Millions of electric cars in the Nordic countries

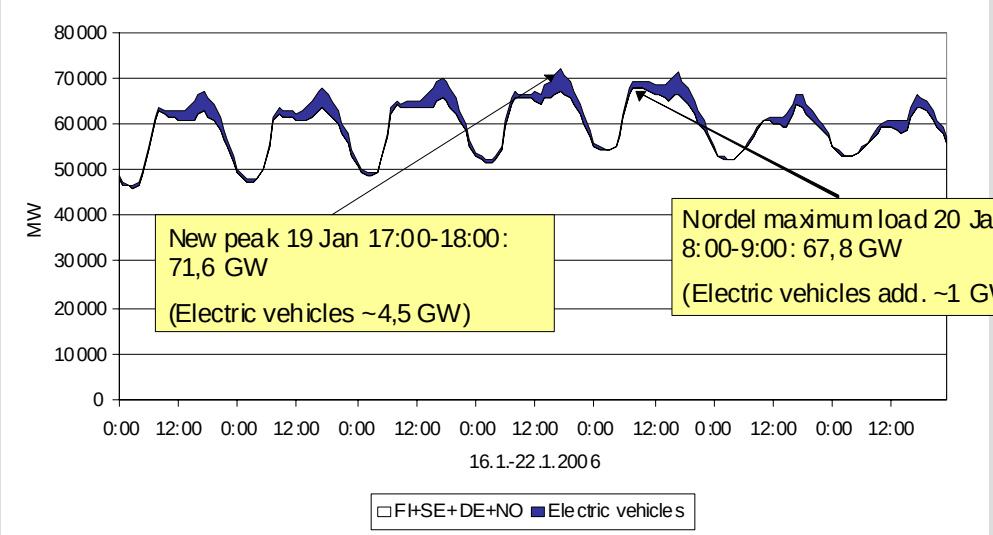
- impacts on the Nordic electricity system

NEP studies indicate new load peaks in the Nordic system after an introduction of 5 million electric cars (EV) on the roads. The study assesses the impact of 1 million battery powered electric vehicles (BEV) and 4 million plug-in hybrids (PHEV) distributed among Finland, Sweden, Norway and Denmark. The global production of EVs is estimated by car component manufacturer Bosch to be around 3.5 millions in 2015, so it is not very likely that there will be altogether 5 million electric cars in the Nordic countries by 2020. But if there were - it is a good bet that there will be at some time - what effects would they have on the Nordic electricity system?

Peak load can grow by 6%

The NEP results indicate that the Nordic system peak load (compared to 2006 data) would grow by 6 % reaching 71 600 MW. However, in this case the EVs are using electricity mainly at high load times.

The daily driving and charging of EVs was stochastically modeled using Finnish survey results about typical distances driven each day, timing of the travel, average trip lengths, trips per day, etc. as basis. It was assumed that all cars were charged through household electricity outlets (max 2500 W) and that 20% of the EVs had the possibility to charge at work, while 2% didn't ever charge at home. PHEVs differ from BEVs in the respect that they have smaller batteries, enough for 20-100 km, after which the car's fuel-based motor is used. Smaller batteries indicate shorter charging times. The charging of the cars was assumed to be without any controlling intelligence (smart charging), i.e. charging started as soon as the cars were plugged in.

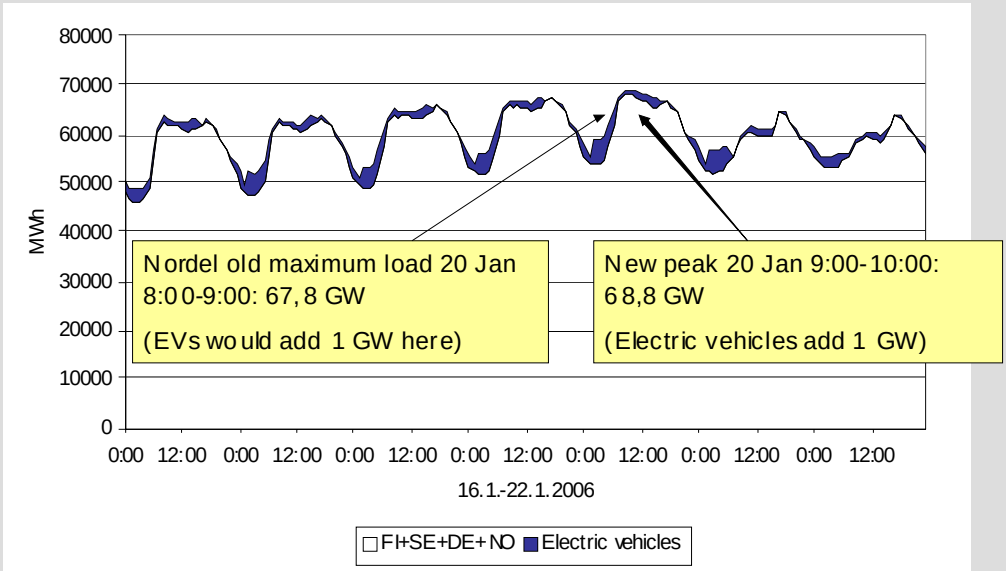


The charging effect of 5 million EVs on the Nordic peak load, if the charging of the vehicles is not controlled. The Nordel peak load week from 2006 is used as basis. The time of the peak load with EVs moves from Friday morning to Thursday evening, and increases by 3 800 MW (6 %).

Smart charging

The charging of the EVs should be affected by policy recommendations issued in all likelihood in the future. If not, then the burden added to the peak load from unregulated charging would be too heavy as shown in the previous example Just a few simple rules or recommendations concerning smart charging would achieve a much nicer picture. For example, if 90% of all charging otherwise taking place between 16:00 and 23:00 local time is moved to the night hours (0:00 - 07:00), then the peak load increases only by 1 000 MW. The gap between daytime and night time consumption diminishes clearly.

The smartness could and probably would be tied to price signals, for example the Nordic spot market price and/or balance regulation prices. And of course express charging places, where a battery will be charged in minutes at high power, will in all probability be available. However, they are considered to be of no actual importance in this study. Most charging is likely to take place at home even when fast charging is available.



Smart charging. *The peak load moves to the next hour compared to the case of no EVs, and increases by a measly 1 000 MW. The load also looks much nicer.*

Total electricity demand up 15 TWh in the Nordic area

Consumption rates of 0.17-0.25 kWh/km including charging losses were used for EVs in the above examples of the EVs' impacts. The 5 million EVs would have a noticeable, but a rather small effect on the Nordic electricity system. The increase in electricity consumption would be approximately 14 TWh. That is only 3% of the total electricity demand in the Nordic area, even though roughly half of all cars would be EVs. Network losses would add another TWh, bringing the total growth in electricity demand to roughly 15 TWh.