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## Towards the climate-neutral society with electricity in mind

### *A summary of the Swedenergy vision towards 2050*

### Sweden and the EU's climate ambitions must go hand in hand with developments abroad

Our scenario is based on a vision of a climate neutral Sweden. However, this is not possible at reasonable cost without the world around us also have the same concern. Swedenergy has with the starting point in this vision commissioned a scenario and describe here the electricity sector's contribution on the way to a carbon-neutral society.

The starting point of the scenario is therefore a global consensus that we must reduce our carbon footprint significantly, striving towards a two-degree target. By 2050, some form of global price on CO<sub>2</sub> is established. The price rises as the targets becomes increasingly stringent. In 2050, we assume that the price has reached 100 Euro / tonne CO<sub>2</sub>.

Carbon dioxide emissions in Sweden decline from over 50 million tonnes / year today to 10 million tonnes / year by 2050, a 80 percent reduction. Electricity and heat generation reaches nearly zero emissions. To a large extent, it is only the process emissions from industry, and certain emissions from the transport sector, which remains at the end of the period. Marginalcosts for the reduction is likely to be 100 Euro / tonne, which is the global CO<sub>2</sub> price in this scenario in 2050.

### The power generation in the Nordic countries is nearly carbon-neutral by 2020 and in 2030 it has become carbon-neutral

Swedish electricity production is today based to 96 percent of non-fossil power sources. Provided that the reinvestment in Swedish nuclear power is allowed, the Swedish electricity system also continues to provide Sweden with a power which leads to very low emissions of carbon dioxide. The Nordic electricity production is on track to become carbon neutral. The entire power generation results in only marginal emissions of carbon dioxide already in 2030. It is assumed that the gas-fired plants which remain in the system will be equipped with CCS technology. The European electricity generation has a longer way to go before it is carbon neutral, but by 2050 this is expected to be possible.

Depending on the assumptions made about future technology development for various types of power, such as fossil fuels with CCS, wind and nuclear power and fossil fuel prices these types of power will play a major or minor role in electricity generation mix in the long run. In the calculations, a very moderate assessment was made of the future technology developments of e.g. wind power.

It is worth noting that the study is based on the Swedish electricity certificate system in accordance with the decision of Parliament, which also means that new plants do not enter the system after 2020.

### Sweden and the Nordic countries have a unique power generation systems! We can use this in different ways;

- Increased domestic use of electricity is an important prerequisite for a carbon neutral and energy-efficient Sweden and Europe.

Electricity will play an increasingly central and important role in the future, in terms of reducing current emissions of greenhouse gases and contribute to an increasingly carbon-neutral society. It is especially in industry, in the transport sector and in heating as electricity will increase its market share. That does not mean that the increased volume of electricity in these markets is substantial. Electricity-effective solutions provide in most cases also a significant energy efficiency. Electric vehicles reduce energy consumption per vehicle, by up to 60-70 percent and a heat pump provides energy savings in the same magnitude compared with, for example, an oil-fired boiler. With climate neutral electricity a shift from petrol, diesel and heating oil to electricity means one hundred per cent reduction in carbon dioxide emissions. Use of electricity could be the most important climate and efficiency measure, both in Sweden and in Europe.

The market share of electricity in industry and buildings will increase from today's nearly 50 percent to over 55 percent in 2050. A further developed electricity-intensive industry means that more products can be produced with carbon-neutral electricity and exported to the benefit of the environment. District heating will also be carbon-neutral long before 2050. This means that a change to district heating from previously fossil fuel consumption is also becoming an important climate action.

Electricity consumption in the transport sector in Sweden will increase from 3 to about 7 TWh in 2030. In addition to the electricity used for rail traffic, the introduction of electricity primarily will take place in passenger cars. Electric power is introduced so that it corresponds approximately to 40 percent of the remaining amount of the energy need of cars. A carbon neutral transport sector in 2050, will require a continued increase of both electricity and biofuels. The conversion to electricity for lighter vehicles such as passenger cars, light commercial vehicles and construction can even be accelerated on the way to 2050.

In total, the electricity consumption is expected to increase by 12-15 percent in Sweden and Scandinavia.

### Export - Nordic electricity export makes it cheaper for Europe to move towards a carbon neutral Europe.

The positive conditions that the Nordic countries have, through the availability of renewable resources to produce climate-neutral electricity makes it cheaper for the EU to move towards a climate neutral society by the export of electricity from the Nordic countries to the rest of Europe, even taking into account the costs for grid expansion.

The increasing price of carbon allowances and the achievement of the objectives with the help of our Nordic support schemes for renewable power, makes investments in both new renewable power and new nuclear profitable. In this way we get an excess of carbon neutral power that can contribute to the reduction of emissions by selling it to neighbors in Northern Europe. This generates export revenues for the Nordic countries. In an alternative scenario, where no reinvestment in the Swedish nuclear power is allowed, Sweden, however, increasingly becomes dependent on imports for the electricity supply, and around 2040 Sweden will become net importer.

Sweden and Europe has already put in place market-based incentives to steer toward a more carbon-neutral society. In order to achieve the carbon-neutral society, we must build upon on these instruments. Among others, the following conditions must be met;

- A global policy for reducing greenhouse gas emissions
- A global price on carbon
- All technology options are kept open in order to produce electricity and other goods in the best possible way
- Faster permitting procedures for grid expansion and carbon neutral electricity production
  
- Transmission capacity is built in and to/from Scandinavia to the extent that new generation is emerging
  
- The network is reinforced in northern Europe to facilitate electricity exports from the Nordic region
- Research, development and demonstration concerning, for example, electricity vehicles related infrastructures and logistics, CCS, and new power sources, such as wave and solar power.