Institute of Transport Economics
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Summary

Electromobility status in Norway

Mastering long distances – the last hurdle to mass adoption

TØI Report 1627/2018
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Oslo 2018 71 pages English language

Battery electric vehicles (BEVs) reached a market share of 20% in Norway in 2017, and a fleet share of 5.1%. This development is the result of very large incentives and a long term stable BEV-policy. In addition, another 20% bought a Plug-in Hybrid Vehicle (PHEV) that make up another 2.6% of the fleet. These results are impressive compared to any other nation, but not nearly enough to meet the Norwegian Parliaments ambitious target of only selling zero emission vehicles by 2025. The main BEV user group has been multi-vehicle households replacing one vehicle. However, after 2025 also single vehicle households must buy BEVs, and BEVs must replace all vehicles in multi-vehicle households, not just one. A flow of new BEVs with longer range coming on the market the coming years will aid the transition. If the charging infrastructure is built out concurrently with the increase in the fleet, then more users will find BEVs attractive and easy to use. Data from main-road toll road stations reveals that peak travel days can become a major barrier. Building out charging infrastructure capacity to absorb these peaks completely may not be economically viable. Users will thus confront a trade-off between daily cost and time savings and longer stops and more queues on long distance trips, or they must buy BEVs with range long enough to get them to the final destination on peak travel days.

Higher electric vehicle share of the fleet than anywhere else

Battery electric vehicles (BEVs) reached a market share of 20% in Norway in 2017, and a fleet share of 5.1%. Norway's large incentives and the long term stable BEV-policy have been essential in achieving these impressive results not seen anywhere else in the world. They are, however, not nearly enough to meet the Norwegian Parliaments target of only selling zero emission vehicles by 2025. Zero emission in this sense is defined as zero tailpipe emissions. The main option for achieving that target seems to be BEVs. Fuel Cell Electric Vehicles (FCEVs) running on hydrogen may be another option, but so far no car manufacturer has started full series production of these vehicles. Plug in Hybrids are only part-time zero emission. In this report the focus is on BEVs ability to contribute to the target.

The main BEV user group has up to 2018 been multi-vehicle households. Earlier research has shown that this user group has had few challenges taking BEVs into use. To be able to reach a target of only selling BEVs from 2025, also single vehicle households must start using BEVs, and BEVs must replace all vehicles in multi-vehicle households. New barriers will thus emerge.

Long distance driving (trips, sum of trips or total driving over a day), exceeding the range of BEVs, lead to a need for owners to charge during the trip or the day, or to adapt their driving behavior. Combined with long charge time this will be the remaining main barrier to adoption of BEVs in Norway. The charging process of BEVs is more time consuming than filling fuel in an Internal Combustion Engine Vehicle (ICEV). Fast charging can give 3-5 km of range per minute of charge. Some vehicles can be fast charged about twice as fast. If charge queues also occurs, then long distance driving could become impractical on

peak travel days. Users will also need larger BEVs as these trips often are done with vehicles full of luggage and with all household members in the vehicle.

These issues are the remaining major barriers to adoption of BEVs as primary vehicles (the vehicle used for long distance driving) in Norway.

Price is not a barrier to consumer adoption of BEVs. The Norwegian incentives even out the cost of a BEV and an ICEV. In many cases the BEV will be the cheapest option. Battery life is still a barrier although the batteries seems to hold up capacity well under Nordic conditions. Surveys indicate that users are less worried about the second hand value of BEVs than they were earlier in the diffusion process.

BEV technology improve and model availability increase

Most automakers announced in 2017 major and concrete investment and production programmes for BEVs, and other types of electrified vehicles such as PHEVs and hybrids. Some of the announcements even specified which assembly plants the BEVs will be produced and the associated investment costs. There will therefore be a huge increase in the availability of BEVs with longer range designed for the mass market in the coming years. There are three potential game changers in the pipeline. Longer range will be possible with larger battery packs and more energy dense lower cost battery cells. These larger packs will also allow at least three times faster charging. The time spent on fast charging will thus become more comparable to filling fossil fuel at a gas station. A larger pack will also increase battery life as fewer charge cycles will be needed for a given mileage. If the purchase cost barriers continue to be repressed through incentives, there is every reason to believe that the market will continue to expand in the coming years.

The market has been cooled down by delays in vehicle deliveries, or too low production capacity, for models such as Tesla Model 3, VW E-Golf and vehicles from Hyundai and Kia. Nissan on the other hand seems to have the ability to deliver large volumes of the new Nissan Leaf. The delivery situation is likely to be subject for delays until the next wave of models designed for the high volumes enters the mass market between 2019 and 2022. The range for these new types of vehicles will be 400-600 km, with fast charge power of 100-150 kW, and up to 350 kW for the largest luxury vehicles.

National policies influence markets

Norway is in many ways an ideal place to introduce BEVs. The population is rich, a large share of households owns more than one vehicle, the access to home parking is good, speed limits are low (leading to longer range), and the electricity is cheap and supplied by a robust grid. The cold winters will however give large reductions in range, whereas temperate summers are ideal for longevity of batteries.

The Norwegian BEV market is fuelled by incentives that eliminates the price difference of BEVs and ICEVs, and in many cases make the BEV option the cheapest. Ownership costs are also lower due to the largest annual energy cost savings of using BEVs instead of ICEVs of any country in Europe. Further cost savings are available many places due to local incentives such as the exemptions from toll road and parking charges. These policies have been in place for a very long time leading to opportunities for vehicle importers to profitably and quickly introduce BEVs into the market in large volumes, which they all

have grabbed as soon as their brands started offering BEVs. The market will continue to expand as long as these benefits and incentives continue to be available to new user groups.

The user benefits are also available to buyers of second hand vehicles, leading to a strong second hand market demand. The depreciation rate of BEVs launched after 2013 has therefore been more or less the same as that of similar ICEVs. Earlier BEVs have however suffered higher value losses, mainly due to the rapidly decreasing new vehicle prices early in the diffusion process.

Will BEVs meet enough vehicle user's needs?

A small share of early BEV users only own the BEV and have no other vehicles at their disposal unless they rent, loan or use car sharing vehicles in addition. An even smaller share of households owns more than one BEV, with no ICEVs in the household, but these are people that have taken a special interest in the technology. Most BEVs are however owned by multi-vehicle households also owning an ICEV. These households keep the flexibility to effortlessly do long distance driving with the ICEV.

Meeting mass market demand for general purpose vehicles will be very different. People have very different usage patterns and some users need large vehicles capable of rooming much luggage, or have a need to haul heavy trailers or caravans. It will thus be much more difficult to replace the last 20% of ICEVs in the fleet than the first 20%. Long distance driving, such as vacations and weekend trips will be most difficult to replace, especially if the range is less than the distance to be covered for large share of vehicles. It is unlikely that it will be economically viable to build out charging infrastructure to completely cope with the total travel demand on peak travel days. On some roads the demand on peak days can be more than five times larger than that of a normal day. Another challenge could be the ability to charge at the destination, for instance at vacation homes and huts, due to lack of electricity where the vehicle is parked.

Charging infrastructure is lagging fleet increase but improving

Home charging capability is seen as a main attraction of BEVs, and a prerequisite for BEV ownership. 94% charge their vehicle at home. Up to 75% of all households can park on own land, a further 14% less than 100 meters from their doorstep. It can be estimated, based on results from user surveys, that about 42 000 BEV and PHEV owners had installed homechargers (EVSE wallbox) at the end of 2017. A further 142 000 use domestic type Schuco sockets for charging. There were about 7 500 public "slow" chargers available. Additional electric sockets that can be used for charging are however available outdoors in numerous locations without being termed "charging station". Home charging supports most of the local driving, but when fast chargers are installed in cities they are quickly fully utilized, indicating that some users stretch their vehicles range capability also in daily day traffic.

Fast charging was non-existent in 2010. Today more than 1000 fast chargers are available in Norway. These fast chargers are distributed in more than two hundred physical locations. The rapid expansion of the fast charger network has been the result of a deliberate government policy of supporting the installation of fast chargers since 2011, and various private initiatives. A general support program got the first chargers installed (Transnova), and public tenders resulted in a basic network of chargers every 50 km along all major transport corridors in southern Norway up to Tromsø. A new program will from 2018

support the installation of fast chargers in municipalities that have none. Increasing private investments also leads to more fast chargers being installed in cities and outside shops and restaurants. Life with a BEV has thus become easier in cities, although range anxiety seems to gradually be morphing into a charge queue anxiety. Long distance driving has been enabled across most of Norway, but has so far not often been undertaken by the majority of BEV owners.

Fast charging has been limited to 50 kW, apart from Tesla Superchargers operating at 60-120 kW. That is about to change in 2018. Several operators will install chargers capable of 150 kW charging and some even 350 kW. Vehicles capable of fully utilizing the charging power of these stations will not come on the market until 2019-2020.

Everyone knows the technology and the market will expand

While the BEV diffusion and market introduction started in cities, the market is now rapidly increasing also in rural areas, supported by increased availability of fast chargers, and a knowledge transfer in the population.

All importers offer BEVs across their entire national dealer network, and new models are introduced as soon as they are available in the market. BEVs are thus no longer a city phenomenon, but a real option for most vehicle buyers in most places.

A survey of the general population in early 2018 revealed that 89% of the population of Norway knows someone owning a BEV, 66% have been a passenger in a BEV, and 34% have driven a BEV. Only 22% have never been inside a BEV. The survey also revealed that in the general population the main barriers to sales are range, a lack of sufficient charging infrastructure and uncertainty about battery life. Twice as many respondents believe that ICEV cars will be less attractive in the second hand market than BEVs, as those that believe the opposite. Using purchase intentions of different types of vehicles from the 2018-population survey and splitting it into shares of the total market, it seems to be a potential to sell about 40 000 new BEVs in Norway in 2018, 25-30% of the expected total sales of passenger vehicles.

The range that will be available on future models will meet the needs of larger shares of vehicle buyers. 300 km all year range was seen as sufficient by up to half of ICEV owners and 80% of BEV owners, in a 2016 vehicle owner survey. Short range and long range vehicles will potentially co-exist in the market to cater for different user needs at different cost levels. Another market booster will be an increase in the number of available models, both from a wider range of brands and for user segments currently lacking BEV offerings. One can also expect higher future growth when users that currently own BEVs, trade in their older BEVs for models with longer range and other improvements.

BEV owners spend much less money on energy than ICEV owners do. This advantage comes however at the cost of having to spend more time than ICEV owners when undertaking long distance trips. The reason is that the charging occur at a much slower energy transfer rate than when filling liquid fuels. This trade-off is reduced the longer the range of the vehicle is, and the faster the charging it can accept.