Business from technology

Electric vehicles

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Göran Koreneff

VTT Technical Research Centre of Finland

Nordic Energy Perspectives

Millions of electric vehicles would help with EU 20-20-20 targets for 2020

- **Reduction of CO emissions by 20 % by 2020**
- **Increase share of renewable energy to 20 % by 2020**
- **Improve energy efficiency by 20 % to 2020**

- **and also with other targets such as security of supply**

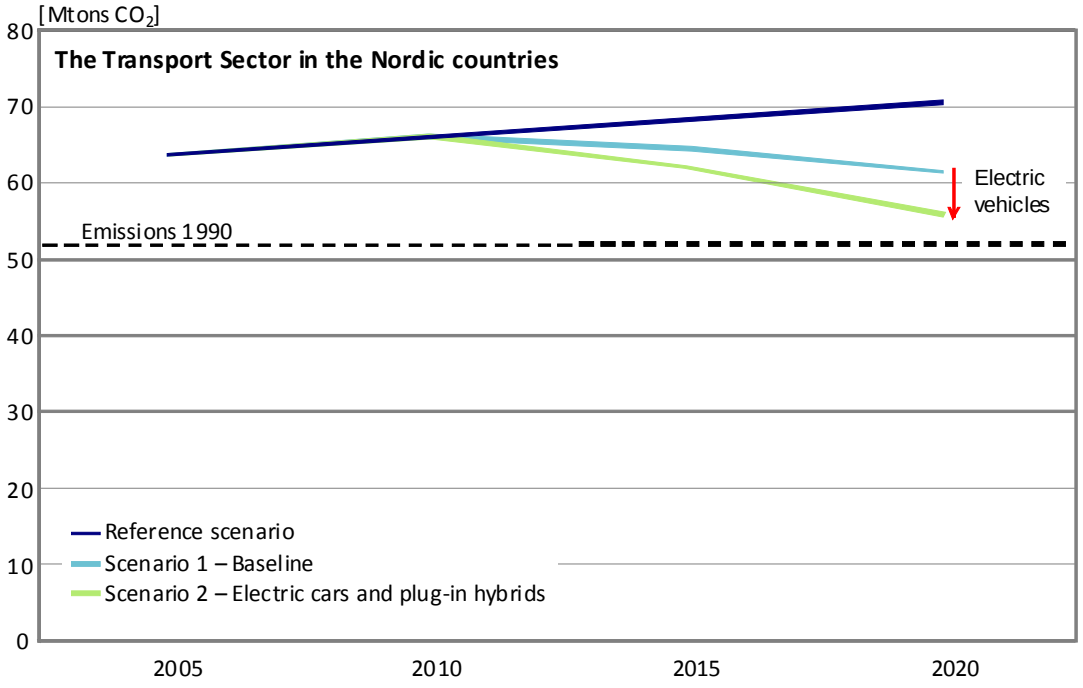
- **without leaving even a dent on the power system**
  (or, actually, a surprisingly small one)

Millions of electric vehicles would help with EU 20-20-20 targets

Millions of EVs will reduce CO2 emissions in a non-trading sector

- helps reaching difficult national obligations for non-trade sectors
- energy conversion moved to the CO2 trading sector

- 1.3 million EVs in the Nordic countries
- => reduce CO2 emissions from transport sector by 8-9 %
- => stands for ¼ of the total reduction commitment by 2020 in the non-trading sector
- => a similar increase in EU will rise the price of emission unit allowances (EUA) by 5-10 €/t



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Millions of electric vehicles would help with EU 20-20-20 targets

Millions of electric vehicles is an efficient means of attaining national renewable targets

- the EU renewable directive calculates the share of renewables according to the end use
- electricity used in vehicles displaces fossil fuel use
  - Nordic countries: ~ 65% of electricity is renewable by 2020 (NEP's analyses)
  - renewable electricity for vehicles is to be counted 2.5 times =>
    1 kWh used in an EV = 1.63 kWh renewable energy (0.65*2.5)
    in RES directive implementation calculations

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Millions of electric vehicles would help with EU 20-20-20 targets

Millions of electric vehicles will improve energy efficiency

- electric vehicles are very energy-efficient, electricity usage is on the average 0,15-0,25 kWh/km including charging losses
- petrol cars have a usage of at least 0,5 kWh/km (5 l/100km)

- **and increase security of supply**
  - less dependence on imported fossil fuels
  - multitude of possibilities to increase electricity production, incl. renewables, peat, nuclear

- **but also increase dependence on the power system**

Millions of electric vehicles would help with EU 20-20-20 targets

but still have manageable impacts on the Nordic power system

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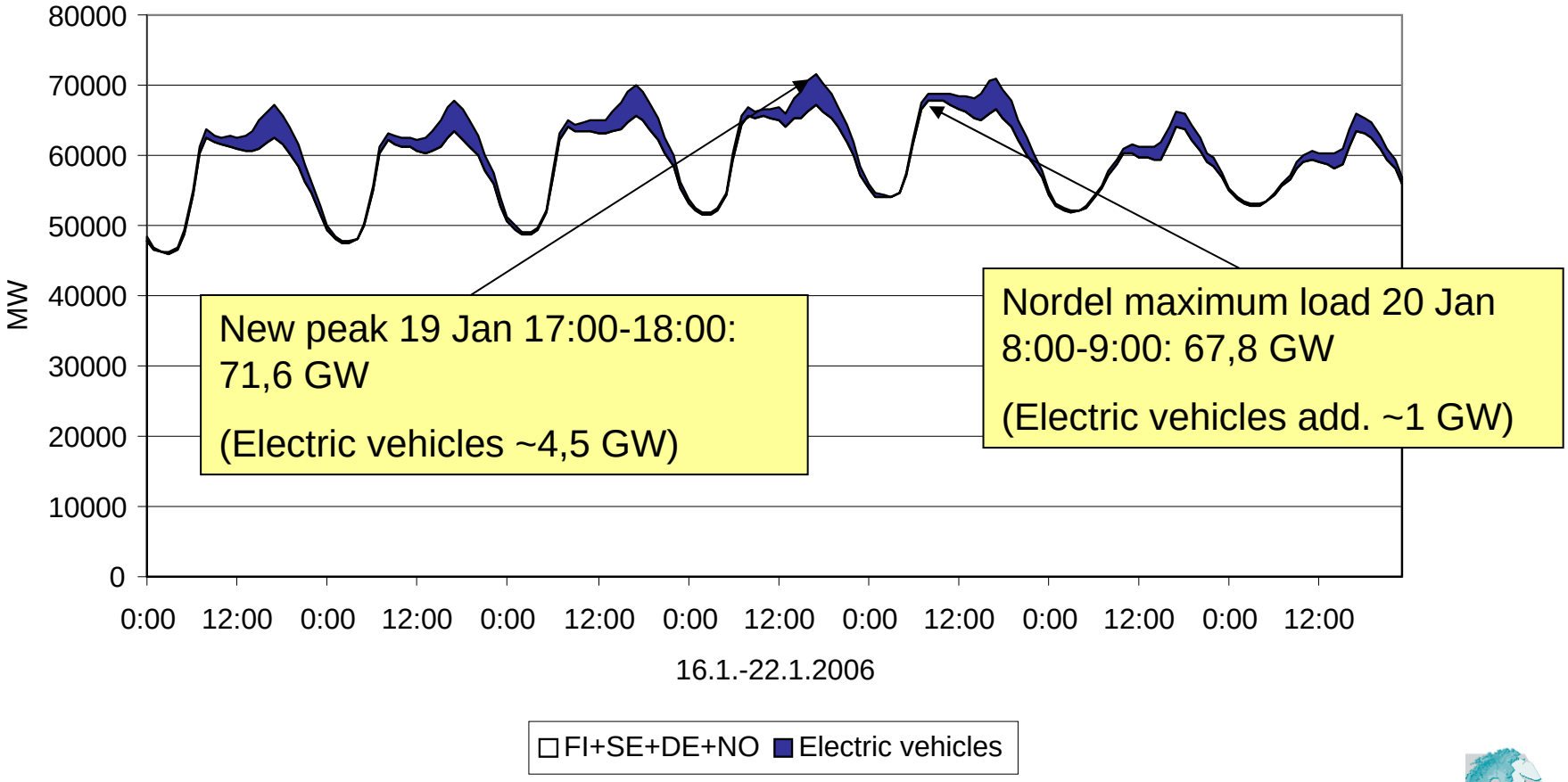
5 MILLION ELECTRIC VEHICLES IN NORD POOL AREA
Peak load rises by 3 800 MW



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5 million EV = 14,0 TWh/a

	Electricity consumption kWh/km	Trip km/a on electricity	Annual consumption MWh/a	Share of electric vehicles
Full electric vehicles				
• FEV 0,25	0,25	17 400	4,34	5 %
• FEV 0,17	0,17	17 500	2,97	15 %
Plug-in hybrid vehicles				
• PHEV 0,25	0,25	14 100	3,53	20 %
• PHEV 0,17	0,17	14 000	2,38	60 %

- No demand/price response in charging
- 20% can charge at work or elsewhere
- Average number of trips per day: 3.0
- Average distance driven before plugged in: 39 km
- Slow charging, max 12A @ 220V
- No heating or airconditioning

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System load and the EV charging peaks coincide => we need smart charging

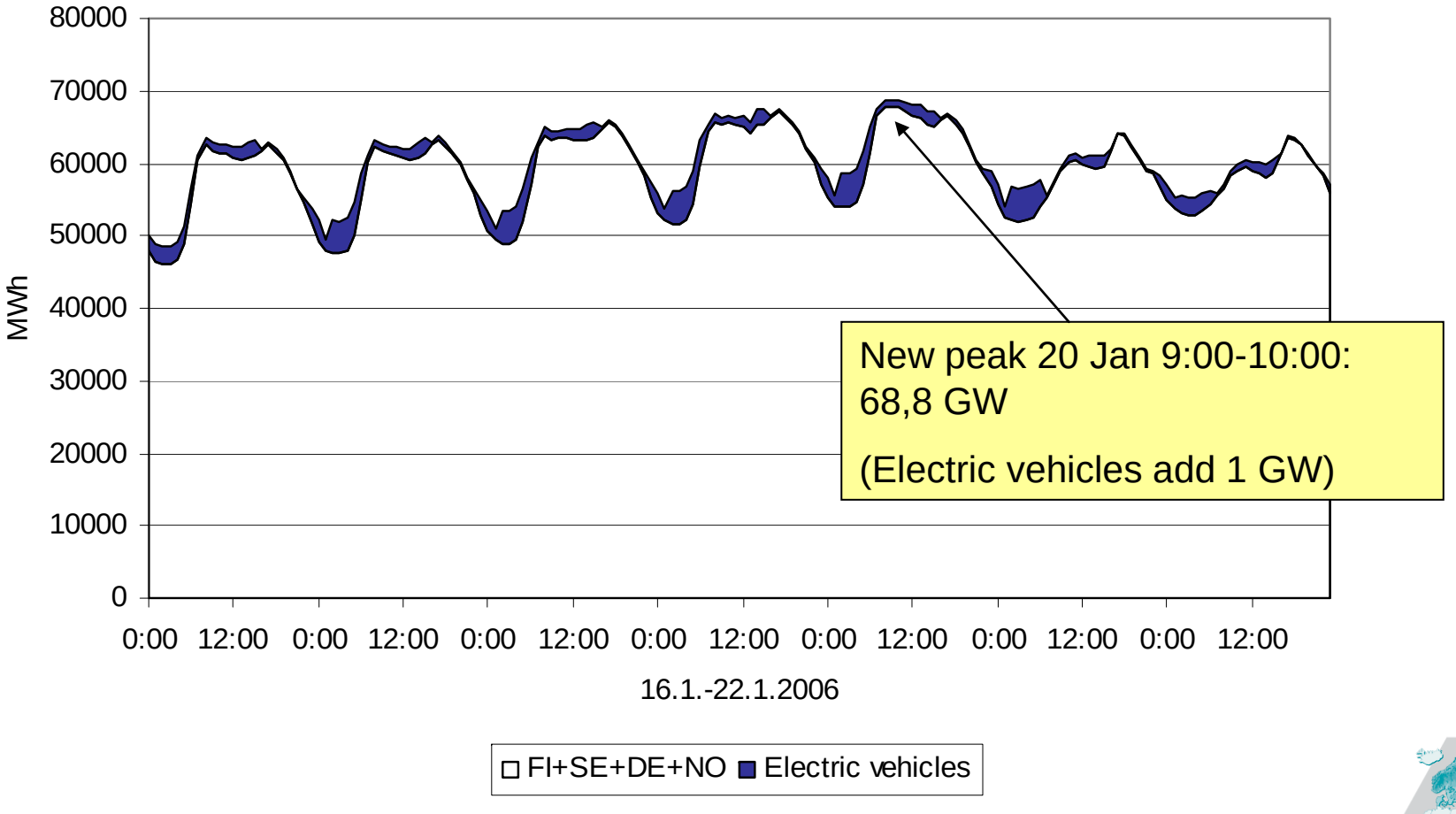
Charging at times when it suits the system best, without noticeable discomfort to the user

- automatic charge response to power system changes and signals, e.g. spot price, balance market price, frequency, direct steering
- smart charging gives only small financial gains, therefore are binding recommendations needed

Simple smart rules carry a long way, e.g. like our test case

- 90% of all charging otherwise taking place between 16:00 and 23:00 is moved to the night hours, 0:00 - 07:00
- maximum charging power is not changed
- No rules for daytime 07:00-16:00
- Rules in Finland follow Finnish time, in Scandinavia Scandinavian time

Peak load rises with smart charging by only 1 000 MW



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VTT creates business from technology

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