Overcoming the Barriers to Electric Vehicle Uptake in Denmark

Abstract

Denmark has a goal of becoming fossil fuel free by 2050. Yet, they have one of the lowest rates of adoption of electric vehicles among developed countries. To understand the consumer's interests in electric vehicles, we utilized background research, performed 12 interviews, and conducted a survey with 1,092 respondents. Four major barriers to electric vehicle uptake were identified: range, price, infrastructure, and consumer knowledge. Recommendations provided to the Danish Consumer Council include: Danish charging station mobile app development, an industry review in Taenk, Value Added Tax exemption for electric vehicles, and increased standardization. This project serves as a tool for the Danish Consumer Council to aid electric vehicles in contributing to Denmark's environmental goals.

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Problem Statement

As an environmentally conscious country, Denmark has developed a strategic energy plan to combat their fossil fuel emissions. They have an ambitious goal of becoming the first fossil fuel free country by the year 2050 (Somethings Green in the State of Denmark, 2012). To achieve this goal, the Danish government invested significantly in alternative energy sources such as wind power. As a result, they are now the world leader with 30% of their electricity being produced through wind power (Shahan, 2013).

Realizing the potential environmental benefits of electric vehicles (EVs), the Danish government developed a number of incentives designed to promote the industry. For example, gas-powered automobiles are taxed at a 180% rate, while electric vehicles are exempt from that tax (Bergman, 2010). Other incentives include free charging and parking in the city.

Even with the offered incentives, only 647 electric vehicles were sold in Denmark in 2013 (Marth, 2013). For a country focused on sustainability, the surprising lack of EV uptake suggests there are major barriers limiting the development of the electric vehicle industry.

The Danish Consumer Council (DCC) desires to promote the EV industry in order to protect the Danish consumer's interests and rights. In turn, this will aid in reaching Denmark's carbon neutral goals.

Background

Before leaving for Denmark, the team conducted 7 weeks of research on the electric vehicle industry, Denmark, and the project sponsor the Danish Consumer Council (Forbrugerrådet in Danish). The Danish Consumer Council is concerned with the lack of consumer adoption of electric vehicles. This is due to the negative impact internal combustion engines (ICEs) have on the environment. Gases emitted from ICEs heavily contribute to the greenhouse effect, and as a result many countries are encouraging the implementation of electric vehicles.

Numerous nations are pushing to put more electric vehicles on the road; however some countries are more successful than others. Norway, for instance, has the highest electric vehicle ownership per capita and the highest total sales. They have 21,000 EVs on the road and a population of only 5 million people (The Ecologist, 2014). In fact, the two bestselling vehicle models in Norway in 2013 were EVs, Tesla's Model S and Nissan's Leaf. This strong EV uptake is in part due to Norwegian incentives including free charging, free parking, waived tolls, access to bus lane travel and other generous government incentives that equate to an estimated savings of $8,337 over 10,000 km (The Ecologist, 2014). With the Danish government offering many of the same incentives implemented in Norway, it begs the question why has Denmark's electric vehicle industry not seen the same success?

Mission Statement and Objectives

The goal of this interactive qualifying project is to provide the Danish Consumer Council with recommendations on how to allocate their resources moving forward in regard to electric vehicles. The objectives of our project are the following:

1. Understand the functions of the Danish Consumer Council in order to align our project with their vision and strategy.
2. Identify the barriers limiting major uptake of Electric Vehicles by consumers in Denmark and how they can be overcome.
3. Determine the interests and concerns the Danish consumer regarding electric vehicles.

Methodology

To achieve our main goal of providing the Danish Consumer Council with future recommendations in the electric vehicle industry, we utilized three different types of data collection techniques: internal research, a consumer survey, and semi-structured interviews.

Through sources provided by the DCC, the project group aimed to understand the Danish Consumer Council's standard protocol of action and how they conduct their business.

By doing so, we were able to align our project recommendations with the organization's standard course of action.

The second method was to conduct a consumer survey. The Danish Consumer Council publishes a quarterly magazine for their 85,000 members (Figure 1) and distributes a survey to a small sample of these members. We posed five questions on this survey, and obtained 1092 responses representative of the entire nation. In addition to the five electric vehicle questions, the project group was privy to demographic information including age, gender, and region.

The survey questions posed by the project group included: type of future car purchase (gas, diesel, electric, hybrid, etc.), acceptable driving range, price willing to pay, acceptable charge time, and most desired EV improvements.

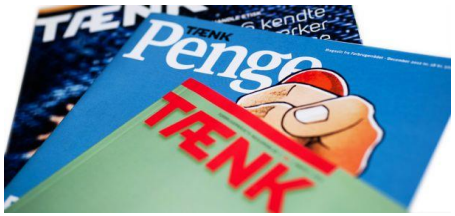

Figure 1- Taenk Magazine

The survey results were analyzed using Microsoft Excel. The team designed graphs based on the questions posed and found any interesting patterns related to the demographic questions. The quantitative analysis was then combined with the interview analysis to achieve our final results.

Semi-structured interviews were the third method for this project. The team contacted many organizations involved with the EV industry including car dealerships, environmental organizations, and consumer organizations. These included BMW, Clever, Danish Eco-Council, Danish EV Alliance, Norwegian Consumer Council, Renault, and Tesla among others.

To conduct the qualitative analysis of these interviews, a process called deductive open coding was used. In this process, each interview is transcribed and then highlighted different colors based on topic at that stage of the interview. The highlighted topics were grouped into categories which were then organized into Excel files. The team then took these categories and conducted a cross analysis of the different viewpoints to identify some of the key barriers preventing the uptake of electric vehicles in Denmark.

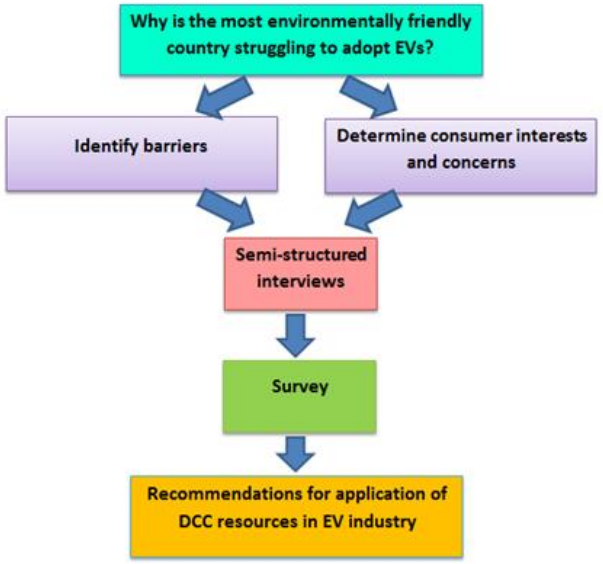

Figure 2- Methodology Flow Chart

Results

The driving goal for the project was to inquire about the consumer interests regarding electric vehicles in Denmark. The dominant response was that in Denmark, electric vehicles are too expensive and the industry is too early in development for consumers to dive in. Range was another major factor consumers brought up. Many of the interviewees expressed that a lack of knowledge is hindering the population from accepting electric vehicles into their daily lives. Below are the results obtained from the qualitative analysis of the semi-structure interviews and the quantitative analysis of the Taenk survey.

Interviews

By conducting twelve interviews across a range of different organizations, our team observed the electric vehicle industry from a number of viewpoints. Price and range were considered the most important barriers according to our expert interviewees. Consumer knowledge, infrastructure, Norway, and what to do moving forward were also common themes among the discussions.

The price of current EVs was mentioned in every interview conducted. Many interviewees thought the tax system needs to be reworked, and microcars need to be priced higher for the EV to have any chance in Denmark. Microcars (small compact vehicles such as Smart Cars) are selling in record numbers in Denmark. They have many tax breaks and as result are the cheapest cars on the market. This price difference between microcars and electric vehicles is greatly hampering the EV industry.

Range was another major barrier according to the majority of our interviewees. 90% of all trips in Denmark can be made with an EV, but range anxiety is preventing consumers from purchasing an EV. Range anxiety is partially due to a lack of information flow between EV manufactures and consumers. The range consumers believe they drive is much greater than the actual number. The Norwegian Consumer Council representative believed that people can make 90% of their trips with an EV, but it is impossible to overlook the other 10% of trips.

Other forms of transportation can be used for the remaining 5-10% of the time when consumers need a longer range. This includes finding charging stations along the way or owning an EV as just a secondary vehicle. Overall, the organizations believed that an EV is not ideal for long trips but can certainly service consumers' needs most of the time.

Standardization was an interesting topic of discussion and the feedback was different than our original assumptions. We hypothesized that infrastructure would be a top concern for consumers, but according to our interviewees, this was important but not a top priority. The major concern is not the amount of charging

stations, but rather the interoperability between the top companies, Clever and E-On. The Clever representative had a strong view that current interoperability was great, however, she was alone in this viewpoint. In order to charge at one of these stations you must be a member, and if you want to charge at a different provider's station, you have to call through to the company's customer service. This added step wastes time and hinders consumers. The interoperability needs to be as easy as filling up a tank of gasoline or consumers will reject it.

Next the team inquired further about the country of Norway in our interviews because there are many similarities to Denmark yet Norway has much more success in their EV development. First and foremost, Norway is simply a wealthier nation. Their inhabitants have a higher per capita income on average. This makes electric vehicles more feasible to purchase for their population. The team was also informed by the Norwegian Consumer Council that cars are a more prominent means of transportation in Norway when compared to Denmark. Another major factor is that Norway has a large amount of hydro-electric power which provides cheap electricity for EVs. Lastly all mentioned that Norway offers more incentives for electric vehicle buyers. The main difference is that in Denmark electric vehicle purchase is exempt from the vehicle registration tax but not the 25% Value Added Tax. In Norway they pay neither.

Finally the interviewees were asked how the uptake should move forward and each organization mentioned various solutions. The Eco Council believed that hybrids were a crossover solution to full EVs and could be a great stepping stone. The EV Alliance thought targeting fleet owners and not private consumers would be a better option. The Federation of Danish Motorists representative said that EVs were not the solution to the transportation emission problem. The numerous suggestions aided the project group in making its final recommendations to the Danish Consumer Council.

Taenk Survey

The survey was sent out to 2710 consumers and had 1092 respondents, which correlates to a 40% response rate. Demographically, the majority of respondents were female at 61%. 79% of the respondents were over the age of 35, and 60% were over age of 50. In terms of regions in which the respondents live, the majority come from Greater Copenhagen and Central Denmark.

The first question we asked the respondents was "what type of car would you consider buying for your next car?" Overall, more than half of the respondents said they would purchase a gas car as their next car with 57.8% while electric was only 12.5%. The data showed that the older a person is, the less likely they are to purchase an EV.

The second question posed was "what is the price range you would be willing to spend on a new vehicle?" An interesting result from this question was that 11.1% of all respondents said they would under no circumstances purchase a car. 20% of respondents from Greater Copenhagen said they would under no circumstances spend money on a car, and this is most likely because of the large amount of people who commute by bike or public transportation in the Copenhagen area.

"What improvements concerning electric vehicles would substantially impact your decision to purchase one?" was the third question. The results of this can be found in Figure 3 below. Overall, respondents would like to see electric vehicles have longer range per single charge, increased availability of charging stations, and a cheaper MSRP, with 53.4%, 43.1%, and 38.6% subsequently.

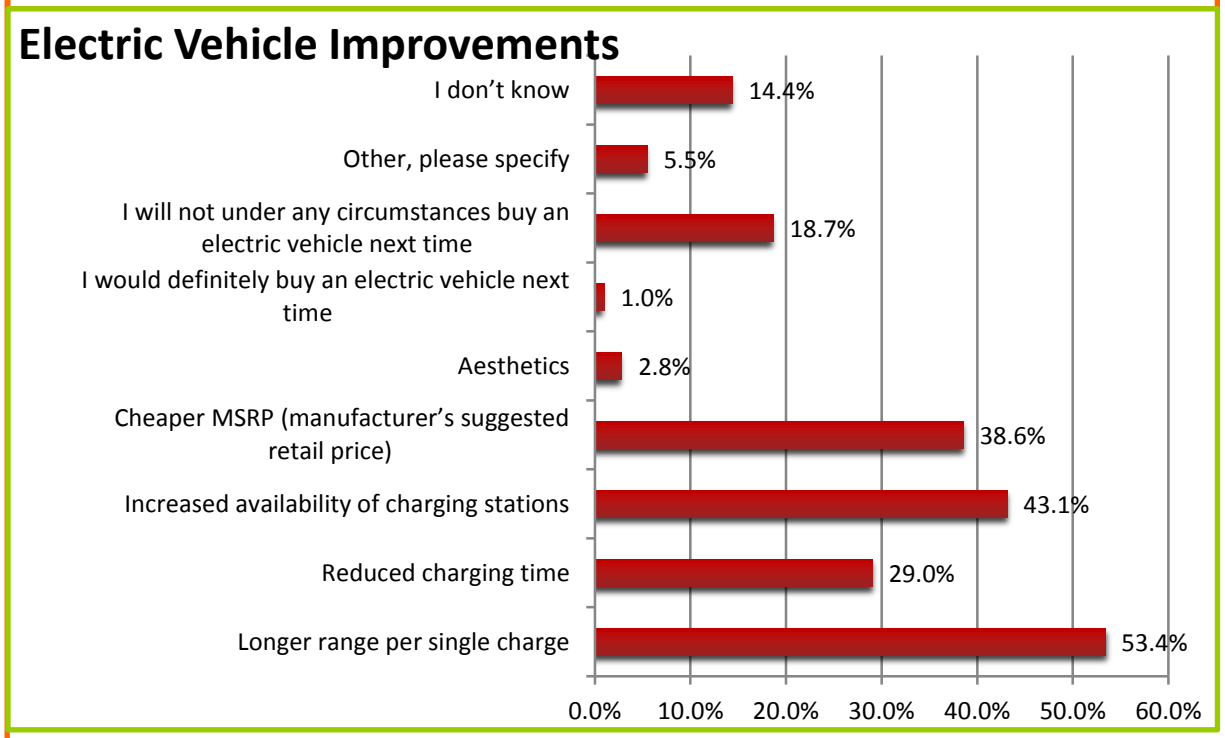

Figure 3- Electric Vehicle Improvements

The fourth question was “what would you consider to be the longest acceptable time to fully recharge the battery of an electric vehicle?” The majority of respondents chose “under 2 hours,” or “I don’t know.” In terms of gender, the “I don’t know” answer choice was chosen by 35% of females compared to only 14% of males which indicates that females have less overall knowledge of the EV industry.

Finally, the project group asked “what is the range that an electric vehicle would need before you would consider buying or leasing one?” “I don’t know” was the most common answer closely followed by “161-320km” and “321-450km,” respectively. Again 35% of females responded “I don’t know” compared to only 14% of males.

Overall, the survey made it clear that electric vehicles were the least popular answer for which type of car would be purchased next. In addition, many respondents had no interest in purchasing a car because they do not need one. Range is the biggest issue that the respondents had and in order for consumers to consider EVs to be viable options, they need to be convinced that there is no acceptable range. Another common theme from the Taenk Survey was that a large percentage of respondents lacked education on electric vehicles. Females made up the majority of these responses saying “I don’t know,” to questions concerning improvements, charge time, and range for electric vehicles.

Conclusions

After completing the data analysis, the project team determined what the contributing factors were to the lack of electric vehicle uptake in Denmark, and how the Danish Consumer Council can help combat the problem. We found there are four top barriers in Demark for the EV industry uptake (ranked highest to lowest): range, price, consumer knowledge, and infrastructure.

53.4% of our survey respondents said that range was an improvement that needed to be made in order for them to consider purchasing an electric vehicle. This places range at the top of the list for consumer concerns and identifies it as a major barrier to electric vehicle uptake. Through our qualitative analysis, we also determined that range is a major obstruction. However, the ability to have more in-depth research with qualitative compared to quantitative allowed the group to realize that it is not just range but range anxiety. Consumers are unaware how far they actually travel and what electric vehicles could fit their needs.

Price is the second largest obstruction to the development of the EV industry in Denmark. Current prices for the average EV are still higher than the average internal combustion engine, even with the exemption of the 180% vehicle registration tax. Micro cars are taking a high percentage of the EV market because they fit the same needs, yet are priced significantly lower (many under 80,000 DKK).

The third barrier, lack of consumer knowledge could potentially be the best target area for the DCC to focus on. The Taenk survey participants expressed that range was the largest obstruction to uptake, but the team realized that consumers were not aware which EVs could fit their needs. When inquiring about price, the project group learned that consumers disregard EVs typically due to their initial cost. Most consumers are unaware of cost over time.

The lack of infrastructure, in this case the availability of charging stations, is identified as the fourth barrier. The fear of running out of fuel while on the road is a very real factor in potential buyers’ minds. Additionally, there is a need for more standardization of charging stations. Currently, there are two main charging providers in Denmark, Clever and E.On, and crossing over from one to another is not as convenient as refueling at a gas station.

Figure 4-Team Member Vincent Samuel at Tesla

Figure 5- Team Member Brodie Green at BMW

Recommendations

After identifying the four main barriers preventing consumers from purchasing electric vehicles, the team provided specific recommendations that fall within the Council's operations to push the EV industry. This is in accordance with objective one; understand the functions of the Danish Consumer Council. The DCC could further benefit consumers by overcoming the barriers mentioned and approaching three main parties listed by priority: Consumers, Danish government, and car dealerships. These groups represent different areas in the development of the electric vehicle industry.

To increase the information flow to consumers, the DCC could create a product or industry review in the Taenk Magazine. These product reviews are commonplace in the magazine and would provide consumers with more information on the electric vehicle industry. In addition, a major help to consumers would be the development of a mobile application and website that provides the location of all EV charging stations. Currently, there are no such apps made specifically for Denmark, which contributes to the consumers' lack of knowledge and range/infrastructure anxiety.

Recommendations for the Danish Consumer Council under Government utilize one of their main tactics, political lobbying. In the case of electric vehicles, the removal of the Value Added Tax would be substantial, and has been successful in Norway. In addition, ease of interoperability is a consumer right and without which, the EV industry will be hampered. This would best be approached from a government level to enforce standardization of charging stations and plugs. Also, the expansion of current EV incentives such as free tolls and access to bus lanes will aid in the advertisement of the benefits of purchasing an EV.

It is in the best interests of the consumers for the DCC to conduct further studies to determine why dealerships are reluctant to promote their EVs. Specifically, determining the EV pricing framework compared to ICEs. In addition research on whether the consumers are receiving full benefits from the tax exemptions or if dealerships are just receiving larger profits.

In closing, this project is a valuable tool for the Danish Consumer Council's use. The impact of consumer uptake of electric vehicles will result in a more sustainable environment and be instrumental in reaching Denmark's fossil fuel free goal. Information provided within this report identified four barriers to the industry's development and included recommendations on how they can be overcome. See figure 6 below for a table of these problems and possible solutions.

Target Group	Problems	Recommendations
Consumers	• Lack of knowledge • Range anxiety • Current negative opinion of EVs because of Better Place	• Industry review in Taenk • Smartphone application locating all charging stations
Government	• Exemption of Vehicle Registration tax is not effective enough • Microcar tax breaks are too extreme • Interoperability of charging stations and plugs • Limited EV incentives and advertisement	• Lobby for removal of value added tax (successful in Norway) • Propose standardization between charging stations and plugs (use of Clever and E.ON) • Expanded incentives and advertisement Ex. Free tolls, access to bus lanes
Car Dealerships	• Reluctance to push EVs • Battery technology • EV Prices after tax exemption	• Study why Dealerships are not pushing EVs • Research EV vs. ICE model pricing

Figure 6- Table of Recommendations

Figure 7- Team Member Jacqueline Lynch at Renault

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Figure 8- Team Member Lawrence McGillicuddy at Tesla