Nordic Energy Perspectives

Newsletter 2009:1

The use of renewable energy increases in the Nordic countries

- heat pumps very competetive

The EU's 20 % goals regarding increased use of renewable energy, improved energy efficiency and reduced emissions of greenhouse gases stimulate, as expected, the use of renewable energy in the Nordic countries. NEP's continued analyses of the EU's climate change and energy package shows that the use of wind power and heat pumps increase significantly, while the use of biomass only increases slightly compared to a situation where only the present policy instruments are used.

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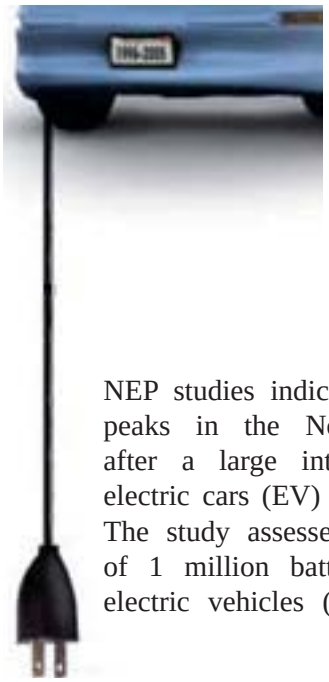

Millions of electric cars in the Nordic countries?

- impacts on the Nordic electricity system

NEP studies indicate new load peaks in the Nordic system after a large introduction of 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.

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Read more about the project

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The Nordic forest industry faces challenges

At present, Nordic pulp and paper companies will not invest in new mills. Even reinvestments in major repairs are being questioned.

Further information: PETER FRITZ and PER-ERIK SPRINGFELDT, EME Analys

The Nordic forest industry has historically profited from the relative closeness to both customers and raw materials. Other advantages include relatively low electricity prices and a raw material based on long wood fibres. However, a number of negative factors are now affecting the Nordic forest industry.

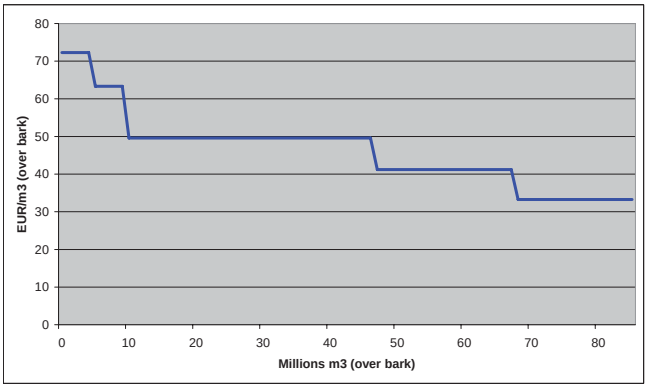
- Demand for paper products in developing countries has been met by an even faster growth in the production capacity of pulp from fast growing eucalyptus and wood from rainforests.
- The demand growth in developed countries is expected to remain low and might even decline.
- Russian exports tariffs and demand for wood from the energy sector will push wood prices in the Nordic region upwards.
- Modification of the eucalyptus fibre and Russian fibre export will result in a larger supply of newspaper qualities and therefore more competition for the Nordic forestry industry.
- The electricity price in the Nordic region has become (and may continue to be) less competitive

There are however, still factors that are favourable for the Nordic forest industry. Examples are:

- Large share of efficient integrated pulp and paper mills
- Expansion of eucalyptus plantations, new production capacity and infrastructure is time consuming
- Restrictions on wood supply from rainforests and eucalyptus plantations could result in higher wood prices in developing countries

The ability to pay for wood in the Nordic region

An approach to illustrate the forest industry's situation is to look at the industry's ability to pay (ATP) for the wood they use. In the figure below, this is illustrated by a "demand curve". The curve is based on statistics from the Swedish paper, pulp and sawmills industry for 2003 and 2005. The ATP is defined as the wood prices at which the different industries reach "break even" (the cost of investments is included in the calculation).



Long term demand (ability to pay) for wood from the Swedish forest industry (EUR/m3 over bark))

Without going into details the analysis indicates that the relation between ATP and present market prices are unfavourable for certain parts of the Swedish (and Nordic) forest industry. Does this mean that important parts of the Nordic forest industry will be forced to close down and that large amounts of wood will be destined to other areas such as energy? We know that the industry is currently facing problems. This is rather obvious after reading company statements and witnessing the closure of plants. However, some important adjustment measures can be expected.

Closing mills will lead to a reduced demand for wood from the industry, resulting in downward pressure on the price of wood in the region. Some wood will be consumed by the energy sector, but their demand is limited, at least in the short run. In theory, large volumes of wood could be exported, provided that the world market price of wood is sufficiently high. This will however, also affect the Nordic forest industry's international competitors, especially competitors in countries that are dependent on imported wood.

Prominent strategies for environmental sustainabililty

- in corporations in the energy sector

There is an obvious need for the stationary energy sector to intensify its efforts to contribute to sustainable development, both at a strategy level and in order to integrate sustainable practices into its operations. To gain insight in how environmental sustainability is put into practice within corporations, close-up investigation is essential. For this reason, case studies of companies with a prominent strategy for environmental sustainability were chosen as a research methodology. The selection of case companies was based on an emerging frame-work of measures for environmental sustainability that was established from an initial study of Swedish and European energy companies.

Focus areas for sustainable development

The findings from the case study interviews are reported by highlighting five focus areas for sustain-able development. The first focus area, **Corporate Governance**, focuses on the interplay between owners and the management in relation to corporate environmental issues. The focus area **Co-operation** highlights the possibilities and dimensions offered to sustainable development by joining forces. **Communication** is a further area of interest, exploring the role and benefits of communicating to enhance environmental sustainability. In the forth area, **Innovation**, it is explored how energy companies enhance the sustainability of their products and processes. Lastly, under the heading **Integration** the processes and structures effectively enhancing environmental sustainability are studied.

Further information: GABRIELA SCHAAD and ANDERS SANDOFF, School of Business, University of Göteborg

Framework of measures for environmental sustainability

The framework builds on a four-field matrix divided into measures with an internal or external focus. A distinction is also made between technical measures and “bonding” measures that require greater social involvement.

1. Emission Reductions: The focus lies on minimizing emissions generated internally as a result of different corporate activities. Also internal efficiency measures fall under this category.

2. Product Stewardship: The company searches for new opportunities to produce its current products more sustainably or effectively, extend the use of its products or offer new products that are beneficial to sustainable development.

3. Clean Technology: Shows the range of renewable and bridging technologies that companies can adopt to reduce its environmental impact or improve efficiency. Internal green R & D also falls under this stage.

4. Sustainable Development: In this most advanced stage, the focus is again external and most measures require high social involvement. A wide perspective is taken on possible measures that lie within the reach of energy companies to promote sustainable development.

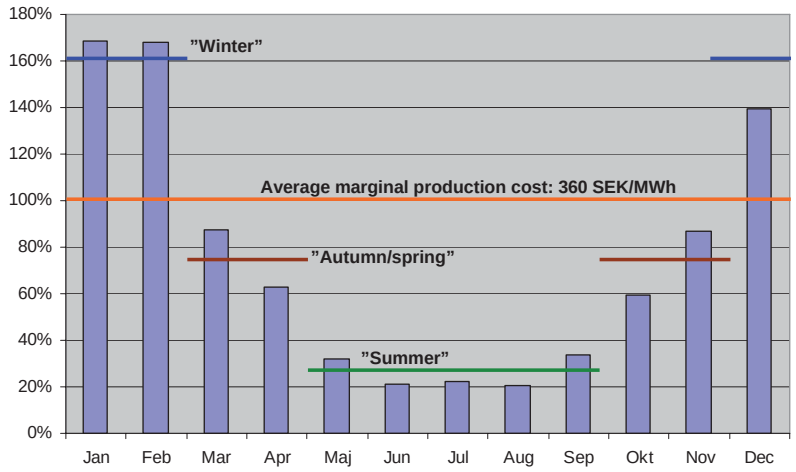
The development of District

Impact of pricing structures

Results from NEP studies of district heating (DH) in the Nordic countries indicate that the pricing strategies used by the DH companies may be of great importance for the future development of the business. One challenge is competing with local alternatives like heat pumps.

District heating production costs differs between seasons

Due to the structure of the district heating production mix, the variable costs differ between seasons. The marginal costs for district heating in Sweden varies according to the figure below. (Although the differences may be smaller in the other countries the basic trends, e.g. high costs during winter, are the same.) Far from all DH systems operate with differentiated prices for summer and winter, and if they do, price differences are typically small. In order to become more cost-correct the analyses show that the price should reflect the variable costs and the seasonal differences in production costs better. If not, there is a risk that suboptimal behaviour by the customers are encouraged.



Marginal cost of DH production in winter, spring/fall and summer relative to the average marginal cost (Sweden)

In recent years Swedish DH systems have experienced decreasing specific heating demands from their existing customers and competition from increasingly efficient heat pumps. This competition is influenced by how the district heating price is designed, e.g. regarding the balance between fixed and variable parts and whether the variable price is season differentiated or not.

If we take the example that a district heating customer introduces a heat pump that covers the base load, corresponding to one third of the total heat cosnumption, it is obvious that the structure of the district heating price influences the economy of this action. If a 100 % variable district heating price without season differentiation is assumed the customers cost reduction for the district heating part of the heating decreases by twice the amount compared to a case where a more cost-correct district heating price (with a fixed part and substantial season differentiation of the variable part). The heat pump investment could therefore be profitable in the first case but not profitable in the second case (where the district heating price much better reflects the real costs for the district heating company).

The introduction of the heat pump, profitable or not, would also cause less economical disadvantages for the district heating company if the remaining delivery results in an income that corresponds to the costs for the supply of this district heating. For that purpose the cost-correct district heating price is much better than e.g. the 100 % variable price.

Further information: MONIKA HAVSKJOLD, Xrgia

Cost and price for district heating in the Nordic countries

A substantial part of the cost for district heating is typically related to investment in heat producing equipment and a distribution system. Labour is also typically a fixed cost. The variable cost is to a large extent fuel cost (including taxes). For a lot of the base load technologies (waste incineration, waste heat, combined heat and power production (CHP) and heat pumps) the variable cost is low.

In **Sweden**, analyses shows that the variable price for DH is as an average comparable to the average marginal cost. The technologies for marginal production differ during the year, and vary between different DH systems. Many DH systems use low cost alternatives for base load (e.g. waste heat, waste incineration, biomass CHP). During the winter the high cost alternatives are only used for short periods (e.g. oil boilers). The district heating prices in Sweden (and in Finland) are not regulated.

In **Finland**, the base load is typically covered by one large solid fuel (coal, biomass, peat) boiler or a CHP plant. The peak load amounts to only 10% -15% of total heating energy and is often based on oil fired boilers. Availability of low cost alternatives may be weak in the summer, and especially during annual maintenance, in small CHP networks. The DH pricing is mostly set against long term heating alternatives of customers.

In **Norway** most companies have a large variable part of the DH tariff, independent of either base load or peak load technology. DH price is often linked to the electricity price, due to the price regulation (DH price not allowed to be higher than electricity for heating). In **Denmark** district heating is regarded as a natural monopoly, and thus DH prices are, as in Norway, regulated.

Heating in the Nordic countries

Less district heating when the EU's three 20% goals are applied!

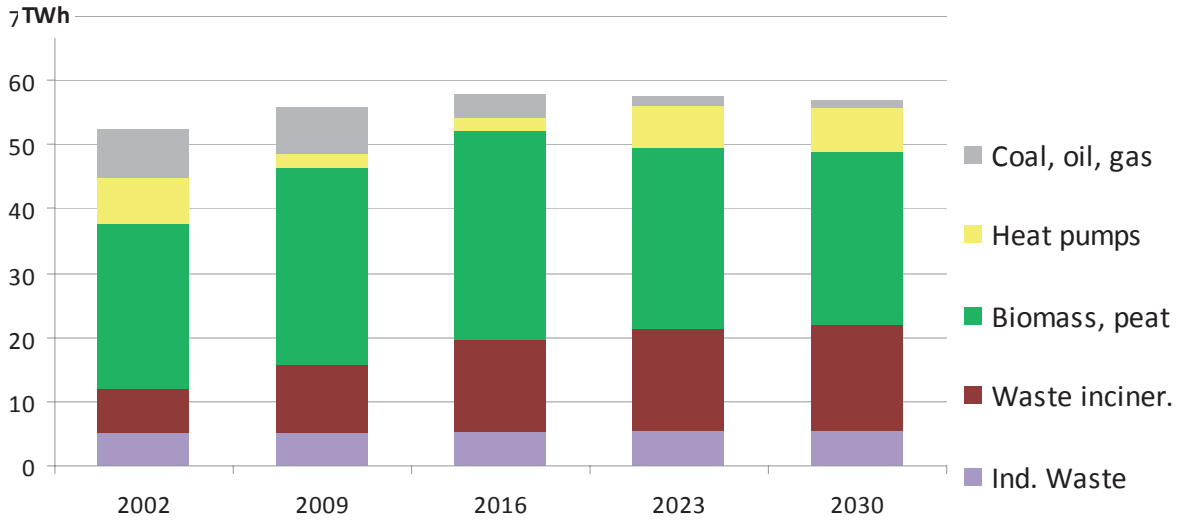
Strong competition for biomass from waste incineration, heat pumps and stagnating district heating use in Sweden

The EU´s three 20% goals will obviously have a large impact on the development of the energy systems in the Nordic countries. District heating is an important energy carrier in the Nordic countries and it is therefore interesting to study how district heating production will be influenced by the targets. During the first months of 2009 updated and improved model calculations have been made within the NEP project in order to analyse the impact on the Nordic district heating production from the EU's climate change and energy package. Although the main trends can be found in all Nordic countries the development differs somewhat between the countries. Here we have chosen the calculated development of Swedish district heating production as an example.

Calculations where only the present policy instruments are applied show an increasing use of district heating in Sweden, with biomass as the dominating source for heat production. When the EU´s 20 % targets regarding increased use of renewable energy, increased energy efficiency and reduced emissions of greenhouse gases are added, the use of district heating stagnates in Sweden and the use of biomass starts to decrease after an initial expansion.

When only the present policy instruments are applied the use of district heating continues to grow. The production mix shows increases for waste incineration and biomass, while the use of fossil fuels and heat pumps decreases somewhat. This development changes significantly when all three EU goals are applied. The energy efficiency goal leads to a general decrease in heating demands. This can also be seen for district heating, where the use stagnates or even decreases slightly after the year 2016. At the same time the three goals make heat production based on fossil energy sources even less competitive. Waste incineration is still competitive, largely due to waste treatment sector policies. The definition of the goals also makes heat pumps increasingly attractive. This leads to a situation where the use of biomass, after a period of rapid growth, could decrease. (On the Nordic level there are, however, larger quantities of fossil fuels to substitute, which could give room for long term increased use of biomass also in the case with all three EU targets.)

Further information: HÅKAN SKÖLDBERG and THOMAS UNGER, Profu



Total district heating production in Sweden in the scenario with all three EU 20 % goals, i.e. the EU's goals of increased use of renewable energy, greenhouse gas reduction and improved energy efficiency are applied simultaneously (also keeping the current emission trading system (EU ETS) and national policy instruments)

RES deployment profoundly changes the market balance of the Nordics

Implementation of the RES directive shifts power market balances and trade patterns in Europe significantly. The Nordic area has large and relatively cheap RES potentials, combined with (probably) lenient targets because of a high initial share of RES-E generation. The proposed burden sharing does not take current or future supply/demand balances into account, and the Nordics may become large exporters of both electricity and green certificates if trade in certificates (TGC) develop. The ef-fect is reduced Nordic power prices and reduced thermal generation. The huge expansion of RES-E generation may be accompanied by higher grid costs.

Results from the NEP models clearly demonstrate that ambitious renewables targets profoundly affect market balances in the Nordics. As can be seen in the figure on the right, the market balances in the Nordics are almost reversed compared to 2007 (modelled). Denmark becomes a net electricity importer, while Norway and Sweden become large exporters in 2020. Finland is also a net exporter to the Nordics (imports from Russia and Estonia are not included in the figure).

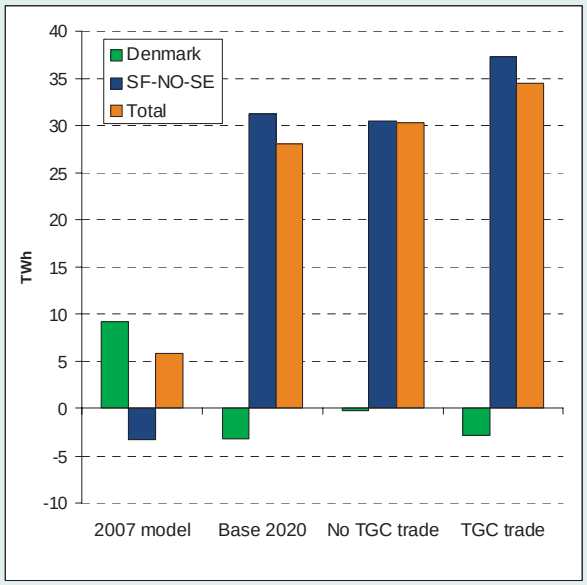
New interconnectors more profitable with RES-E certificate trade?

As the price differences and traded volumes increase, so does the income from trade. In the Trade scenario the NorNed cable is fully utilized for exports from Norway to the Netherlands, i.e., prices are higher in NL than in NO in all load blocks, and the price differences indicate that an expansion of the capacity may be profitable.

The results are however very sensitive to changes in the RES-E level, and to the way trade is modelled.

Huge challenges for national grids

The reversal of trade patterns and the dramatic increase in net exports from the Nordics indicate that the RES-E expansion poses a huge challenge for TSOs. The description of the system in 2020 shows increased transit, particularly through Sweden and Denmark, increased intermittency as the share of wind power increases, and reduced flexibility as the share of conventional power generation is reduced.



Net electricity exports from the Nordic countries. Total Nordic exports to Germany, Netherlands and Poland is 34 TWh in the scenario with an EU-wide market for green certificates (TGC).

The pattern is similar in all three RES 2020 scenarios:
Base: RES generation is developed according to national policies and there is no certificate trade
No TGC Trade: The EU RES target is fulfilled without certicifate trade
TGC Trade: The EU RES target is fulfilled with certificate trade

The RES directive

Targets: In order to reach the 20% RES target, the electricity sector is set to increase RES-E generation to an estimated 30-35% from today's level of around 8,5%.

Burden sharing: Remaining potentials for RES-E generation and the ability to lift such massive investments vary across EU member states. The Commission has proposed a burden sharing which takes these factors into account. The result is that RES-E investments will be unevenly distributed among member states.

Measures: An EU wide market in Guarantees of Origins have been rejected by major member states. Certificate trade in the form of joint target compliance, joint pro-jects of transfer certificates will be permitted.

Further information: BERIT TENNBAKK, ECON Pöyry and THOMAS UNGER, Profu

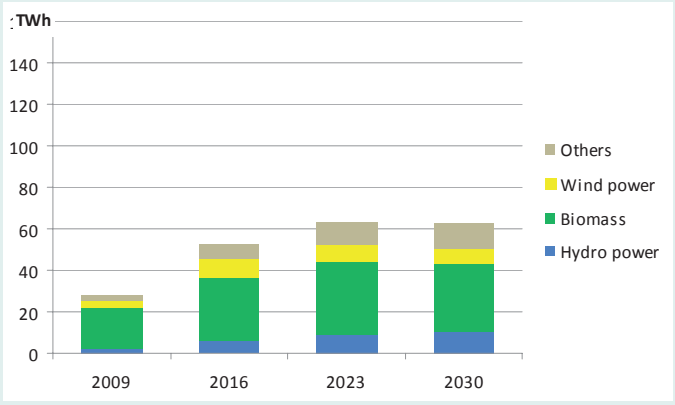
The use of renewable energy increases in the Nordic countries

Heat pumps very competitive when the EU´s three 20 % goals are applied

The EU's 20 % goals regarding increased use of renewable energy, improved energy efficiency and reduced emissions of greenhouse gases stimulate, as expected, the use of renewable energy in the Nordic countries. NEP's continued analyses of the EU's climate change and energy package shows that the use of wind power and heat pumps increase significantly, while the use of biomass only increases slightly compared to a situation where only the present policy instruments are used.

Reference case

The EU's three 20% will obviously have an impact on the use of renewable energy in the Nordic countries. The effects of different combinations of the goals have been analysed within the NEP project through model calculations. During the winter 2008/09 updated and improved model calculations have been made in order to analyse the impact on the Nordic stationary energy system from the EU's climate change and energy package. Here we concentrate on results regarding the use of renewable energy. The starting point has been a calculation of the development where merely the present policy instruments are used. The calculation shows that biomass is the renewable energy source that grows fastest, while the expansion of wind power is limited. "Others" (includes heat pumps, industrial waste heat and solar heating) increases slightly.



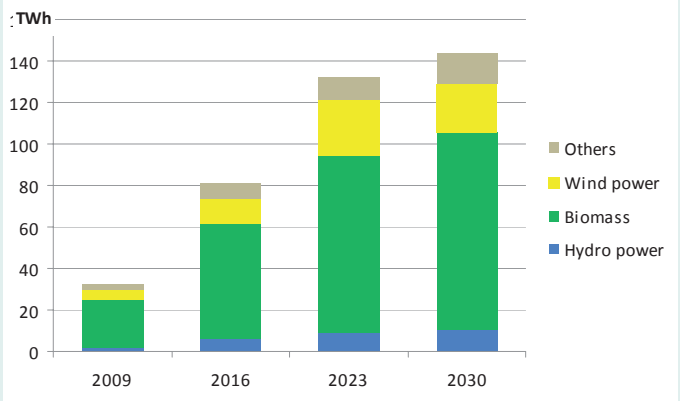
Reference case: *Increase in the use of renewable energy in the Nordic countries, compared to 2005, without any new EU goal*

20% increased use of renewables

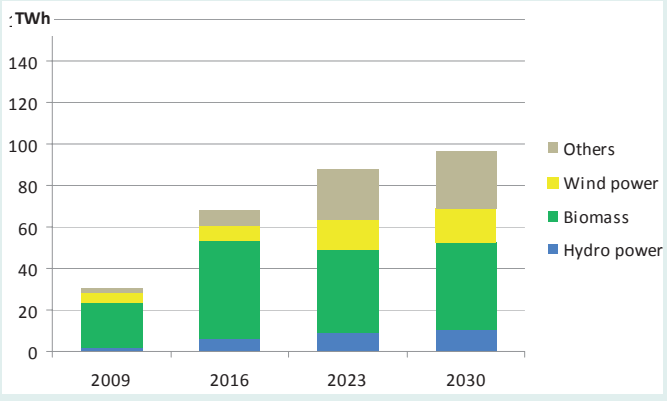
In the next calculation, the EU's goal of 20 % increased use of renewables has been added. This has been described in the model as a common Nordic effort, based on the specified national goals. As expected, the use of renewable energy increases significantly. This case shows a much greater use of biomass and wind power than when only the present policy instruments are used. The use of heat pumps also increases slightly.

All three EU 20% goals

When all three EU goals are applied simultaneously the use of renewable energy reaches lower levels than when only the goal of increased use of renewable energy is applied. This is largely a result of the reduced general use of energy through energy efficiency measures. However, the combination of goals also influences the mix of different renewable alternatives. The use of heat pumps is stimulated, while the use of biomass and wind power increases slower than in the 20 % increased renewable case. (The waste heat utilized by the heat pumps is not included in the energy amount that is to be reduced.)



EU goal of 20% increased use of renewables: *Increase in the use of renewable energy in the Nordic countries, compared to 2005, when EU´s goal of increased use of renewable energy is applied*



All the three EU 20% goals: *Increase in the use of renewable energy in the Nordic countries, compared to 2005, when EU´s goals of renewable energy, greenhouse gas reduction and energy efficiency are applied together*

Millions of electric cars in the Nordic countries

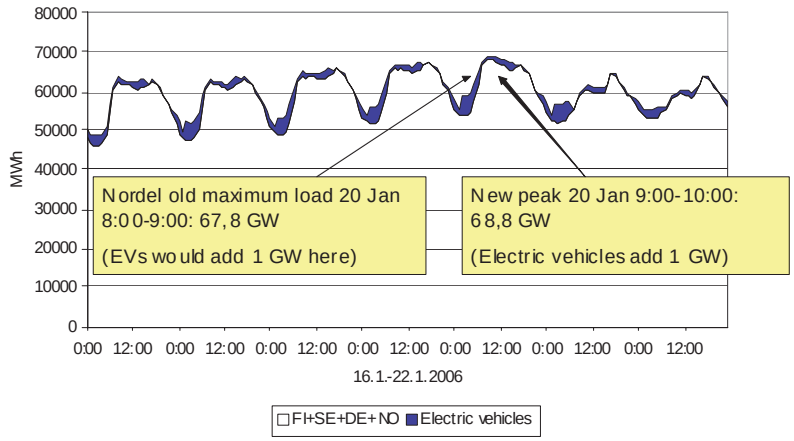
- impacts on the Nordic electricity system

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.

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. 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.



Smart chaning. *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.*

Smart charging

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.

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.

Further information: GÖRAN KORENEFF, VTT

Calender 2009

March, 17	NEP Conference in Oslo
May, 12	Workshop, Arlanda, Stockholm
May, 12	Board meeting, Arlanda, Stock-holm