

Summary

Fast Charging and Long-distance Driving by Electric Cars in Inland Norway

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This study addresses the question of what factors promote and hinder using electric cars for long-distance driving in Buskerud, Hedmark and Oppland, and how drivers of these electric cars use their vehicles. Further, it focuses in depth on how drivers of electric cars travel to their cabins/vacation homes. The study also looks at how the electricity grid in the transport corridors Oslo-Bergen and Oslo-Trondheim may be affected by an increased share of electric cars.

We find a clear correlation between the battery capacity of the electric cars and the length of the travel that they are used for. The owners of the Teslas, unsurprisingly, had more frequent, and also longer, trips than the other electric car owners. They were also more content than other drivers with the quality of the fast charging facilities. Most of the very long travels of at least 300 kilometres happened during vacations, primarily the summer vacation. More than 40 % of the respondents in Buskerud, Hedmark and Oppland (the three-country sample) had used their electric car for a trip longer than 300 kilometres during the last year. In households with one electric car with a small or medium large battery and one diesel/petrol car, the latter was usually used to travel to the cabin/vacation home. However, 57 % of the respondents in the three-country sample often or always used their electric car to travel to the cabin/vacation home. Thus, for owners of electric cars, electric cars have become normal also for this travel purpose.

Two out of three can charge their car at or nearby their cabin/vacation home, and 68 % of the respondents used fast chargers to or from the cabin/vacation home. With the large-scale introduction of new models of electric cars, steadily more people will use an electric car for long travels and to their cabins/vacation homes. This shows the importance of further establishment of fast charging infrastructure, and that the electricity grid companies and others continue with enabling the further electrification of the transport sector. As of 2020, there is still a lack of electric car models with a range more than 400 kilometres combined with good storage space, four-wheel drive, a tow hook, and not least models in the hatchback category. As the number of electric car models in the market is booming, and these are in different price classes, we expect that "all" people in the longer run can buy/attain an electric car that covers their needs.

Introduction

In order to reach the target in the National Transport Plan (2018-2029) that in 2025, all cars sold shall be zero emission vehicles, persons in regions with conditions that, for example, significantly shorten the range of electric cars at winter time, will also have to choose these vehicles. This study therefore discusses what promotes and hinders people in using electric cars for long-distance driving in Buskerud, Hedmark and Oppland, with special focus on the travel corridors Oslo-Bergen through Hallingdal and Oslo-Trondheim through Gudbrandsdalen. These are relevant areas because they have extended periods with very low temperatures during the winter, that reduces the range of the electric cars substantially. Furthermore, they have large hilly areas with challenging driving conditions that may require a car with a four-wheel drive. A substantial share of the residents in Buskerud, Hedmark and Oppland probably also want to have a tow bar. Until 2019, there were very few electric cars with four-wheel drive and a tow bar in the Norwegian market.

In order for everyone to drive a zero emission vehicle in the future, people must also choose an electric car (or other zero emission vehicle) when they are travelling to their cabins/vacation homes. The (former) counties Buskerud, Hedmark and Oppland have areas with many cabins/vacation homes, used in particular by people from the Eastern parts of Norway. Thus, it is also important to enquire into the travel habits of persons from Eastern Norway when they are on long-distance journeys. The electrification of the transport sector gives the electricity grid companies (distribution system operators, DSOs) new challenges, such as delivering enough electricity simultaneously when more and more electricity is needed at the same time. Thus, it is also imperative to investigate how the electricity grid companies are influenced by the drive to electrification.

Accordingly, our research questions for this study here are:

- 1) How are the drivers of electric cars in Buskerud, Hedmark and Oppland charging and driving?
- 2) How are drivers of electric cars charging and driving in Gudbrandsdalen and Hallingdal, and what are their experiences from long-distance driving in these areas?
- 3) What promotes and hinders the use of electric cars in Buskerud, Hedmark and Oppland in general? And in Gudbrandsdalen and Hallingdal in particular?
- 4) How does the increase of electric cars in these areas influence the local and regional electricity grids?

Methods

Different quantitative and qualitative methods have been used here to shed light on the research questions and to obtain as precise data and inferences as possible. This includes: surveys, interviews, observations and document analysis. Our samples are:

- 1) Semi-structured interviews with two persons from the power sector.
- 2) Interviews of and communication with persons who are fast charging their cars in Gudbrandsdalen and Hallingdal. Interviews, N = 3. Communication, informal interviews N = numerous persons.
- 3) Survey among persons who are fast charging their electric car in Gudbrandsdalen and Hallingdal. N = 52 (the ‘fast charging sample’)
- 4) Survey among persons who have bought an electric car in Buskerud, Hedmark and Oppland. N = 1361 (the ‘three-county sample’).

These methods have been supplemented with field observations at various fast charging stations in Gudbrandsdalen and Hallingdal, and with document analyses.

Main results

Most respondents in the three-county sample charged their cars at home. More than 40 % of the respondents charged their cars at home daily. Over half charge 3-5 times a week, and over 90 % charged their car there at least once weekly. This charging took place in their own parking place, in a garage, or carport, cf. Figure S 1. For a certain share, charging at the work place was also important, somewhat less than 40 % did this at least 1-3 times a month, and around 30 % did it 1-2 times weekly.

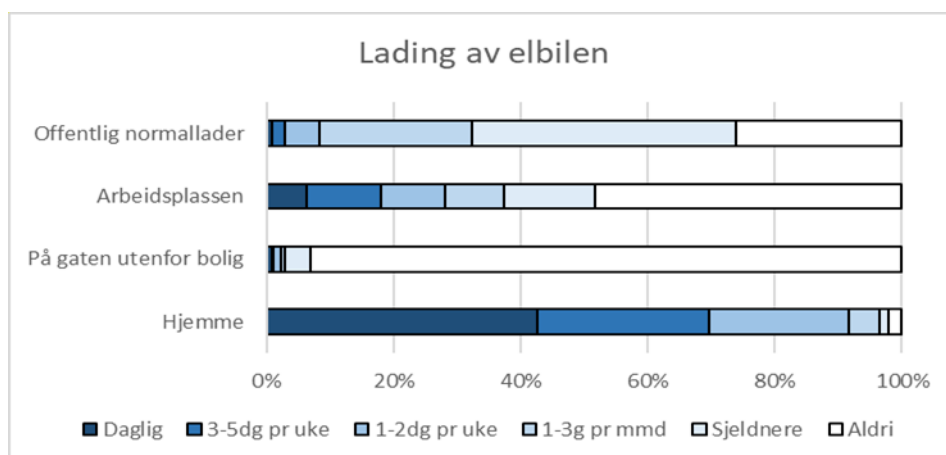


Figure S 1: Charging of the electric car in everyday life. Three-county sample. N= 1 328.

More than 85 % of the electric car owners in the three-county sample had made at least one trip more than 100 kilometers in the last year, see Figure S 2. More than 60 % had made 5-9 trips of at least 100 kilometers, and closer to 30 % had more than 20 trips that were between 100 and 200 kilometers yearly. Almost 60 % of these respondents had conducted at least one journey that was longer than 200 kilometers.

Almost 60 % of the respondents in the three-county sample had not used their electric car on a journey longer than 300 kilometers in the last year. However, more than 40 % had done this at least 1-4 times. More than 30 % in the three-county sample had also used their electric car on a journey that was at least 400 kilometers during the last year, see Figure S 2. Thus, the numbers reveal that there is large variation as to how long the drivers of electric cars are driving, and that a substantial share of the aforementioned sample had used their electric car on a journey of at least 300 kilometers. Those who owned a Tesla used, unsurprisingly, their car for more long journeys than the owners of the other electric cars. Since this sample is fairly representative for owners of electric cars in Norway, this indicates that a similar pattern likely describes the patterns of the electric car drivers in Norway in general.

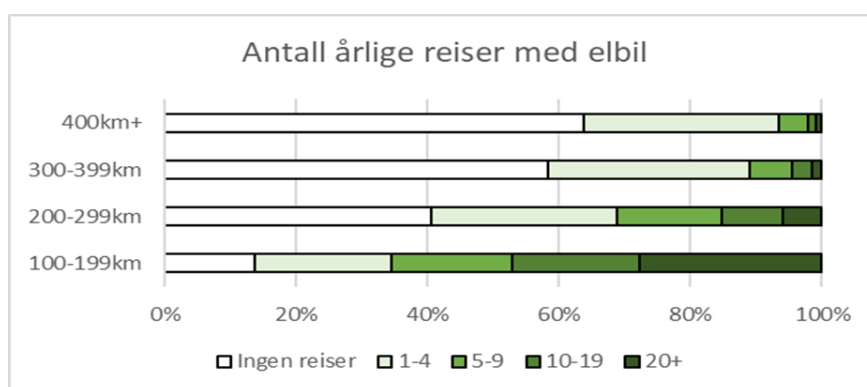


Figure S 2: Number of trips longer than 100 kilometers with an electric car during the last year, in distance intervals. Three-county sample. N=1 316.

The data shows that there is a systematic correlation between the battery capacity of cars and the length of the corresponding journeys. In particular, those who had a battery of at least 56 kWh systematically drove more journeys longer than 100 kilometers and 200 kilometers than those with smaller batteries than this.

Approximately 66 % of those respondents who possessed or had access to a cabin/vacation home charged the electric car either by or nearby this place. In addition, the majority also used fast charging facilities the way there, c.f. Table S 1. Fast charging is particularly popular in connection to long travels: More than 80 % of the car owners had used a fast charger in connection to long-distance driving, and closer to 40 % used a fast charger at least 1-3 times monthly. About 30 % of the three-county sample had used a fast charger in Hallingdal, while around 40 % had used a fast charger in Gudbrandsdalen.

Table S 1: Where the respondents are charging when they are travelling to their cabins/vacation homes. Three-county sample. Percentage of respondents who charge at certain locations.

	Never	Sometimes	Often	Always
Fast charging, during trip (N=618)	31.6	32.2	11.8	24.4
At friends/family, during trip (N=605)	87.3	10.9	1.2	0.7
At destination (N=618)	34.3	14.1	12.3	39.3
Other places (N=573)	86.6	10.3	0.7	2.4

Most of the electric car owners, regardless if they owned a Tesla or not, were happy with the last charging stations' user friendliness, trustworthiness, capacity, waiting time, service offering, availability and location. The Tesla owners were, however, even more satisfied than the other owners of electric cars.

The price of fast charging was, however, something they often were not happy with, or found to be neither good nor bad. Among the electric car owners (apart from Tesla owners), 17 % answered that they did not think the price for fast charging was good, while another 40 % answered that they were neither content nor discontent with it. Among the non-Tesla owners, around 25 % also answered that they were not happy, or neither content or discontent, with the user friendliness of the payment options. The capacity of the last used fast charging station was also by these respondents regarded as bad by 15 %.

These numbers point towards the fact that it would be beneficial for the further electrification of the transport sector if the price for fast charging was lower, and if it would become (even) simpler to pay at the charging stations. An increased number of fast charging stations and ultra-fast charging stations, together with more electric cars that can be charged at high and very high effects, will also be an advantage in the future. This will likely reduce the tendency of forming charging queues and contribute to lower 'charging angst.' Furthermore, the electrification of the transport sector makes it pertinent for the grid companies to continue their preparation for charging of electric cars when new fields with cabins/vacation homes are established, and enabling charging in already established areas with cabins/vacation homes.

With the introduction of further electric car models, and with larger battery capacities, even more persons will likely use an electric car when they are travelling long distances and to their cabins/vacation homes. This points towards the importance of further expansion of the fast charging infrastructure in Norway, and that the grid companies and others continue to enable for more electrification of the transport sector.

Per 2020, there are still gaps in the car markets for electric cars with long driving range, good storage space, four-wheel drive, and tow hook, particularly in the hatchback category. As new models are become steadily available in all price classes, also with long range and good storage space, we expect that 'everybody' in the longer run will have the chance to attain an electric car that covers their needs.

Nevertheless, if close to 100 % in the future shall buy an electric car in 2025, for a few years, such sales will still be dependent on the solid incentives for electric cars in Norway to

continue, at least until they reach cost competitiveness, so that it will continue to be cheaper to own and drive an electric car than a car running on petrol or gasoline. This has different reasons, including that the second hand market value of electric cars seem to be lower than that of cars with a combustion engine. Moreover, a certain segment of the population say they simply would not like to have an electric car.