# Norway energy storage for load shifting

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Changing to non-emission transport can result in approximately 1.5 mill. private electric vehicles by 2030, resulting in an energy need of 4 TWh. This represents a 3% increase of the Norwegian electricity consumption. This blog presents results from the CINELDI-ModFlex-project, evaluating the consequences of the increasing share of electric vehicles and the potential for demand response and flexibility in charging.

Demand response is a change in the power consumption of a customer to better match the demand for power with the supply.

Norway is currently the largest market in the world for electric vehicles (EVs) in comparison to the total number of vehicles sold. The high number of EVs is due to good incentives. There is also a political goal to stop the sale of new conventional cars by 2025 (conventional cars use gasoline or diesel to power the engine).

The increased number of electric vehicles, and the 3 % increase in the Norwegian electricity consumption, will not be an energy problem. But it can be a capacity related problem in the distribution grid if all households are charging at the same time.

The results presented in this blog from the CINELDI – ModFlex-project, are based on a survey performed among households with electric vehicles (in cooperation with Elbilforeningen) and meter data of the energy consumption from charging. The data is collected from a selection of the most common electrical vehicles in Norway and the results were published at the UPEC 2018 Conference.

By the end of 2017 the total number of EVs in Norway was more than 142.000, including both private cars and vans. EVs represented approx. 5,6% of a total of 2,5 mill. private cars, and in 2018 EVs reached almost 30 % market share. Plug-in hybrids have a market share of 19 %. The development of the amount of private EVs in Norway, and their market share, is presented in Figure 1.

An overview of the 10 most popular types of electric vehicles in Norway, per 31 March 2018, is presented in Figure 2. Nissan Leaf is the type with the largest market share, with approx. 38.000 cars, with Volkswagen e-Golf as number two with approx. 25.000 cars. In total there is approx. 23.400 Teslas in Norway, split on both Model S and X. The other types of EVs among the top 10 in Norway are BMW i3, Kia Soul Electric, Volkswagen e-Up, Renault ZOE, Mercedes-Benz B250E and Hyundai IONIQ.

Mitsubishi i-Miev was one of the EVs that really sped up the EV market in Norway. This car was introduced in 2010, and in 2011 this EV represented 52% of the total number (1.040) of EVs sold that year [4]. Peugeot and Citr?en released equal models, in cooperation with Mitsubishi - the so-called “triplets”. The “triplets” are Mitsubishi i-Miev, Citro?n C-Zero and Peugeot Ion.

In 2017-2018, the CINELDI/ModFlex project cooperated with Elbilforeningen (the association for owners of EVs) on a survey directed at their members. The survey posed questions like:

In 2017 the customers were asked about which hours during the day they normally charge their EV at home. The results are presented in Figure 3, showing that most of the charging occurs in the afternoon and during the night. Very few respondents answered that they charge their EV at home during daytime (hours 11-16).

To map the potential for flexibility in time of charging, the respondents were asked about their willingness to postpone the time of charging from day/afternoon to night (hours 21-05). If this shift in charging time has no negative consequences for the user, 90% are willing to postpone the time of charging. However, if this reduces the driving distance the next day to 80%, the share of positive respondents is reduced to 56,5%.

Looking at Figure 3, this would imply a reduction of EV owners charging in the afternoon, and an increased share charging during night time. The figure shows that there are several customers already charging during nighttime, and that there’s potential for more to do this. The reason for this is that the charging in the afternoon starts in a period when there is already high consumption at households due to cooking, washing clothes etc. Appliances such as washing machines and dishwashers should not be shifted to night time, but the charging of the EV could be shifted.