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Experiences from Norwegian EV owners – Using the EV for all purposes

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Summary

Norway is the world's leading electric vehicle market with a 31% battery electric (EV) and 18% plug-in hybrid (PHEV) market share by the end of 2018. In this paper, we will look at the experiences from the Norwegian battery electric vehicle (EV) owners. Are the EVs able to replace the use of traditional internal combustion engine (ICE) cars? What are the experiences of the Norwegian EV owners and what lessons can be learned? How has the use of EVs developed the last years and what challenges lie ahead? In this paper, we will present the results from the Norwegian Electric Vehicle Association's latest EV owner survey with more than 9500 respondents. The data is compared to previous survey conducted by the Norwegian EV Association to better understand how the use of EVs develops over time. The results show that an increasing number of households rely on the EV as the only car in the household. In multi-car households, the EV is the most used car.

1 Introduction

Norway is the world's leading EV market with a 31% EV and 18% PHEV market share by the end of 2018 [1]. Demand has been outstripping supply as consumers are subjected to long waiting lists and high second-hand prices. This paper aims to reveal the experiences of the EV owners who live in the country with the highest EV density in the world. The analysis in this paper is based on data from the Norwegian EV Association's annual EV owners survey. The method will be further described in Chapter 2. Some background information regarding the Norwegian EV policy and the Norwegian charging infrastructure will be presented in chapter 3 and 4. The presentation of these topics is important to understand the ongoing EV transition in Norway and to understand the enabling of a full transition in the future. Chapter 5 will go through the background of the EV owners. In chapter 6 the analysis of the survey results will be presented. The analysis will finally be concluded in chapter 7.

2 Method

The method in this report is survey through digital questionnaire. The main survey results are from the EV owner survey 2018, though some comparisons to older EV owner surveys will be made. The EV owner survey is s survey conducted by the Norwegian EV Association on an annual basis since 2012. The EV owner survey 2018 was conducted in May and had 9520 respondents, all EV owners. The population of the survey is the Norwegian EV owners. The sample consists of both members and non-members of the Norwegian EV Association. The survey was sent out to 44559 EV owners and got 9520 responses. The response rate is 21%. A digital questionnaire was sent to the respondents by e-mail. The median response time was 22 minutes.

The sample is not weighted by gender, geography and age. The sample might be skewed in comparison to the population on different variables. It is likely that the membership base of the Norwegian EV Association consists of a higher share of new EV owners, than the general population, due to an increased need for information as a new EV owner. It is also likely that there are more new car owners in the sample, than in the general population. This is due to the one-year free membership in the Norwegian EV Association that is given to many new EV owners in Norway. The male share of 76% might seem overrepresented in the sample, but a similar gender distribution can be found in other EV owner studies. The geographic distribution of respondents is similar to the geographic distribution of EV owners in Norway, with a slightly lower distribution of respondents in Hordaland county (shown in Table 1). The underrepresentation of Hordaland is explained by a lower number of members in Hordaland county in the Norwegian EV Association's membership base.

Table 1: Geographical representation.

Share of EVs per county		
County	The EV owner survey 2018	Statistics Norway 2017
Akershus	21 %	21 %
Aust-Agder	2 %	2 %
Buskerud	6 %	4 %
Finnmark	0 %	0 %
Hedmark	2 %	2 %
Hordaland	12 %	16 %
Møre og Romsdal	3 %	2 %
Nordland	2 %	2 %
Oppland	2 %	1 %
Oslo	16 %	18 %
Østfold	6 %	4 %
Rogaland	9 %	9 %
Sogn og Fjordane	1 %	1 %
Telemark	3 %	2 %
Troms	1 %	1 %
Trøndelag	7 %	7 %
Vest-Agder	3 %	4 %
Vestfold	5 %	4 %

As shown in fig. 1, the distribution of EV models amongst the respondents compared to the total EV fleet is quite representative of the fleet. Nissan LEAF is somewhat underrepresented with 3 percentage points share

lower in the sample. Kia Soul and Tesla Model S are overrepresented with a 2 percentage points higher share in the sample.

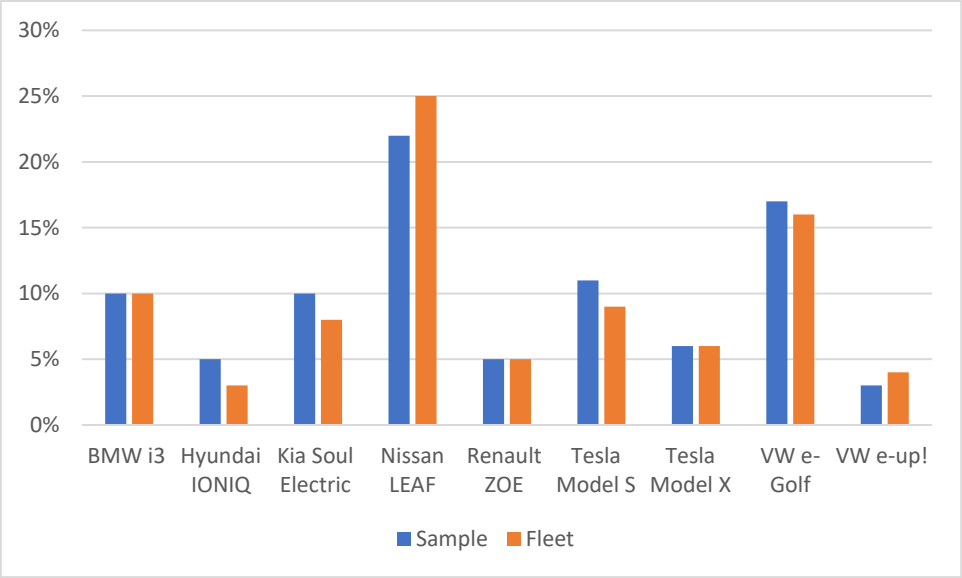

Figure 1: Distribution of top ten EV models, comparing the sample with the national fleet.

The main categories for the questions are vehicle ownership, purchase process, user satisfaction, travel habits, charging, EV incentives, environment and technology, membership in the Norwegian EV Association and socio-demographic background.

3 EV policy

Most of the Norwegian EV incentives were implemented in the 1990s with the intention to support the incumbent Norwegian EV industry. The first years after the incentives were implemented, they did not lead to any significant increase in the EV sales. Since the introduction of new EV models around 2010, the EV market share has kept on rising. The Norwegian government has decided that all new passenger cars should be zero emission by 2025 [2]. Further, the government wants to keep the purchase incentives throughout 2021 [3]. The car tax system is based on a polluter pays principle, which means that it should always be beneficial to choose low- and zero-emission vehicles.

The different EV incentives can be categorized in three groups; purchase incentives, owning incentives and usage incentives. The purchase incentives are the exemptions of both purchase tax and value added tax when buying a zero-emission vehicle. The exemption of purchase tax was introduced in 1990, and the exemption of the 25% value added tax introduced close to a decade later in 2001. Amongst the owning incentives are the exemption of annual road tax and the reduction in company car tax. The annual road tax is a cost of about 300 euros for the owner of a passenger car. If you have an EV as a company car, there is a 40% reduction in the company car tax. The usage incentives include free parking and charging at municipal charging stations, exemption of toll road fees, free ferries and access to the bus lane. In 2016 the Parliament decided on implementing a 50% rule, which means that while counties and municipalities can start introducing payment for, they cannot charge more than 50% of the price for conventional cars for ferries, public parking and toll roads. In cases where the bus lane has become congested, the EV incentive has been regulated so that the EVs cannot drive in the bus lane without a passenger.

The results from our EV owner survey show that the policies affecting the purchase price of the EVs are the most crucial for the consumers when deciding to buy an EV. 51% say they would not have bought an EV without the exemption of value added tax. 49% say they would not have bought an EV without the

exemption of purchase tax. After the exemption of purchase tax, the exemption of toll road fees seems to be most important with 39 % who say they would not have bought an EV without this benefit. Interestingly, the importance of the EV incentives for the consumers have been reduced the past couple of years. The share of respondents who would not have bought an EV without the exemption of purchase tax and VAT has been reduced from about 70% in 2015 to about 50% in 2018. This could imply that the EVs are becoming more competitive without incentives, with more attractive cars to a lower cost.

4 Charging

The initial establishment of normal and fast charging started in 2009-2010. The charging points received governmental funding through different support schemes. In the beginning the charging stations for normal charging were built with Schuko outlets. Many of these charging stations have been taken out of service as these points have proved to have high maintenance costs and little suitability for long term EV charging. The new and upgraded AC charging stations are now built with Type 2 outlets. In 2015 the state enterprise Enova held a tender to establish fast charging stations at every 50 km along all main roads in Norway. Today, all main roads have a fast charging station on every 50 km, except from some areas in the northern parts of Norway. The fast charging stations are equipped with both Chademo and CCS contacts. By the end of 2018 there were about 1700 fast chargers in Norway. A more thorough introduction of the Norwegian charging infrastructure has been presented in "Charging infrastructure experiences in Norway – the worlds most advanced EV market" by Lorentzen et al. [4]

Most EV owners do their main charging at home. 88% of the EV owners charge their car home on a regular basis. 50% of the EV owners who charge at home use a regular socket (Schuko outlet). The share of EV owners charging on a regular socket has been decreasing the recent years, as the share of EV owners using a home charging stations has been increasing. 43% use a home charging stations to charge their EV. The increased use of home charging stations offers opportunities for more flexible, efficient and economic home charging. The importance of home charging can develop into a challenge for shared apartment buildings. Since the population in many cities mostly live in apartment buildings, with or without a shared garage, charging opportunities for these residents must be made available in order to reach the goal of only selling zero emission cars in 2025. The Norwegian government has recently stated that they will establish a national support scheme for charging stations in shared apartment buildings.[5]

In recent years charging operators have started to establish fast charging stations without governmental support, especially along the highways and in and around the larger cities. The fast charging stations in these areas experience high traffic and are considered to be fully commercial [6]. Results from our survey show that 84% use fast charging stations, which is an increase of 7 percentage points since the previous survey. A share of 15% use the fast charging station on a daily or weekly basis. The majority of EV owners use the fast charging stations on a monthly basis or less, which could imply that the fast charging stations are used on infrequent and longer trips. The survey results are supported by the findings in a recent analysis of the fast charging usage in Norway, which finds that fast charging is mostly used for regional and longer trips [7].

There has been an increase in the share of respondents who experience queues when fast charging. 58% say they have experienced queues during fast charging (fig. 2). The share who have experienced queues at fast charging stations has increased by 9% in the last three years, indicating an increased use of fast chargers, which is not followed by the expansion of the fast charging infrastructure. Although the fast charging stations in areas in and around the cities now are seen as commercially viable by the operators, there are still some challenges for the fast charging stations in remote areas. These challenges are related to the costs of using and connecting to the grid, which currently does not have suitable pricing system for the building of fast charging stations in remote areas. A change in the pricing system will be necessary to achieve an

upscale of the fast charging infrastructure in all of Norway.

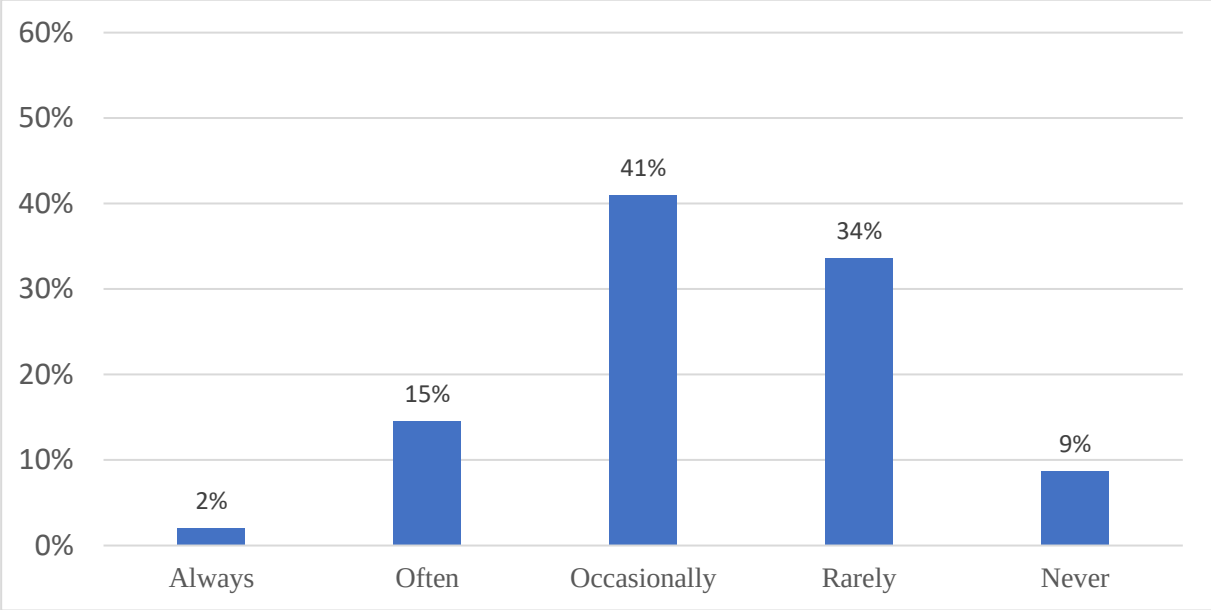

Figure 2: Do you experience queues at the fast charging stations? N=4828

5 Who are the EV owners?

The majority of the EV owners are located in the counties with bigger cities and high populations. These are also the areas where the local incentives (like exemption of toll road fees and free parking) are the strongest. 48% of the respondents live in the counties with the four biggest cities. 12% are in the age group 25-34 years, 27% are 35-44 years old and 32% are between 45 and 54 years old. The EV owners generally have a high level of education and high income. 76% of the respondents have a higher education and 48% have an annual household income of 1 million NOK (about 100 000 EUR). 58% are three or more people in the household. The findings regarding the characteristics of the EV owners are supported by other research in the field, finding that EV owners generally are younger, with higher income and more people in the household than other car owners [8]. The fact that EV owners generally have more people in the household can be seen as interesting, considering the fact that the majority of the EVs in the fleet are in the compact segment. Some of these traits can be attributed to new car owners in general (not only EV owners) and is expected to decrease as EVs become less costly both in the new and used car markets.

6 A change in use

It is often claimed that the EV is an additional vehicle to the household, rather than a replacement of an ICEV. The results from our survey show that the EV is increasingly being used as the number one car in the household. These findings are also supported by previous studies of Norwegian EV owners [9]. The use of the EV has expanded over time. The share that only has an EV in the household has increased from 26% in 2017 to 32% in 2018. The share of respondents who own a petrol or diesel car in the household has decreased by 18% in the last four years (Fig.3). There has been an increase in the usage of the EV outside everyday use, as the share who have used their EV to go on holiday has increased by 42% in the last three years.

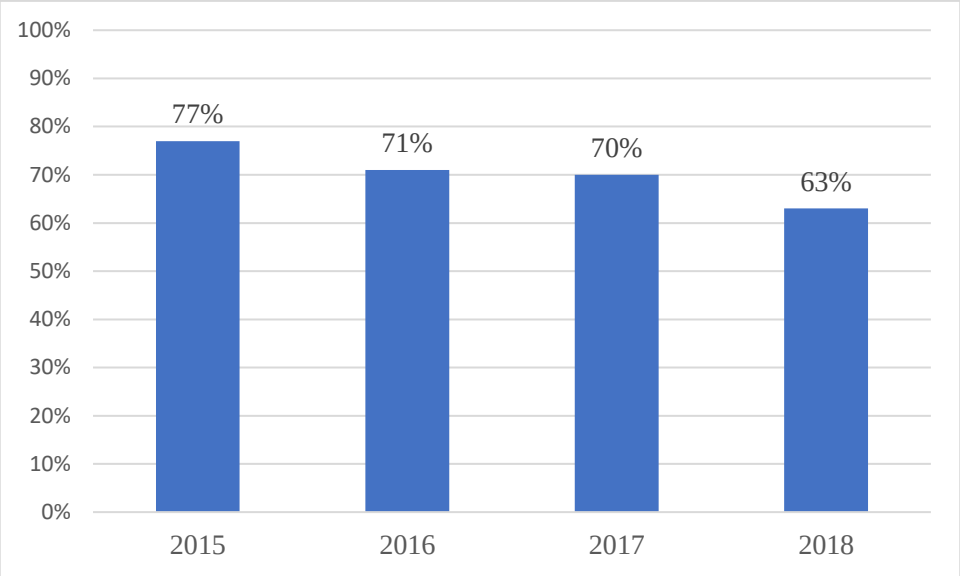

Figure. 3: Percentage share with a petrol or diesel car in the household.

The respondents can be categorized in two groups. The first group of respondents own the EV as the only car in the household and is referred to as “the one car owners”. The second group owns two or more cars in the household and one or more petrol or diesel car. We will refer to this group as the “multi car owners”. The one car owners do not differ a lot from the general sample when it comes to car model. The distribution of car models is quite similar to the distribution of models in the general sample, with a higher share of Tesla Model S owners. Nissan LEAF is the most common car model amongst the one car households holding the same share as in the general sample (22%).

The one car owners have a higher share of respondents living in a one-person household and a lower share of respondents living in a 4- or 5-person household. 76% of the multi car owners live in detached house, while 40% of the one car owners live in a detached house. The share of one car owners who live in an apartment is 37%, while the same share amongst the multi car owners is 9%. The share of one car owners living in Oslo and Bergen (the two biggest cities in Norway) are about twice as high as the share of multi car owners. The survey results show that the one car owners have a shorter average daily driving distance than the multicar owners. The share who drive between 21-40km per day is equal between the two groups. As shown in fig. 4, the share of one car owners decline as the kilometres increase. One car owners drive shorter distances more often and live in the cities. However, the results also show that the one car owners both travel more with their car and use fast charging more often. Close to half of the one car owners use their EV for travelling on holidays, while 25% of the multi car owners do the same. 88% of the one car owners and 80% of the multicar owners use fast charging. These results support our claim that a solid charging infrastructure will become more important as more and more are becoming EV only households.

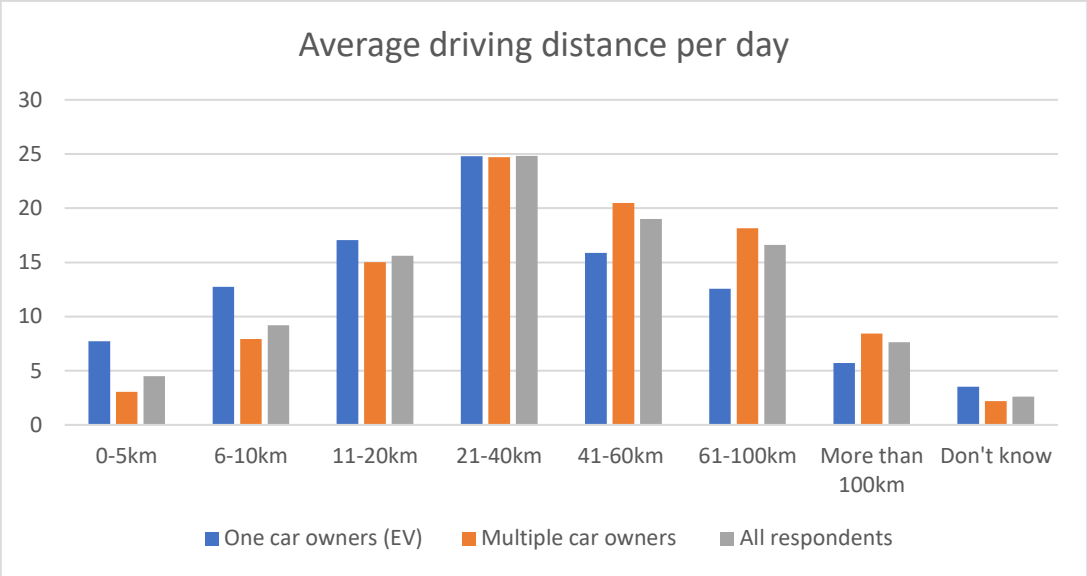

Figure 4. Average driving distance per day N=2903 N=5181 N=8975

Despite of charging queues and other challenges that may come with adapting to a new technology, the EV owners are very happy. 92% are satisfied or very satisfied with being an EV owner.

The one car households have a higher share of Tesla Model S owners. There has been a trend of more and more car brands offering long range EVs. As these cars are likely to be the main cars of the future Norwegian households, it is important to study their travel habits. We have categorized the respondents in three groups of short range (battery capacity of less than 35 kWh), medium range (35-65 kWh) and long range (more than 65 kWh). The long-range car owners are less likely to have a petrol or diesel car in the household. They show a more extensive use of the car, with a higher share using the car for day trips, overnight holiday trips and for work. 83% of the respondents who have a 35 kWh or less or 35-65 kWh battery capacity on their car use fast charging. Amongst the respondents with battery capacity over 65 kWh 94% use fast charging. These findings confirm the importance of a suitable fast charging infrastructure when more longer-range models are entering the market.

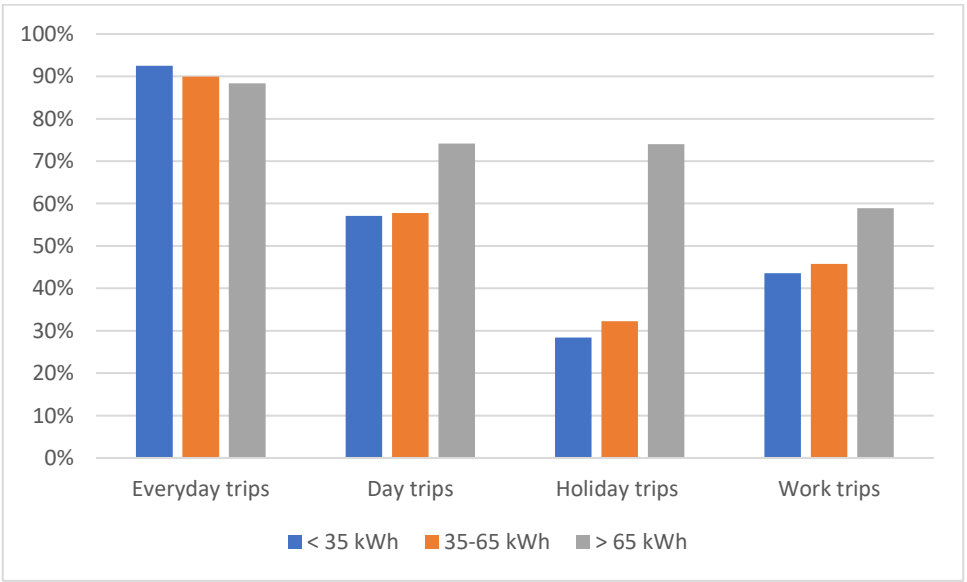

Figure 5. What type of trips do you typically use your EV for? N=4072 N=1434 N=1806

7 Conclusion

The EV has often been called the “car number two” in the household. According to the findings from our survey, the EV is replacing the ICEV as an increasing share of households with EVs have the EV as the only car in the household. Our survey results show that in multiple vehicle households, the EV is the most used car, replacing the usage of fossil fuel cars. Results show that one-car households generally drive shorter distances than multi-car households. But as the battery capacity of new models is increasing, so is the usage of the car. As EV owners are taking their EV on longer trips and fast charging more, the need for an upscaling of the fast charging network is crucial. As the usage of the EVs is getting more extensive, the need for a charging infrastructure that can serve the EV owners in all areas and at all times is crucial.

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