a nation's total emitted pollution (Intergovernmental panel on Climate Change, 2014). In Norway, air pollution from cars still contributes over 10 million tonnes (more than 18% of the national total) of greenhouse gasses each year. It is the 3rd largest source of pollution from the country. In response to this, lobbying efforts from Norwegian associations such as Zero and Bellona have been promoting electric vehicles as a replacement to (ICE's) since the early 1990's. Since then, legislation and public awareness promoting electric vehicles has risen sharply and Norway has become the world leader in adoption of Electric vehicles per capita (see figure 1, (Opplysningsrådet for Veitrafikken, 2015)).

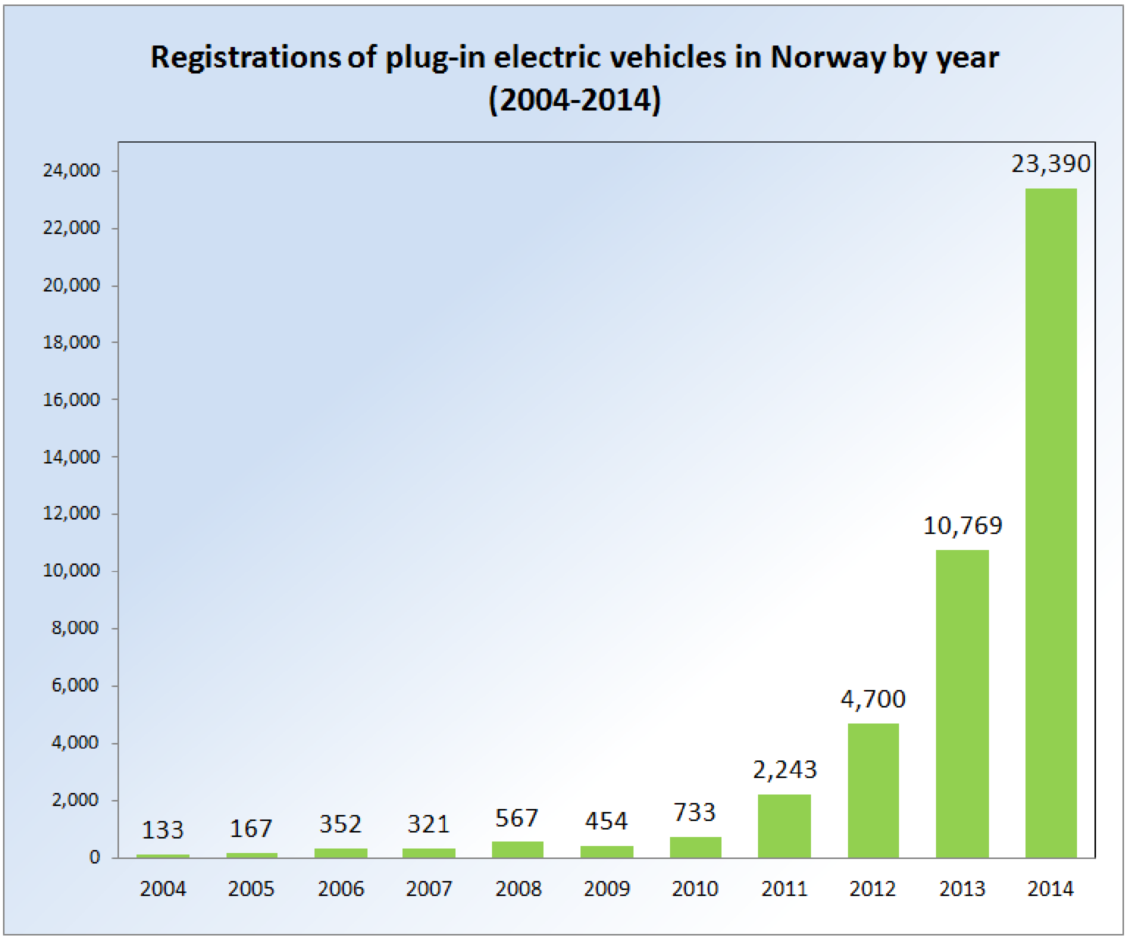

Figure 1- Yearly registrations of PEV's in Norway. Source: Norwegian road federation

Two major incentives have been credited with making such an achievement possible; the government's incentive scheme for EV's and the establishment of Transnova, a government organization which supports the development of charging infrastructure financially and otherwise. Whilst many countries have incentive schemes for electric vehicles, Norway's are seen as some of the most generous (Overgaard, 2014). These benefits include among others no purchase tax, exemption from 25% VAT, no charge on toll roads, free parking, free charging and free access to public transport lanes. These incentives are due to be revisited in 2017 or after the sale of 50,000 electric vehicles (more than 55,000 EV's have been registered as of the beginning of May 2015 (Gronnbil, 2015)). On the infrastructure side of the equation, Transnova has enabled the construction of one of the most comprehensive and dense charging networks in the world with over 6,500 charging stations available (the vast majority of them being free for use by the public). Both the incentive scheme and Transnova will be discussed in more detail in the coming sections. In addition to these major initiatives, a number of other factors have been attributed to this increase in sales. These include other relatively smaller initiatives (financial or otherwise), actions of associations such as ZERO, the rising price of fuel the influence of the media on public perceptions, the increased exposure to electric vehicles being used, the increase in average education of the population, the increase in wages, the culture of a community and the introduction of more cost effective and higher performance electric vehicles such as the Nissan leaf and the Tesla series.

Before we discuss the problem at the centre of this research project, it is necessary to take a quick look at the timeline of these initiatives and possible drivers. Figure 2 shows that the beginning of the EV movement in Norway began in 1989 (Breivik & Volder, 2014). Some notable years from the figure are the introduction of the permanent abolishment of the import tax for EV's and reduced registration tax in 1996, the exemption from road tolls in 1997, free parking in 1999 and 0% VAT in 2000. Aside from gaining access to bus lanes in 2005, the next major initiatives to be introduced don't happen until Transnova is introduced in 2009 and charging infrastructure increases rapidly.

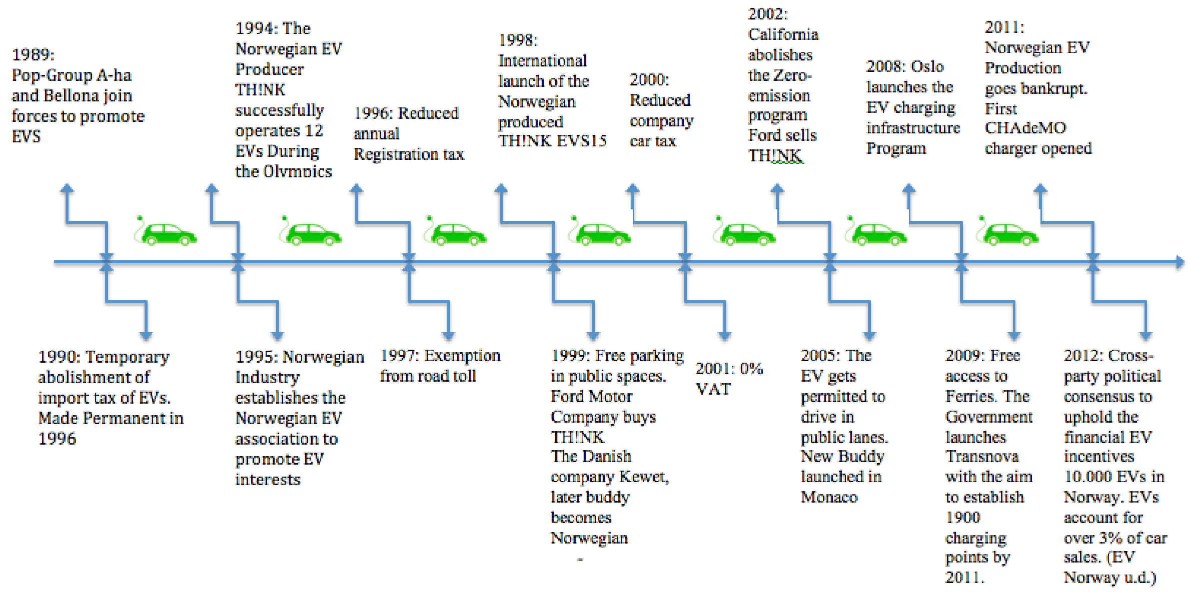

Figure 2- The development of EV policy and significant historical events in the Norwegian EV industry. Source: (Breivik & Volder, 2014)

Another notable figure is the timeline of the highest selling electric cars, their price and their performance. Table 1 below shows some examples of electric vehicles that have been popular over the last 17 years along with their release year, price, battery range and top speed. It must be pointed out that this list is not exhaustive. It does however help provide a little insight into the decisions faced by prospective EV buyers. Figure 3 highlights a few of the key insights a little more clearly. The green line represents an average price for the EV to which it corresponds on the X axis whilst the blue and red lines correspond to range and top speed respectively. The prices have been adjusted for inflation to correspond more accurately to the price of the modern EV's. They are also estimates averaged from prices found online.

We can see that both the range and top speed of electric vehicles has been increasing over time quite significantly (from sub 100 range and speed to well into the mid hundreds). The increase for range is particularly apparent and although the prices also appear to be rising, this is much less pronounced. Indeed, as we approach the modern EV's we see the price tend to become far more reasonable in comparison to the other 2 variables.

Year	Make	Model	Price	Range	Top Speed
1998	Peugeot	106	182,000	100	90
2000	Citroen	Saxo	174,000	80	100
2005	Buddy	Kewet	173,000	120	80
2008	Tesla	Roadster	850,000	400	200
2008	Th!nk	City	244,000	160	110
2010	Mitsubishi	I Miev	140,000	160	130
2011	Nissan	leaf	190,000	175	145
2011	Volkswagen	e up	190,000	160	130
2011	Volkswagen	e-Golf	246,000	190	140
2012	Tesla	Model S	511,000	480	210
2012	Renault	Twizy	91,000	100	80
2013	BMW	i3	250,000	190	150

Table 1- Comparison of EV's including price, range and top speed. Source: Own development

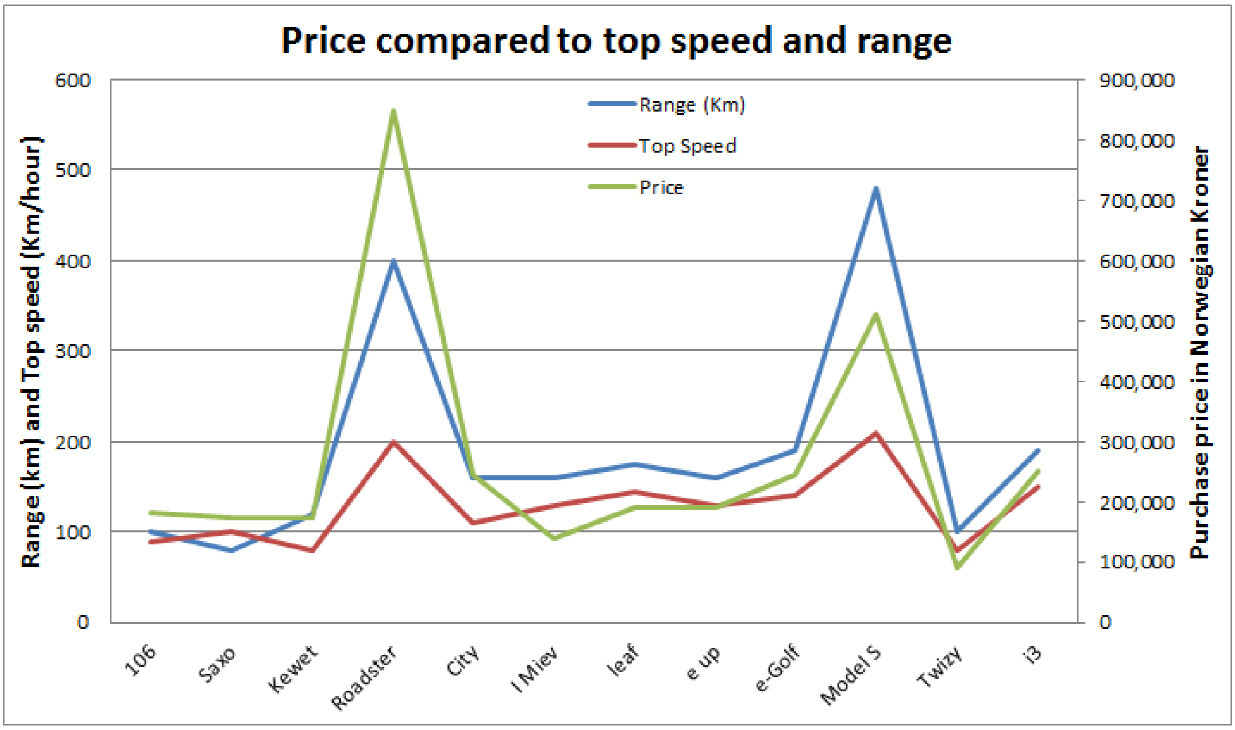

Figure 3- Visualisation of the data in table 1. Source: Own development.

This observation is made apparent when we compare the 2012 Renault twizy to the 1998 Peugeot 106. Although the performance is roughly similar, the cost price of the twizzy is almost half as much. It is also apparent that there has been a greater selection of EV's in recent years. It is likely that this is connected to adoption rates and will be considered later on in the analysis.

1.3 Statement of the problem

As was mentioned in the introduction, a popular belief today is that the success of the EV market in Norway can be attributed to the generous incentives offered by the government. However, examination of the timeline of events reveals that most of the incentives were active for many years before the spike in adoption rates began. Hence, we assume that the 'boom' in sales of EV's is due to some other event than the financial incentives, or more likely, due to the combination of the financial incentives with other factors.

On a smaller level, we also see a lot of variation between the different municipalities in Norway despite all of them being subject to the same incentives. This indicates that there are underlying drivers which affect the susceptibility of people to be enticed by the different incentives offered.

It would appear that there are several other factors which influence the legitimacy of the technology and affect the adoption rates.

1.4 Objectives and research questions

The research question under investigation in this report is the following:

> What can explain the variation in EV adoption in Norwegian municipalities and to what degree?

This research question will be answered in two parts. The first part, describing 'what explains the variation,' will be discussed with reference to recent literature on the topic. There will not be any original research done on this part of the question as it has been discussed and verified frequently in past reviews. This section was then utilized to decide which variables should be investigated in an attempt to answer the second part; 'to what degree do these factors explain the variation in EV adoption'. This part of the research question is what has been lacking in the literature and will be the focus of this research project.

In order to make this task more manageable, it has been reduced to several research objectives which will provide individual insights into the numerous possible aspects of the question:

- To determine the impact that the accessibility of charging stations had on the adoption of EV's
- To determine the impact of an increased random interaction with electric vehicles by the people within a municipality
- To determine the impact of personal values and community identity on the adoption of electric vehicles
- To determine the impact of level of high tech employment on the adoption rates of electric vehicles

The first of these points looks at the most obvious of all the possible explanations behind the adoption of EV's. Numerous studies have pointed out the importance of charging infrastructure both for the practical aspects as well as its role in reducing "range anxiety" which has been dubbed as one of the largest barriers for EV drivers today. The second objective focuses on a more intrinsic part of the decision process. Many people understand the benefits of EV's but struggle to convince themselves that purchasing one instead of an ICE is worthwhile. There is a complex decision process involved here which is briefly described in Roger's theory of diffusion of innovations in the next chapter. This second objective is designed to measure the impact of increasing a technology's legitimacy by increasing an individual's exposure to that technology.

Many studies have purported a relationship between education level and income to the adoption rates of electric vehicles. This study attempts to show a significant correlation between these variables. Finally, most of the reports on the motivations behind buying an EV cite 'reducing greenhouse gas emissions' as one of the top factors. This would fall into the realm of personal values along with a number of other motivations. It seems logical that thoughts of this kind can manifest within the culture of a community as a whole as well. These factors will also be investigated throughout this analysis.

1.5 Layout of the paper

This paper begins with a discussion about the literature surrounding this issue. It begins with an overview of literature surrounding EV adoption and the major drivers of adoption which have been identified. It then moves onto the theory of diffusion of technology and then the relevant parts of institutional theory. Core theories in this literature are used throughout this section to derive a set of hypotheses which are to be investigated throughout this research project.

The next section of this paper discusses the methodology used throughout the research project. It begins with and explanation of the philosophical choice, research approach and research strategy which was used. An in depth explanation of the data collection process is then given for the different variables outlining data sources, reasoning and an evaluation on data quality. We finish up this section with an explanation for how the data was analysed and interpreted.

In the section for results and analysis, the findings are taken and put into perspective using the theories which were adopted in the literature review. In addition, the implications of our findings are discussed in the context of how adoption rates could be further improved within Norway and possibly around the world.

In the final section the main findings of this research are restated and summarized. The research project is closed with a few notes regarding possibilities for future research.

2.0 Literature Review and Theoretical Framework

The revival of interest in the electric vehicle (EV) has been underway since the 1990's. In that time, a multitude of government policies have been put in place to stimulate the growth of the industry. In parallel, numerous articles and reports have been compiled by scholars across the world aiming to understand the underlying drivers behind the adoption of this industry. This literature review begins with an introduction to the previous literature surrounding this topic. It then goes on to discuss in detail some of the important theoretical ideas behind the adoption of new technologies, in particular diffusion of innovation theory and Institutional theory. Throughout this section, several hypotheses are proposed which are to be tested in this analysis.

The scope of this review covers the motivations, barriers and policies which influence EV adoption. These articles are primarily from the wealthier countries which have a stronger emphasis on promoting renewable energies. These include the US, strong European adopters (such as Norway, Sweden, Netherlands, UK), Japan and China. More than anything, these countries received special attention as they tend to be hubs for EV sales as well as scholarly articles regarding their adoption. The review is limited to journal articles, dissertations and government reports which focus on the topic at hand. All articles which were cited were written in English and whereas some older articles have been used for historical context, only recent articles (no earlier than 2005 and primarily published post-2010) were used for presenting modern assessments.

Literature on people's motivations for EV's is abundant on the web with numerous surveys being conducted on a number of demographics and in many countries. This also includes surveys both pre and post-purchase of EV's. The majority of literature on the subject concludes that the primary motivations for wanting to purchase an electric vehicle have not changed much since the initial revival of the industry in the 90's. The big two motivations are still environmental concerns (such as CO_2 emissions) and dissatisfaction with current price, volatility and dependency on gas and petroleum (Ozaki & Sevastyanova, 2011) (Reed, 2010) (Sovacool & Hirsh, 2009) (Lovellette & Lee, 2011). Lesser motivations which were noted were things such as social status connected with EV's, style of modern EV's and the comfort levels of driving modern EV's (quiet, modern technology etc). In a comprehensive study of almost 1500 people who had bought a hybrid vehicle in the past 2 years, Ozaki (2010) filtered down the responses for individuals motivations into 10 common themes: 'It is environmentally responsible' was the most common response with 22% of responses, followed by 'pride in adopting a relatively new technology' (16%), 'Social responsibility' (13%), 'reduced dependence on fossil fuels (8%) and the 'financial incentives' (6%) (Ozaki & Sevastyanova, 2011). These findings were in line with findings by Ona Egbue (2012) and her colleagues in the US when they conducted an internet-based survey of 481 people in order to determine their primary motivations for purchasing an EV. It was noted that the "decrease or elimination of the use of petroleum [was] the most appealing attribute of an EV followed by lower maintenance costs and then greenhouse gas reduction". Other responses included style and comfort; however they received significantly lower scores than the other reasons (Egbue & Long, 2012).

Several common barriers are also identified in the way of EV adoption by the majority of sources. These barriers include price, technology/performance concerns and social concerns (Egbue & Long, 2012) (Sovacool & Hirsh, 2009) (Ozaki & Sevastyanova, 2011) (Calef & Goble, 2007). As will be discussed in the following section on diffusion of innovation, we can note that all the motivations and barriers will fall into the persuasion stage of the decision process proposed by Rogers (Rogers, 2003). Hence, factors such as price, environmental impact of the EV's, pride as being high-tech and environmental concern of the population will prove to become important predictors of EV adoption according to Rogers.

Erdem (2010) performed a quantitative study of the factors which had an impact on the consumers' willingness to pay a premium for hybrid vehicles. It was noted that "that the variables of gender, education, income, being first to adopt an innovation, marital status, choice of high performance on the car, level of reluctance to use alternative energy sources, number of automobiles, concern about global warming and risk attitudes had statistically significant impact on the willingness to pay a premium for hybrids" (Erdem, Senturk, & Simsek, 2010).

An interesting study performed as part of a master thesis in San Francisco examined the importance of charging infrastructure in electric vehicle adoption in California (Bakker, 2011). This study utilized a path dependence and socio-cognitive lens for examining this phenomenon and found that building EV infrastructure was of particular importance as it simultaneously serves dual purposes, one of functional and one of psychological importance. The results were concluded on the back of evidence provided by two projects: The TEPCO and BMW Mini E experiments tracked the use of electric vehicles of a company's employees over time as charging infrastructure was installed in the region. Both tests have shown that public charging infrastructure reduces the range anxiety of the electric vehicle driver. It also shows that Electric vehicle drivers are less hesitant in using their electric vehicle and feel more confident driving further from their usual routes. The use of public charging infrastructure remained very low, but were able to provide consumers extra electricity when needed. Hence, they concluded that public charging infrastructure will function as a psychological aid to the early adopters of electric vehicles (Bakker, 2011). This insight leads to our first hypothesis

1. *Municipalities with a high number of charging stations will also see a high adoption rate of electric vehicles.*

2.1 Diffusion of technology theory and its impact on decision making

One of the most prominent theories relating to how technology is adopted and spread is the theory of diffusion of innovations. This theory was popularized by Everett Rogers, a professor of communication studies, in his book 'Diffusion of Innovations' in 1962, (now in its fifth edition). In this book, Rogers defines adoption as a decision of "full use of an innovation as the best course of action available" and diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2003). He expresses that there are 4 key components of *diffusion of innovations*; innovation, communication channels, time, and social system. He describes that all four of these factors play an instrumental role in the diffusion process. The role of each can be seen clearly in how it applies to adoption of electric vehicles in Norway.

Innovation is the *perception* of an idea as new by a user (i.e. electric vehicles were invented over 100 years ago but are still perceived as relatively new technology today). Newness brings along with it the obstacle of uncertainty which must be overcome in order for it to be adopted. This uncertainty has a strong impact on three of the 5 steps (knowledge, persuasion, and decision) of the innovation-decision process that will be discussed later.

Communication channels are "the means by which a message gets from the source to the receiver" (Rogers, 2003). Mass media and interpersonal communication are two communication channels; whilst mass media channels are media such as TV, radio, newspapers etc, interpersonal channels consist of a two-way communication between two or more individuals. Rogers posits that "diffusion is a very social process that involves interpersonal communication relationships" (Rogers, 2003). Thus, he concludes that interpersonal channels are more powerful to create or change strong attitudes held by an individual. In regards to the Norwegian EV market, these communications channels include growing media coverage for new models of electric vehicles, groups/associations such as EVNorway, Grønnbil, Norsk Elbilforening, Zero and Transnova appearing to push an environmental (and electric vehicle) friendly agenda and a rapid growth in infrastructure and political incentives motivating conversation between the population. It should also be noted that an innovation can become self-sustaining once it reaches a certain number of adopters or a so called 'critical mass' (Rogers, 2003). At this point, interpersonal communication channels are frequent enough to enable further growth.

Time and Social system are the last two elements of diffusion. Time is relatively obvious as it takes time for information to spread throughout a population. Since diffusion of innovations takes place in the social system, it is influenced by the structure of the social system. It is at this point that the diffusion of innovation theory crosses over with institutional theory which will be discussed in the next section. Rogers claims that the nature of the social system affects individuals' innovativeness, which is the main criterion for categorizing adopters (Rogers, 2003).

An important part of the diffusion of innovations process is the *innovation*-decision process which is the process by which individual actors learn about an innovation and subsequently decide on whether or not to adopt it. Rogers describes the innovation-decision process as "an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation" (Rogers, 2003). The innovation-decision process involves five steps; knowledge, persuasion, decision, implementation and confirmation. Roger's states that these steps are taken in a time ordered manner.

Whilst the implementation step is generally the easiest variable to measure in an analysis such as this, it will be the first three steps that are directly responsible for the rate of this implementation. In particular, it is the speed of the diffusion of knowledge and the strength of the persuasion stage that have the largest impact on the decision and in turn the rate of implementation. It has been shown in a large number of quantitative studies that variables in the knowledge and persuasion stages are significant predictors of implementation levels (Surendra, 2001) (Jacobsen, 1998) (Blankenship, 1998) (Carter, 1998).

As was mentioned previously, the innovation-decision process begins with the knowledge stage. In this step, an individual learns about the existence of innovation and seeks information about the innovation. Questions in this phase revolve around "What?" "how?," and "why?". These questions form three types of knowledge: (1) awareness-knowledge, (2) how-to-knowledge, and (3) principles-knowledge (Rogers, 2003). Awareness knowledge is simply the knowledge of an innovations existence. It begins the process and prompts an individual to learn more about an innovation and can lead to the other types of knowledge. This type of knowledge is most effectively spread initially through mass media such as TV, radio, internet etc. How-to-knowledge is information about how to use an innovation correctly and is vital for the adoption process. To increase the adoption chance of an innovation, an individual should have a sufficient level of how-to-knowledge prior to the trial of this innovation (Rogers, 2003). This is quite intuitive with electric cars as they work in much the same way as ICE vehicles. Finally, principles knowledge is an understanding of how and why an innovation works. Innovations can be adopted without this understanding but could lead to improper use and cause its discontinuance. How-to and principles knowledge are more effectively communicated via interpersonal contact hence Rogers belief that "interpersonal channels are more powerful to create or change strong attitudes held by an individual". To most effectively create new knowledge about an innovation, one should provide not only a 'how-to' experience but also a 'know-why' experience (Seemann, 2003).

The persuasion stage follows the knowledge stage and occurs when an individual has a positive or negative attitude towards an innovation. Rogers states that while the knowledge stage is more cognitive centred, the persuasion stage is more affective (feeling) centred. Thus, the individual is involved more sensitively with the innovation at the persuasion stage. The degree of uncertainty about the innovation's functioning and the social reinforcement from others (such as colleagues, peers, etc.) affect the individual's opinions and beliefs about the innovation. Hence, while information about a new innovation is usually available from outside experts and scientific evaluations, individuals tend to seek it from trusted friends and colleagues whose subjective opinions of a new innovation are more convincing (Sherry, 1997).

Whilst individuals are trying to reduce uncertainty about an innovation during the persuasion stage, Rogers proposes that there are 5 key attributes that they consider; these are relative advantage, compatibility, complexity, trialability, and observability. Rogers states that "individuals' perceptions of these characteristics predict the rate of adoption of innovations" and that "relative advantage is the strongest predictor of the rate of adoption of an innovation" (Rogers, 2003). He defines relative advantage as "the degree to which the innovation is perceived to be better than the idea it supersedes". Relative advantage includes factors such as cost, social status, efficiency, user experience etc. When conducting quantitative research on rate of adoption, it is these factors, coupled with factors from the knowledge stage, that will be most significant at predicting adoption rates (Jacobsen, 1998) (Carter, 1998) (Surendra, 2001).

Compatibility refers to the "degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. Rogers states that "if an innovation is compatible with an individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase". Similarly, complexity is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers, 2003). Electric vehicles are generally seen as a compatible technology as their functioning is in line with regular vehicles and the charging aspect is identical to most household appliances. They are average in terms of relative complexity in comparison to regular vehicles. The degree of trialability of electric vehicles varies from country to country but in general, the more prominent electric vehicles are in a society, the more sales points there will be and the more trialable they will become. Finally, observability is defined as "the degree to which the results of an innovation are visible to others". In fact, according to Arlene Parisot, "Role modelling (or peer observation) is the key motivational factor in the adoption and diffusion of technology" (Parisot, 1995). Hence we would expect that even proximity to municipalities with high levels of electric vehicles would increase the observability of EV's in nearby municipalities. Hence we pose our second hypothesis:

> *2. Municipalities with a high number of EV's in nearby municipalities will see a higher adoption rate of electric vehicles.*

The final point of discussion regarding the diffusion of innovation theory is the rate of adoption. This is generally defined as the relative speed at which participants adopt an innovation. The rate of adoption is usually measured by the length of time required for a certain percentage of the members of a social system to adopt an innovation. Figure 4 below shows the typical adoption curve of successful innovations. Within the curve at some point the innovation reaches critical mass. At this point, the number of individual adopters ensures that the innovation is self-sustaining.

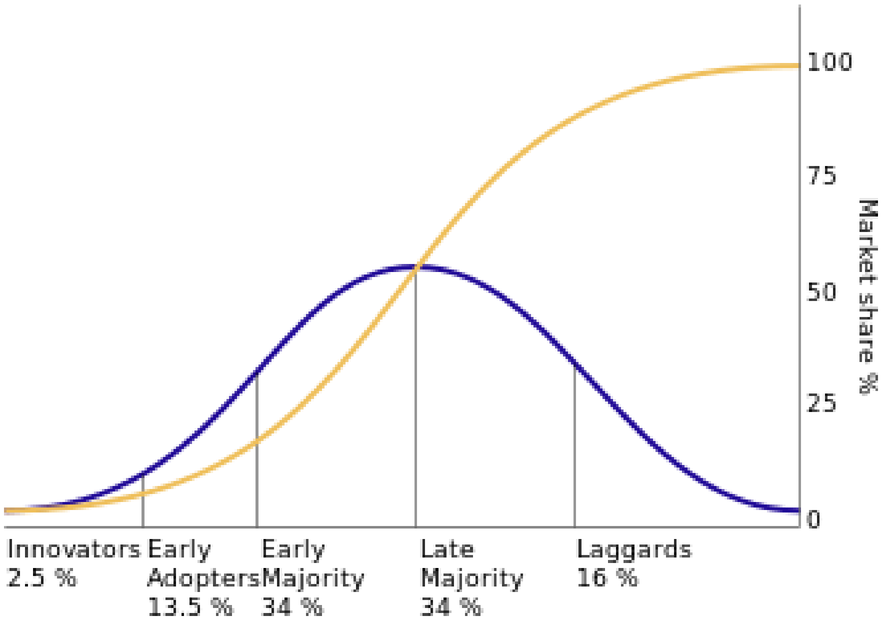

Figure 4- Adoption of innovations curve

The rates of adoption for innovations are determined by an individual’s adopter category. In general, individuals who first adopt an innovation require a shorter adoption period (adoption process) when compared to late adopters. Communities with a large number of individuals who are likely to be early adopters will generally have a faster rate of adoption.

In short, the theory of diffusion of innovation identifies several mechanisms by which innovations are discovered and adopted within a social system. However, this theory does not cover social systems themselves although it does acknowledge that they play a crucial role. Different social systems can promote or impede an individuals’ innovativeness, which is the main criterion for categorizing adopters and hence has a large role to play in how a society on a large scale will adopt a new technology, such as electric vehicles. This concept is tackled much more directly by institutional theory which studies the formal and informal ‘rules of the game,’ which tend to govern the decisions of societies on a larger scale.

2.2 Institutional theories effect on culture and decision making

Traditionally, Institutional theory was concerned with how various groups and organizations were able to better secure their positions and legitimacy by conforming to the rules and norms of the institutional environment (Meyer, Rowan, Powell, & DiMaggio, 1991). The theory relates to the so called 'rules of the game' and in its simplest sense states that all companies and people operate within the institutions (both formal and informal) that have arisen within their society. Douglass North, a Nobel laureate in economics, formally defines institutions as "the humanly devised constraints that structure human interaction." (North, 1990). Some broad examples of institutions include religion, legal systems, the police force, family etc.

Institutions can be classified as either formal (explicitly defined and enforced rules) or informal (which can be thought of more as unspoken but understood rules that guide peoples decisions). Whilst marriage could be seen as a formal institution, we can view the process of courtship is an informal institution as its process is generally understood and accepted within each society but not explicitly stated. Three pillars support institutions; these are the regulatory, normative and cognitive pillars (Scott W. R., 1995).

The regulatory pillar explains how formal rules, laws and regulations influence the behaviour of individuals and firms. It is most often associated with formal institutions and it is the coercive power they wield (Peng, 2009). For example, all vehicles that are imported into Norway are subject to an import tax. The level of this tax is decided upon and enforced by the government. Whilst some importers may wish to pay these taxes to help support the nation financially, most importers comply with these taxes out of fear of what would happen should they not pay. In this manner, their actions are coerced by the regulatory pillar.

On the other hand, the normative and cognitive pillars tend to be associated with informal institutions. These are coercive powers that tend to originate from things like norms, cultures and ethics. The normative pillar refers to the coercive powers of cultures, values, beliefs and actions of the people with whom you associate. These are often simply referred to as the norms and are likely to vary slightly within different environments (Peng, 2009). For example, the way you behave around family may be different to how you act around friends or work colleagues. In relation to vehicles, a well-known norm is that successful business men and women drive vehicles that reflect their success. This norm can influence the behaviour of these people as they may face ridicule if they were to purchase a car that was not seen as impressive such as a Nissan leaf. The Tesla series can be viewed as one step towards to overcome this norm.

Finally, the cognitive pillar refers to the coercive powers of an individual's internal beliefs and values. In another sense it can be seen as a person's belief in what is right and wrong (Peng, 2009). For example, whilst the norms (both formal and informal) at the NSA are not to "rock the boat," "whistle blowers" such as Edward Snowden are coerced by their cognitive pillar to follow their internalized personal beliefs on what's right by overcoming the norms that encourage silence. Another example might be purchasing an electric car because of ones belief in the benefits they provide for the environment outweigh the benefits of purchasing a cheaper or more convenient alternative.

Culture can be thought of as a collection of these formal and informal norms of a group of people (Scott W. , 2007). For the purposes of this paper, culture will be defined as "the collective programming of the mind which distinguishes the members of one group or category of people from another" (Hofstede, 1997). This intentionally vague language highlights the diversity of the concept of culture as is can have many layers, such as regional, ethnic, and religious cultures. In addition, we can talk about a specific organizational culture within a single organization (such as the Toyota culture).

Norway as a whole may be considered to have a specific culture; we can imagine these as a set of norms and ethics that are generally found across the country. For example, Norway as a whole is known to the world as being very practically minded in regards to business and very outdoor oriented and sporty in regards to leisure, particularly with snow sports. However we also find slight differences between the norms and ethics on a municipality level. Throughout this research project, the term culture will be used to refer to the specific culture of each of the municipalities of Norway unless stated otherwise. A specific example of this which applies to this thesis would be the image each municipality has of itself being environmentally conscious. Municipalities with a larger portion of citizens who are concerned about the environment would be considered more environmentally conscious. Municipalities who are more environmentally conscious would be more oriented towards electric vehicles and hence would have higher adoptions rates according to diffusion of innovation theory. Hence we state our third hypothesis:

> *3. Municipalities with a greener political orientation will see a higher adoption rate of electric vehicles.*

This hypothesis rests on the assumption that the degree of environmental concern of a municipality can be measured by proxy by measuring the percentage of the population who vote for the greens party. Justification for this logic is given in the methodology. It is also important to acknowledge that there are also numerous sub-cultures within each of the municipalities, for example immigrants in a municipality may have differing cultural values to nationals who were raised in a region.

Another important cultural aspect to this research project is the identity of a municipality as high-tech. According to findings by Michele Jacobsen in her 1998 dissertation (and based on Rogers diffusion of innovation theory), people who identified as proficient with computers were more likely to be in the early adopter category in the diffusion of a new computer technology than those who did not (Jacobsen, 1998). She infers that there is a connection between those who are more technically proficient and those who are likely to adopt new technologies more readily. This also fits with Rogers' theory of diffusion as a higher technical proficiency would reduce the perceived complexity and could possibly increase the perceived relative advantage of an innovation (Rogers, 2003). Using this, we hypothesise that cultures with higher technical proficiency will be more likely to become the early adopters of technical products such as electric vehicles.

4. Municipalities with larger high tech industries will see a higher adoption rate of electric vehicles.

3.0 Methodology

This section describes the methodology used throughout this thesis. The idea began with a general interest in electric vehicles. I have had an interest in all forms of renewable energies and applications for several years. I was first exposed to the success of the EV market here in Norway when I moved here at the beginning of this master's degree, since then I have been keeping tabs on its progress. It started with the occasional check-up of market statistics using online resources such as GrønnBil.no and EVNorway.no. My understanding of the market was further deepened whilst working as a consultant for start-up firms. One of our projects involved gaining a firm understanding of market dynamics (especially in relation to growth in EV's and charging infrastructure). Following this, I delved deeper into the literature regarding technology adoption, legitimacy and EV's as part of smaller university related project prior to the beginning of this Master thesis. It seemed natural that I continue this research and these experiences have helped me to narrow down the design and objectives of this Master Thesis.

As a starting point to this section, I will begin with an overview of the philosophical choice I have chosen to take on whilst conducting this research and I will explain my reasoning for doing so and the strategy I will employ in order to implement it. I will then follow on with a detailed description of the data collection process including my choice of sources, my reasoning behind my choice in variables, my justification for any omissions or interpolations and finally an evaluation of the quality of the data. I finish this section by describing the data analysis software and process used.

3.1 Philosophical choice, Purpose and Strategy

3.1.1 Philosophical Choice

During this research project I adopted the positivist approach to the nature of knowledge. As stated by Wilson (2010), "positivists believe that research needs to be carried out in a scientific nature." It was the aim of this research to remain independent of the data and to be completely objective in the analysis. In attempting to determine the main drivers for electric vehicle adoption in Norway, a look into historical events and data was required in order to be thorough. This enabled a scientific approach to be taken and the drivers to be determined quantitatively with a high level of reliability.

Similarly, I took an objectivist stance towards the ontology of our research philosophy. This implied that social phenomena are based on external realities beyond our reach or control. In the context of this analysis, it assumed that the different drivers could be treated as tangible objects which are clearly defined and external from the everyday interactions of individuals.

Finally, in line with the positivist approach that was taken in this research project, I considered the process of this research as value-free since my values are independent of this research topic.

3.1.2 Research Approach and Purpose

This thesis adopted a deductive approach which began by revising the current theory on the topic. The existing theory was then used to develop a set of hypotheses which were subsequently tested throughout the rest of the thesis. Throughout the research project, theories which had already been proposed were tested by analysing quantitative data regarding the EV market in Norway. This research approach tried to identify and explain a causal relationship between variables and used controls to ensure validity of the data.

The purpose of this research strategy was to highlight the drivers of EV adoption which could be influenced by public or private institutions. In addition, it is also intended to act as a mechanism to predict *how* effective a driver would be, which ones should be used in parallel and how to allocate resources to each. In other words, by understanding which factors promote EV adoption, entities could invest more wisely in order to achieve the maximum benefit from the limited resources available.

3.1.3 Research Strategy

The research project used a quantitative strategy in order to test the hypotheses which were derived from the theory. As previously mentioned, this analysis was intended to "emphasise the measurement and analysis of causal relationships between variables, not processes" which is in line with the definition proposed by Norman K. Denzin and Yvonna S. Lincoln (2000).

3.2 The Data Collection Process

The analysis was primarily made up of secondary data. Being an organized and regulated society in Norway, it was possible for the entirety of data necessary for this analysis to be extracted directly from a number of different online sources (ie. population per municipality) or to be synthesized from data gathered online (the number of registered EV's per thousand people was calculated using both datasets). The data sources used for compiling the data were all highly reputable government sources and are noted as each variable is explained.

Before introducing the variables, it is important to quickly explain the scope of the analysis, including which data was analysed and why. As was mentioned in the introduction, this project is most interested in the events which caused the spike is sales around the year 2010. For this reason, the data points between 2005 and 2013 have been included in the analysis. This gives several data points both before the spike occurred and after. Due to the nature of the data available on each of the variables, all data points were analysed in yearly intervals. This was the shortest time period that was common among all the data points and left us with 9 data points for each municipality.

As was also mentioned in the introduction, this analysis was limited to EV adoption rates in Norway alone. No statistics from any other country have been included. The unit for this analysis was municipalities in Norway. Although the administrative structure of the Norwegian regions is constantly changing, as of March 2015 there were 428 different municipalities. Several of these were excluded from the analysis due to inconsistency in the data. This was usually caused by a merger between two municipalities during the period under investigation. The municipalities excluded were the following: Utsira, Vindafjord, Kristiansund, Aure, Inderøy and Harstad. Utsira was excluded due to an error in data collection recorded on one of the variables. The remaining 5 were all involved in municipality mergers between 2005 and 2013 and sometimes reported inconsistent data which would have affected the analysis. Since 422 eligible municipalities remained for comparison, it was thought as acceptable to err on the side of caution and remove all 6 of these municipalities from the analysis completely as these omissions were unlikely to largely affect the overall analysis.

I have chosen to conduct this research project through a number of lenses relating to new technology adoption, all in relation to the decision process. These included Rogers's theory of diffusion of technology and Institutional theory (with particular attention to the roles of the normative and cognitive pillars and the importance of legitimacy).

In line with our hypothesis and based on the research findings of reports on adoption from researchers mentioned in the literature review, a number of variables needed to be collected and then analysed (Egbue & Long, 2012) (Sovacool & Hirsh, 2009) (Ozaki & Sevastyanova, 2011) (Calef & Goble, 2007) (Erdem, Senturk, & Simsek, 2010). With reference to the list of hypotheses posed in the literature review, the variables (in the order that they will be discussed below) are:

- The number of registered EV's per 1000 people per municipality (dependent variable)
- The number of charging stations per 1000 people per municipality (H1)
- Proximity to and density of EV's per municipality (H2)
- Votes for the greens party at Storting elections (H3)
- High Tech employment per 1000 people per municipality (H4)
- Median income per municipality (control)
- Population density per municipality (control)
- Sports spending per capita (control)

3.2.1 Dependent Variable

The number of registered EV's per municipality

This was our dependent variable and possibly the most important dataset in relation to the reliability of the results. In order to be able to reliably compare the results between the municipalities, the number of EV's per municipality was divided by the number of people in each municipality per year. This set of data showed the levels of growth in each municipality on a yearly basis. Like many of the other datasets, these numbers were obtained from Statistisk Sentralbyrå (SSB) (Statistisk Sentralbyrå , 2015). It is important to note that these numbers are based on the number of EV's which were registered each year and is not directly related to sales. In Norway, all vehicles are required to pay a registration fee yearly in order to help pay for the road networks. In this registration, the 'type of fuel' is typically recorded and this is the data that is eventually displayed on NSB. The number of vehicles which were shown under the label of 'electric' vehicles was those which are purely electric and run only off battery power. Hence, plugin hybrids were not considered as part of this analysis. This omission of hybrid vehicles is unlikely have a huge effect on the outcome of this analysis here in Norway as the number of hybrid vehicles was small in comparison with purely electric vehicles (around 6% of sales). In addition, hybrid vehicles were not the focus of this project as the research question is only to analyse what drives the adoption rates of electric vehicles.

The data available to the public had a yearly resolution; hence any and all data with finer resolution (such as charging stations) needed to relax this attribute in order to perform a comparative analysis. Stated differently, since the dependent variable had the resolution of 1 year per municipality, all subsequent datasets needed to have similar attributes if the 2 datasets were to be compared. In addition, it is important to note that the concept we were trying to measure was the adoption rate of EV's which would be most accurately represented by the number of sales. This data does not show sales volumes but rather the total registrations per municipality and hence may contain small errors if for example an electric vehicle is not registered one year for some reason or an EV is registered in a different municipality to where it is used. It was believed that this deviation would likely be so small that it did not impact the results significantly from the true value of adoption.

A final comment with regards to this dataset is that it differs slightly from what was found at some other sources online. Grønnbil.no is probably the most reliable free online source as it compiles monthly data directly from (Opplysningsrådet for Veitrafikken, 2015) (OFV) in order to display quarterly or annual statistics (Gronnbil, 2015). OFV is directly responsible for monitoring the sales of all vehicles in Norway. I was unable to gain access to this data as it is a paid product and I have been unable to secure funding in order to assist this research project. The data from SSB is obtained from 'The Register of Vehicles at the Directorate of Public Roads' and vehicle refund data from the 'Directorate of Customs and Excise'. It would seem logical that the data sources should be identical; however a discrepancy of 2100 EV's (11.9%) was seen between the data gathered from SSB and the data online at Grønnbil.no. It is likely that this gap was representative of the number of hybrid vehicles which were purchased.

The data was given a lead time in order to correlate with the correct data points of the independent variables (as opposed to giving all the dependent variables a lag). This meant that antecedents, such as the number of charging stations installed in 2010 were correlated with the number of EV registrations in 2011. Finally, in order to make the data points as normally distributed as possible, a log transform was also performed on the dependent variable.

3.2.2 Independent Variables

The number of charging stations per 1000 people

It was believed at the outset of this research project that the large increase in infrastructure was one of the main drivers behind the growth in EV adoption rates. Thus, obtaining a reliable and detailed dataset was vital. The data used was from the NOBIL database (NOBIL, 2009). This was a database established in 2009 with collaboration between Transnova and the

Norwegian Electric Vehicle Association in order to ‘maximize knowledge about the availability of charging infrastructure’ (Norsk Elbilforening, 1992). The databases API is free to use under a creative commons licence for anybody who requests access.

During the rollout of the national charging infrastructure which began in 2009, Transnova was heavily subsidizing the costs of new charging stations. One of the terms for accepting the subsidy was that all charging stations had to report information regarding its location, status, ownership etc. to the NOBIL database. In this manner, Transnova succeeded in growing its database to include all public charging stations around the country. It has since grown into one of the largest charging station databases in the world and now contains information from most of Scandinavia although this data was not used for this analysis.

After requesting access to the API, a data dump was performed on the 13th of March 2015. This resulted in a very messy JSON file which needed to be compiled into an excel sheet. After completing this process, information was gleaned for every charging station in Norway relating to: Charging station ID, Name, Street, House number, Zip Code, City, Municipality ID, Municipality name, County ID, County Name, Ownership details, the Number of Charging points, GPS coordinates, when the station was ***registered*** and when it was last updated, Country and international ID. This data was used to create a table which showed the number of charging stations which were installed in each municipality in Norway each year between 2010 and 2014. It also contained a plethora of attribute data such as funding type and ownership details which were not used.

One main issue with the dataset relates to the date that the charging station was *registered*. This does not show when the station was *installed* which would be a more accurate for this analysis. Since the database came online in 2010, it is possible that the numbers in 2010 are a result of retroactive registration of charging stations installed in the decade or so before that. Although these numbers were small in comparison to the number of stations installed post 2010, it nevertheless instils a degree of uncertainty into the dataset. The administrator of NOBIL was contacted in this regard and commented that due to the introduction of the charging infrastructure program, the vast majority of charging stations registered in 2010 were indeed built in that year. With this in mind it was assumed that 2/3 of charging stations registered in 2010 were indeed built in that year. It was then assumed that the remaining charging stations were built between 2000 and 2010 and were installed linearly between those years. In this manner the data points for each municipality were extrapolated for the years 2005 to 2009. As with the number of EV's, the variable was scaled according to the number of people per municipality. The final variable of CS's per 1000 people was obtained by dividing the number of CS's in a municipality by the number of people and multiplying it by 1000.

Proximity and density of EV's from other municipalities per municipality

We assume that the number of cars in proximity to citizens in a municipality is proportional to the number of cars within the county of which it is a part. I.e. a municipality with a neighbouring municipality that has a higher number of EV's will still be exposed to randomly seeing EV's on the street more frequently.

This dataset was calculated first by finding the number of EV's per year in each ***county***. This was the figure used to estimate the number of EV's that a person from a particular municipality might randomly be exposed to. For a more accurate calculation however, the density of EV's within that county was then found as it was thought to be more representative of the *likelihood* of a citizen randomly encountering an EV. Hence, the number of EV's per county was divided by the area of each county to provide an estimate for the number of EV's per square kilometre within each municipality in that county. As there is a huge degree of circulation between the people of Oslo and Akershus, these two counties were considered as one when calculating the number of EV's in the proximity of each county and then each was divided by their own area to determine the number of EV's per square kilometre within them.

Votes for the greens party at Storting Elections

The Storting is the supreme legislature in Norway. It is a parliament made up of 169 members and is elected every 4 years based on a 'party list proportional representation'. Like in many other countries, these parties represent differing levels of values towards issues facing the country at a national level. People generally vote on parties based on the values they can most identify with most strongly and the parliament is intended to represent the overall values of the nation. Whilst there are several parties who promote a green and environmentally friendly agenda, it is the greens party which is most readily identified with these values. For this reason it was decided that the number of votes for the greens party could be used as a fair proxy for the levels of environmental concern in each municipality.

The rationale behind this data set is that municipalities who were more environmentally conscious would be more likely to vote for the greens party as well as purchase an electric vehicle. This data was collected from SSB and is measured every 4 years in national elections. Coincidentally, election data is posted for the years 2005, 2009 and 2013 fitting nicely with the scope of this analysis. For the remaining years, data points have been linearly interpolated to enable analysis.

Employment in High Tech industries per municipality

It was hypothesised that a higher rate of high tech employment in a municipality would lead to a higher rate of EV adoption. As 'high tech' is not an industry division per se, looser connections had to be made in order to utilize the data from SSB on employment. Data was obtained regarding the number of people employed and their level of education. From this, information on the number of people employed in each municipality with a master's degree or higher was gathered as a proxy for the measure of high tech employment.

This data set was further manipulated to represent the number of people in High Tech employment per capita and further extended to number of people in High Tech employment per 1000 people to make for easier analysis.

3.2.3 Control Variables

Median income

The median income dataset was straightforward and taken directly from the SSB database. The median income dataset displays the median income in 1000NOK after tax for each year for all household types.

Population size/ area and density per municipality

The population size dataset states the population from the 1st of January each year for each municipality. The area information for the municipalities and counties was collected from Statens kartverk (the Norwegian mapping authority) in 2008 and the density was calculated using these figures in conjunction with the population register. The density displays the number of people per municipality divided by the area of that municipality. The unit is people/km^2.

Sports spending per capita

This data was intended to represent the identity of a municipality as environmentally active based on their degree of spending on activities such as sports and outdoor activity centres. The idea is that communities who perceive themselves as active/outdoorsy and environmentally conscious will both spend more money on cultural activities as well as be more inclined to purchase electric vehicles. Once again, this data set was obtained from SSB and measured the 'Net operating expenditures to sports per capita, consolidated accounts'.

One shortcoming of this dataset was that it lacked data for the years 2005 and 2006. To provide a more accurate regression, these data points were linearly extrapolated.

3.2.4 Excluded datasets

Three seemingly important datasets were omitted from the analysis at the municipality level. These were the number and generosity of government incentives for electric vehicles, media coverage promoting electric vehicles and technological advancements in electric vehicles. Undoubtedly, each of these factors has contributed to the adoption of electric vehicles within Norway. Nevertheless, the variable on government incentives has been left out due to the fact that it does not vary between the municipalities. For example, exemption from VAT and import tax affects the sale price of EV's nationwide equally. However, it must be acknowledged that incentives such as free use of bus lanes, ferries and exemption from road tolls acts as a larger incentive in urban areas. Hence, municipalities with many toll points, ferries or higher traffic congestion will provide proportionally larger incentives for purchasing EV's.

A variable measuring media coverage that discusses (and hence legitimizes) EV's has also been omitted from this analysis. Again, this is likely to have a huge effect on the adoption rates of EV's on a national level. However, on the municipality level, the variance is far smaller and more difficult to measure. Many of the media sources are in the digital realm and hence can be accessed nationwide. It is exceedingly difficult to measure the average reach of each of the stories about EV's that appeared in websites, on TV, on the radio, in newspapers and in magazines. However, it is important that we acknowledge the limitations of such an assumption as it is highly likely that these publications were targeted where it would receive the most traction. In addition, public advertising such as billboards and banners would likely target the most populous regions such as Oslo and Bergen.

The final important variable which has been omitted from this analysis is concerned with the relative increase in competitiveness of modern electric vehicles. In the last decade we have seen enormous advancements in EV technology. Perhaps not so coincidentally, the three major selling models on the market in Norway (the Nissan leaf, the Tesla model S and the Mitsubishi iMiev) were all released between 2008 and 2010. The Tesla model S provides the first truly classy premium brand for citizens with money who would like to invest in an electric car but feel pressure to conform to societal norms and not purchase some of the other models for which they may be scrutinized. In addition, the leaf and the iMiev are leaders in value as they have particularly good range and top speed compared with their price. We can see from figure 3 in the introduction that top speed and range are trending slowly upwards. In addition, sales price tends to reduce compared to performance.

The reason this dataset has been omitted is that is does not vary between municipalities. Hence, whilst it is likely to correlate very strongly with adoption in Norway, it will not be able to correlate with adoption at a municipality level.

3.3 Data analysis process

The data analysis process began with a summary of the datasets. Visual representations were generated to help visualize the adoption process and that of the independent variables as well. The data was then correlated using Pearson's correlation coefficient. Since a few of the variables were found to be highly correlated ($R>0.6$), a quick test was performed where these correlated datasets were removed from the panel analysis to check the affect it had overall. As it did not greatly affect the significance or the direction of correlation, the effect of the correlation was assumed not to interfere with findings. This was later verified using the Wooldridge test for serial correlation (Wooldridge, 2002).

Due to the longitudinal nature of the dataset, panel data with robust fixed effects was used to test the hypotheses. This approach enabled us to model the variance within a municipality in EV adoption rates and to control for any unobserved heterogeneity that is constant across time (Greene, 2006). To verify that this was the correct method, both the fixed and random effects models were run and then the Hausman's test was applied with the null hypothesis assuming that the difference in the coefficients is not systematic. The probability value was highly significant ($Pr = 0.00$) and hence we could reject null hypothesis and conclude that indeed the fixed effect model was better than the random effect model. Since the original fixed effects model showed a great deal of heteroscenasticity and serial correlation, we used the robust fixed effects model to adjust the standard errors in the 422 municipality clusters. Since we have such large values of N (422) and T (3798), this method is most likely to be reliable (Wooldridge, 2002).

We used a lagged data structure in this analysis since we assumed a one year lag between the independent variables and the adoption rates of electric vehicles. This is a common practice among studies at a high level (municipality, state, national) where correlations are sought between motivating factors and rates of adoption (eg (Meek, Pacheco, & York, 2010)). Hence, a one-year lag between the independent variables (measured at time t−1) and the dependent variables (measured at time t) was applied. Finally, while the use of a panel design introduced the potential for serial correlation (Wooldridge, 2002), statistical assessment using the Wooldridge test suggested that this analysis is not subject to such limitation.

4.0 Results and Analysis

This section will treat the results of our analysis as well as discuss the implications of the findings. The section begins with an overview of the descriptive statistics. These statistics highlight some of the more obious trends in the data. This is then followed with an explanation of the table of corrolations. This section talks outlines the strength of the connections between certain datasets and provides insights into some of the final findings. The results of the regression analysis follow the correlation table and provide insights into the direction and significance of the relationship between the antecidents of interest and the dependent variable. It is here that we will gain insights into the true degree of the impact of certain incentives and determine the best practices for policy making.

4.1 Descriptive statistics

Observing the data for the first time can appear daunting as the datasets for each of the variables contains almost 6000 points each (up to 14 initial points for each of the 422 municipalities and down to 9 points each for the regression). In addition, the variation between the different municipalities could be staggering. However, when looked at as a whole (i.e. on the national level) things begin quite simply. This is where the analysis began. When we plot the number of registrations of EV’s per year on a national level as we can see in figure 5 below we see a relatively calm adoption rate between 1998 where less than 200 EV’s were registered and 2010. Between 2010 and 2011 we see adoption rates skyrocket with more than 100% *growth* per year. This corresponds closely with the beginning of the diffusion of technology chart shown in figure 4 back in the literature review.

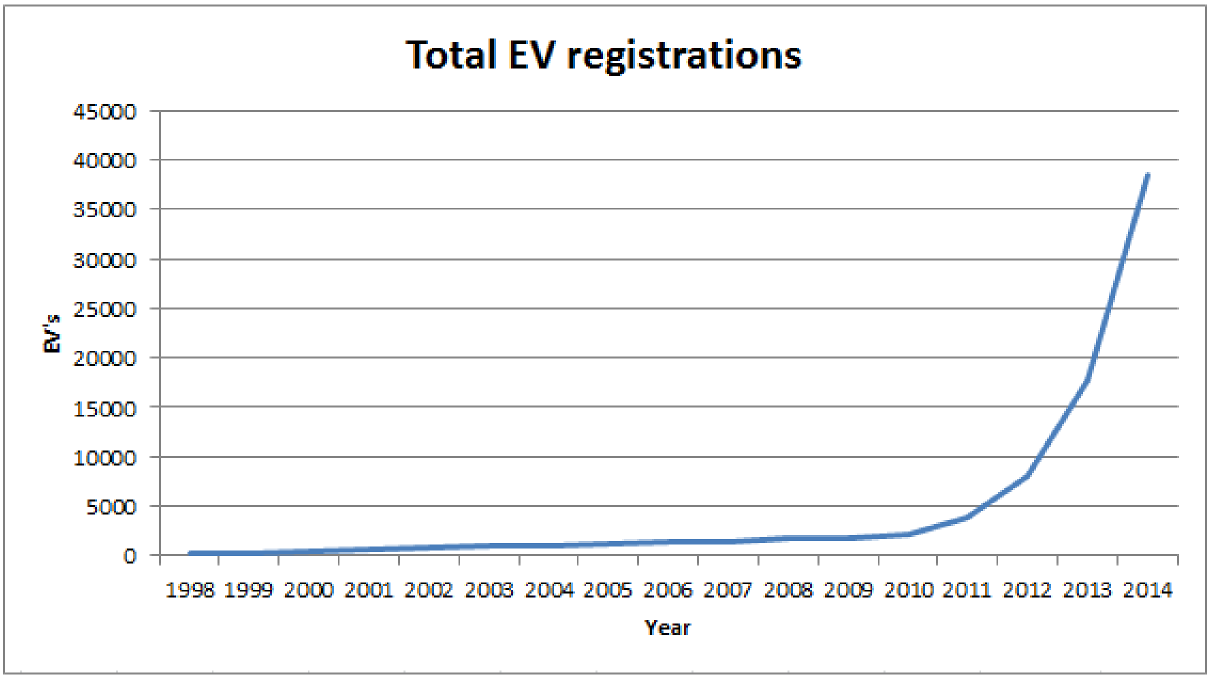

Figure 5: Total registrations of EV's in Norway. Source: SSB

Observations on a municipality level are more difficult to visualise and understand but also provided interesting insights into adoption at this smaller level. For example, in 1998 out of the 422 municipalities which were monitored, only 41 of them (10%) had any electric vehicles. Seven years on in 2005 this number had grown to 115 (27%) and in 2014, this number had grown to 373 (89%). This shows that adoption of Electric vehicles has been more or less nationwide. However, the distribution of electric vehicles is far from evenly spread and is highly concentrated around the urban areas. For example, in 1998 over 1 third of all EV's were located in Oslo and 90% were located in the top 20 municipalities, all nearby the main urban regions. Over the years this diversified a little with 1 in 6 EV's located in Oslo and 90% of EV's being located in 40 municipalities in 2005. In 2014, Oslo continues to house the largest portion of EV's with more than 1 in 6 EV's (around 7000 in total) presiding there but with 90% of the nation's EV's now spread over 85 different municipalities, no longer so centrally located but with a tendency to cluster. This supports our second hypothesis which states that municipalities with a high number of EV's in nearby municipalities will see a higher adoption rate of electric vehicles. We see that the hubs for EV's in 1998 are still hubs in 2014 and that nearby municipalities have also increased adoption.

Charging station data is also quite telling once visualized. As can be seen in figure 6 below, there is a 1 year lag between when the number of charging stations takes off and when the number of EV sales begins to grow exponentially. In addition, although the two may not appear to correlate perfectly when visualized in this way, it still appears highly coincidental that they tend to grow at similar speeds at similar times. This tends to support hypothesis 1 which states that it was the growth in infrastructure and the legitimacy it conveyed which was partially responsible for the dramatic rise in adoption of EV's.

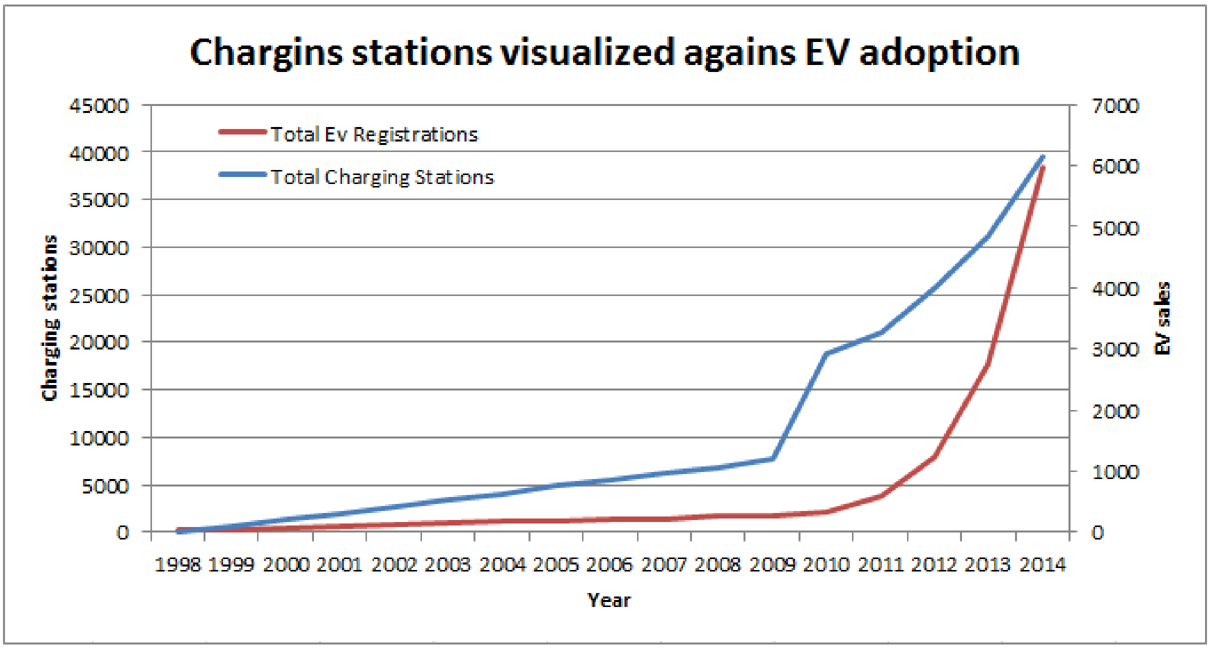

Figure 6: Charging stations and EV registrations per year in Norway. Source: SSB

Once again, the municipality level shows a similar picture in that public infrastructure plays an important role in the adoption process. Before the jump that occurred in 2010, the top 5 municipalities in terms of charging stations were Oslo, Bergen, Ullensaker, Trondheim and Stavanger; Oslo, Bergen and Trondheim were also in the top 5 of EV adoption at that time. In addition Akser and Bærum were also in the top 5 for EV adoption we see that at this time they were 12th and 7th respectively in terms of EV numbers and are also in direct proximity with Oslo. As of 2014, we note that the top 5 municipalities for charging stations are Oslo, Bergen, Bærum, Ullernsaker and Trondheim. Simultaneously we notice that the top 5 in terms of EV adoption are Oslo, Bergen, Bærum, Asker and Trondheim (Asker comes in 12 in terms of charging station). We see overall that the municipalities with a high number of charging stations tend to have the largest number of EV's. An interesting exception to this pattern in the municipality of Ullernsaker, it is 5th in terms of charging stations but 35th in terms of EV's. Upon closer inspection it was found that Ullernsaker is home to Oslo's main airport and that 253 of the municipalities 281 charging stations are located there. This could explain the lack of EV's registered in the area and the excess of charging stations. Indeed, if we were to replace the number of charging stations there as 28 (the municipality minus charging stations at the airport) then it would come in 33rd in terms of charging stations and 35th in terms of EV's.

This pattern for municipalities with more charging stations having more EV's becomes less pronounced as the numbers get lower. In 2014, whilst 8 of the top 10 municipalities in terms of charging stations were also in the top 10 in terms of EV's, only 4 of the next 10 in terms of charging stations were in the top 20 in terms of EV adoption.

I finish this section with a quick discussion of the distribution of the variables. A summary of the panel data is shown below in table 2. Although this is described in the methodology, for clarity the variables in order are:

- ln(lead data on EV's)- this is the natural log transform of the lead data on EV's per 1000 people
- Charging stations per 1000: the number of CS's per 1000 people in a municipality
- Density of EV's: this is the density of EV's in a *county* and is expressed as the number of EV's per km^2 in the municipality. It is a measure of the likelihood that a random person in the street is likely to see an EV.
- Density of People: This is a measure of urbanisation. It measures the number of people per km^2 per municipality.
- Median income (1000 nok): this is the median income of a municipality in 1000's of nok's. It highlights the average wealth
- Votes for the greens percentage: This shows the percentage of voters who are likely to vote for the greens party in the Storting election per municipality.
- High tech with master's degree per 1000: this is a measure of high tech employment in a municipality based on education level of its citizens. This variable displays the number of people per 1000 that have a master's degree or higher.
- Sports spending per capita extrapolated: This shows the consolidates expenditures of each municipality of sports facilities per person.

Table 2: Summary Statistics

Summary Statistics

	Mean	S.D	Min	Max
LeadLn(Ev's per 1000 people)	0.330	0.584	0	4.1
Charging Stations per 1000 ppl	0.216	0.690	0	15.8
Density of EV's	0.046	0.359	0	17.0
Density of People	51.2	140.3	0.30	1,809.4
Median income (1000 Nok)	399.4	63.0	232	626.0
Votes for greens (%)	0.675	0.799	0	10.2
High-Tech w/ master degree (per 1000 ppl)	19.3	13.1	1.34	108.5
Sports spending per capita consolidated	256.4	466.5	-4519	8,576.0

***p<0.001, **p<0.01

A quick look at this table shows that despite various transforms, the data representing EV adoption, charging stations, density of EV's, Density of people, high tech employment and votes for the greens party are quite positively skewed. This is likely what introduced the heteroscenasticity into the data and what was corrected for with the robust error terms. In terms of visualising what this means, we can understand it in the following way: the vast majority of the 422 municipalities have values surrounding the mean of each of the positively skewed variables. However, a decent percentage have exceedingly high values which skew the data positively. For example, roughly 70% of municipalities have less than 1 charging station per 1000 people but the other 30% range from 1-16 charging stations per 1000 people which introduced the skew.

4.2 Table of correlations

Table 3 below shows the pairwise correlation between each of the variables used for this analysis. We can see that due to the large number of observations for each entry, the statistical significance of almost every value is very high. We also notice a strong correlation between some of the variables. This connection can possibly lead to serial correlation when performing panel regression but as mentioned before the Wooldridge test ensured that this was not the case (Wooldridge, 2002).

Table 3: Pairwise correlations between variables. Source: Own creation

Pairwise Correlations

	1	2	3	4	5	6	7	8
1. LeadLn(Ev's per 1000 people)	1.00							
2. Charging Stations per 1000 ppl	0.3***	1.00						
3. Density of EV's	0.25***	0.12***	1.00					
4. Density of People	0.27***	0.09***	0.37***	1.00				
5. Median income (1000 Nok)	0.62***	0.24***	0.13***	0.17***	1.00			
6. Votes for greens (%)	0.59***	0.25***	0.26***	0.15***	0.52***	1.00		
7. High-Tech w/ master degree (per 1000 ppl)	0.41***	0.17***	0.32***	0.61***	0.36***	0.37***	1.00	
8. Sports spending per capita consolidated	-0.06***	0.02	-0.03	-0.02	-0.09***	-0.02	0.00	1.00

***p<0.001, **p<0.01

It is interesting to note a strong positive correlation between the adoption rate of EV's and the three variables median income, votes for the greens and High tech with master's degree (per 1000 ppl). The first of these highlights the most common problem cited as the barrier to adoption of EV's; the financial barrier. The extremely strong correlation between EV adoption and median income shows that in municipalities with higher average wages, adoption of EV's is more likely as they are likely to have more expendable income.

Another extremely strong correlation visible on table 3 above is between EV adoption and the number of votes for the greens party. This supports hypothesis 3 as is suggests that in municipalities where a larger percentage of the population votes for the greens party, a larger portion of the population will also purchase an electric vehicle. This is unsurprising as people see combustion engines as a major cause of global warming and they view EV's as a suitable replacement and an individual act which can make a difference. Since the greens party is one of the most publicly active groups promoting renewable solutions which do not contribute greenhouse gasses, it is logical that people that vote for the greens party will also be inclined to purchase an electric vehicle.

The proportion of the population of a municipality that is highly educated was also found to be very highly correlated with the number of EV's. This supports hypothesis 4 in that people who are employed in high technical industries are more likely to identify themselves as highly technical and be inclined to adopt technical innovations more rapidly. It is also possible that the more educated members of society better understand the problem associated with global warming and the need to combat it. This is supported in the correlation table as the density of high tech employment also has a medium-strong correlation with votes for the greens party. Interestingly, it is noted that density of high tech employment is highly correlated with density of people within a municipality. This indicates that dense urban areas have a higher percentage of highly educated citizens. I.e. educated people tend to work around the larger cities. Another interesting observation is the high positive correlation between the percentage of the population who votes for the greens and median income. This highlights that the municipalities with higher average wages also tend to have greater concern for the wellbeing of the environment.

4.3 Results of the regression analysis

I will begin this section with a brief overview of how to analyse the data from a fixed effects analysis. It is first important to check that the probability (F) is greater than 0.05 as this will tests to see if the model is valid. The next step is to look at the t value, if it is higher than 1.95 then we can be confident that the independent variable has a significant effect on the dependent variable. The two tail P value provides a similar insight; if its value is less than 0.05 then we can assume the independent variable is significant in explaining the dependent variable. Finally, we check the coefficients to see the both the direction and strength of the connection. If the coefficient is positive then both the independent and dependent variables will increase together, if the coefficient is negative then an increase in the independent variable will cause a decrease in the dependent variable. An increase in 1 unit in the independent variable will correspond to a change in the dependent variable equal to the value of the coefficient.

The results of the fixed effects regression model is shown in figure 8 below. This shows the analysis of both the control variables and the independent variables. Robust error terms were used to control for heteroscenasticity. As we can see, there are 3798 observations taken into account for each of the 422 municipalities.

The most important observation here is the positive relationship between the dependent variable (Ln of the number of EV's per 1000 people) and all of the independent variables. This implies that all of the independent variables indeed contribute to the increasing adoption of EV's in Norway. The most important of these are the three independent variables; charging stations per 1000 people (t=4.88, P=0), percentage of votes for the greens party (t=6.89, P=0) and percentage of the population with high tech employment (t=6.62, P=0). We see that each of these variables has a significant influence on the proportion of EV's within a municipality. These three observations support hypotheses 1, 3 and 4.

Table 4: Regression analysis of test variables with control variables

Variables/models	1	2
Controls		
Median income (1000 Nok)	0.0062***	0.00084*
	(0.00027)	(.00043)
Density of People	0.014***	0.0017
	(0.0041)	(.0021)
Sports spending per capita consolidated	0.00015***	0.0001**
	(.00003)	(0.00004)
Independent Variables		
Charging Stations per 1000 ppl		0.097***
		(0.020)
Density of EV's		0.097
		(0.11)
Votes for greens (%)		0.27***
		(.039)
High-Tech w/ master degree (per 1000 ppl)		0.041***
		(0.0062)
Constant	-2.883***	-1.112***
	(.19)	(.18)
Groups	422	422
Observations	3798	3798
Rsq Overall	0.135	0.296

*** p< 0.001, **p< 0.05, * p< 0.5

Note: Standard errors in parenthises

For an increase in 1 charging station per 1000 people within a municipality, we see a corresponding rise of almost 10% in our dependent variable. We see an even stronger and more significant effect with the percentage of the people who vote for the green party. A deviation of 1% in the number of votes cast for the greens corresponded with a 27% increase in the dependent variable. Finally, an increase of 1 person per 1000 in a municipality corresponded with an increase in 4% in the dependent variable.

Contrary to Hypothesis 2, it was found that the relationship for density of EV's is not statistically significant (t=0.68; p=.495). This indicates that the likelihood of randomly encountering an EV on the street does not have a significant effect on the adoption of EV's within a municipality. Although we could almost certainly argue that this factor plays a role in increasing the legitimacy of EV technology, it is likely that there are other factors which encourage adoption to a much larger degree. In addition, density of people was found not to be a significant predictor of adoption of EV's (t=0.79; p=.429).

The final two variables (which incidentally were used only as control variables) were median income and the consolidated expenditures on sports per municipality. As expected, both of these variables had a positive correlation with the dependent variable which was statistically significant for sporting expenditures (t = 2.29 and P = 0.023) and just straddling the 95% confidence range for median income (t = 1.95 and P = 0.052). On average, it was found that an increase in 1000 nok per year on the median wage would result in an increase of only 0.08% in the dependent variable. Similarly, an increase in the investment into the outdoor culture of a municipality of 1 nok per capita was found to cause an increase of 0.01% in the dependent variable.

4.4 Discussion and Recommendations

4.4.1 Limitations

As with all empirical research, this study is not without limitations. As was mentioned in the methodology, several key variables were left out of the analysis as they did not contribute to the variance on a municipality level. These variables were the number and generosity of government incentives for electric vehicles, media coverage promoting electric vehicles and technological advancements in electric vehicles over time. However, these factors no doubt had an influence on the overall adoption rate nationwide. Hence, it may be difficult to generalize these findings to other countries in the absence of similar conditions. As it stands, Norwegian incentives are the most generous and numerous in the world and so applying these results in other countries is likely to have a diluted effect.

Another limitation is the useful timeframe of this analysis. As technology advances at an accelerating pace, incremental and disruptive innovations are likely to continue to make electric vehicles a more attractive option. As the value of EV’s in relation to regular cars reaches parity in terms of performance, price and status it is likely that the influence of the variables in this analysis will change.

4.4.2 Implications

There have been a number of investigations which study the motivations for buying an electric vehicle both before and after the fact; all measurements have been at least partially biased by the responses given by the persons interview (Ozaki & Sevastyanova, 2011). This is the first quantitative analysis which looks directly for correlations between antecedents as highlighted by previous studies in this field, and their observable effect on the sales of electric vehicles. This analysis will hopefully be taken into account by municipalities when deciding upon investments in incentives for electric vehicles.

Another insight which should be taken away from this project is that it appears to be the 5 key attributes as defined by Rogers (2003) that are behind all of the variables tested throughout this analysis. To reiterate, these factors were: relative advantage, compatibility, complexity, trialability, and observability. All of the variables tested contributed to one/several of these attributes with 'relative advantage' being the most prominent. It should thus be noted that it is likely not any of these variables that can completely predict EV adoption on its own, as it seems that many factors are taken into account simultaneously when judging these 5 attributes.

4.4.3 The impact of charging station infrastructure

As expected, investments in charging station infrastructure were strongly correlated with the number of electric vehicles in a municipality. This is the factor that municipalities have the most control over out of all the datasets. Due to the exponential relationship in the regression, it was found that an increase in charging stations had an exponential effect on adoption (i.e. the more charging stations in municipality, the faster the adoption *rate* became). Hence, any municipality should be able to grow its level of EV's by installing this infrastructure. This finding was unsurprising since the timing of the infrastructure boom was so close to the massive growth in adoption. However, it should be useful for municipalities to understand the expected growth in EV's that may result from a charging station infrastructure program.

This finding supports a few of the predictions made by Rogers in his diffusion of innovation theory discussed in the literature review. The presence of charging infrastructure provides the new technology (EV's) with a higher relative advantage as well as making them more compatible with their current way of life. As was mentioned, EV's were perceived by the public to be inferior to ICE vehicles in a number of ways; power, distance and performance to name a few. The problem of 'range anxiety' was one particularly prominent drawback. For ICE's this is not a problem as there is an abundance of infrastructure (refuelling stations). The installation of charging stations reduces the perceived drawbacks of EV's and increases their relative advantage. On a lower level, charging stations also increase the compatibility and reduce the complexity of EV's as they operate in a familiar context (i.e. people are familiar with charging electronic devices with power outlets and are also familiar with filling up ICE's with petrol at fuel pumps. These processes are perfectly transferable to EV's.

4.4.4 The impact of education and high tech employment

Although the degree of education and high tech employment in a municipality is less subject to direct control as is charging station infrastructure, it was still found to have a very large and significant impact on the adoption of EV's. This is an especially important insight for municipalities such as Bærum, Asker, Ås and the many other municipalities which already have a large percentage of the population involved in the high tech industry as they are in good positions to really capitalise on this fact. In addition, it highlights just another benefit of growing the high tech sector here in Norway. It is likely that this attribute will be valid on an international level as well and that countries with a greater degree of education and a larger high tech industry will be more likely to become initial adopters of electric vehicles.

This insight also supports aspects of institutional theory and findings by Jacobsen (1998), who noted that people who identify themselves as technically efficient are more likely to become earlier adopters of a technology. This also fits with Rogers' theory of diffusion as a higher technical proficiency would reduce the perceived complexity and could possibly increase the perceived relative advantage of an innovation (Rogers, 2003).

4.4.5 The impact of environmental awareness and activism

Perhaps one of the most prominent drivers of electric vehicle adoption was the culture of environmental awareness and activism that was present in a municipality. Once again, this variable is difficult for municipalities to control directly but can be indirectly influenced by the media and by wise investment decision made by municipalities. Companies, celebrities and political leaders are able to lead by example on a municipality level hence inspiring their citizens to be environmentally conscious. It was found that the degree of environmental pro-activism was one of the strongest predictors of EV adoption. Once again, municipalities with a strong percentage of the population with an environmentally oriented bias should capitalise on this with investments into charging infrastructure. We could also expect this trend to continue internationally with regions with a high degree of environmental awareness being more likely to become early adopters of EV's.

5.0 Conclusion and Recommendation

At the onset of this research project, the aim was to determine 'What can explain the variation in EV adoption in Norwegian municipalities and to what degree?' Since this was such an open ended question to begin with, it was tackled in two parts. The first part of the question 'What can explain the variation in EV adoption' was determined within the literature review. Based on previous research on the motivations and barriers for EV adoption, it was determined that the major drivers of EV adoption were primarily financial, technological and social factors. Specifically, these motivations revolved around environmental concerns and dissatisfaction with inflated and volatile oil prices whilst barriers to adoption were mostly financial and performance concerns.

These factors eventually boiled down to the concept of legitimacy as seen in Roger's theory of diffusion of technology. Technologies which are perceived as legitimate have a greater chance of passing the adoption phase and making it into the implementation phase (purchasing an EV). Hence, it was determined that incentives and social factors that increased the legitimacy of electric vehicles as well as their functional capacity would likely act as significant drivers for adoption. This led to four objectives that were to be the focus of this investigation that were redefined as four individual hypotheses to be tested.

The first objective was to determine the impact that the accessibility of charging stations had on the adoption of EV's. From Bakker (2011) and Furnes (2014) it was shown that an availability of charging infrastructure helped to promote the adoption of electric vehicles in two ways. The first was the practical aspect, where a robust charging infrastructure would enable you to charge an electric car whilst away from home. This increases the distance that EV owners can travel and hence the practicality. The second aspect was psychological and had to do with reducing 'range anxiety'; a phenomenon where an EV owner becomes anxious about the possibility of running out of power before they are able to recharge. This was listed as one of the major problems for EV drivers. The correlation analysis supported this hypothesis and showed a moderate correlation meaning that municipalities that had more charging stations were more likely to have more EV's. In addition, the regression analysis showed this relationship to be highly significant. It was determined that an increase of one charging station per person resulted in an average growth of 10% in the dependent variable. Hence, we concluded that upgrading the charging infrastructure is one of the most cost effective and reliable ways of increasing adoption within a municipality

The second objective was to determine the effect of increasing EV's legitimacy through increased levels of exposure. Observability was one of Roger's (2003) 5 attributes which make up the persuasion stage. Arlene Parisot (1995) states that "Role modelling (or peer observation) is the key motivational factor in the adoption and diffusion of technology." With this in mind, we modelled the likelihood of a random citizen encountering an EV in their municipality against the adoption rates of EV's. Although a moderate correlation was found between the two datasets, the results of our regression analysis indicated that this was not a significant factor in explaining adoption rates. This led to the conclusion that randomly encountering an EV on the street was not the most significant method of increasing observability of EV's. It is likely that individuals will come into contact with this technology far more often through other means such as online and on the television.

The third objective was to determine the impact of personal values and community identity on the adoption of electric vehicles. In the theory of institutions, the role of norms and individual cognition were discussed in relation to their role in adopting new technologies. Scott (2007) and Hofstede (1997) both highlight the role that cultures play on both of these factors. Cultures can be defined on almost any scale, including both a national culture and more regional culture (municipality level). Slight differences between the cultures of the municipalities on the issue of environmentalism were shown to have a large and significant effect on the adoption rate of electric vehicles. There was an extremely high correlation between the number of voters for the greens party and the adoption of electric vehicles. This was further supported by the regression analysis which showed that a 1% increase in the percentage of voters for the greens party resulted in a 27% increase in the dependent variable. Simultaneously, whilst it was found that a municipality's budget for outdoor recreation and sporting activities was not correlated with EV sales, the regression analysis did show it as a significant predictor of adoption. It estimated that an increase in spending of 466nok (1 standard deviation) would result in almost a 5% increase in electric vehicles. This highlights that municipalities or cities with big outdoor/ sporty culture would be slightly more likely to adopt EV's. It was concluded that although municipality culture is a far more difficult variable to change, its effects are highly significant on EV adoption in the long term.

The final objective was to determine the impact of education level and employment in high tech industries on the adoption rates of electric vehicles. It was shown by Jacobsen (1998) that a person's identification of themselves as 'proficient with technology' or 'technologically savy' was positively correlated with their likelihood to be in the adopter category of Rogers's diffusion of innovation graph. Thus, we hypothesised that cultures with higher technical proficiency will be more likely to become the early adopters of technical products such as electric vehicles. Our analysis also provided evidence for this hypothesis as it found a high correlation between employment in high-tech industries within a municipality and EV adoption. The regression found that an increase of 1 citizen per 1000 who was employed in a high-tech position would lead to an increase in 4% in the dependent variable. Most notably, this highlights that municipalities or cities with large high-tech industries would be prime locations for promoting EV's with limited resources.

The information determined in this analysis should be of particular importance to the policy makers of Norway. It highlights the success of the current infrastructure rollout plan as well and predicts the impact of investments for municipalities.

Although these findings may not be directly applicable to other countries, they do serve to highlight a few mechanisms driving EV adoption that are often left out of literature on the subject; namely the role of culture and a high tech image. Nations looking to implement an incentive program for electric vehicles should carefully analyse the social environment in order to understand what locations would be most responsive to such a change. Although many of these findings should not really come as a surprise, it is useful nonetheless to have quantitative evidence supporting the expanse of theoretical research and it is nice to understand why the current methods being used in Norway are working as planned.

5.1 Future research

This analysis has a fairly narrow scope of investigation and is primarily of value within Norway. In the interest of broadening the scope of the findings in this report it would be useful to conduct a quantitative report with different countries as the unit of analysis. This would take factors such as media coverage, number of available EV models and the incentive schemes into account as well as the factors measured here.

In addition, it would legitimize the results if similar reports were to be conducted in other regions where the adoption of EV's is underway, for example the US, Japan or the Netherlands.

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