THE ELECTRICITY YEAR & Operations

2011

SVENSK energi

The Electricity Year

– contents on page 4

Operations

– 12 pages starting after page 46

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THE ELECTRICITY YEAR

CONTENTS OF THE ELECTRICITY YEAR 2011

2011 – an unusually dramatic electricity year "An early spring flood saved a tough situation!"

Intense cold at the beginning of the year and continued low operating availability in the nuclear power plants created a deficit of electricity in the spring that could have had serious consequences in an electricity shortage. Fortunately, the situation was saved by a spring flood that arrived three weeks earlier than normal. Through the remainder of the year, the total power balance shifted and the reservoirs were filled to historically high levels.

Prices for electricity also fluctuated during the year. The average system price on Nord Pool Spot was just over SEK 0.42 per kWh, compared to over SEK 0.50 per kWh in 2010 – a decrease of 16%.

In Swedenergy's opinion, the events of 2011 show that the margins are far too tight. We need to build more production capacity, new power lines and additional international transmission interconnections. The energy industry is seeking wide political consensus on development of the Swedish system.

In this context, Swedenergy's Managing Director Kjell Jansson called for long-term ground rules that would give investors greater security and certainty about the terms that apply. In particular, the Swedish Government needs to contribute to speeding up the time-consuming permitting process that is holding back expansion.

LOW NUCLEAR POWER OUTPUT – DRY YEAR TURNED INTO WET YEAR

Annual nuclear power output reached 58 TWh, compared to 75 TWh in the record year 2004. The aftermath of earlier years' extensive modernization projects led to continued disruptions in 2011. Wind power output amounted to over 6 TWh. Other thermal power accounted for close to 17 TWh. The year's output in the Swedish hydropower plants was 66 TWh.

Sweden's aggregate electrical output was 146.9 TWh. The country's total electricity usage was just over 139.7 TWh (147.0 in 2010), a decrease of 5.5%. This is mainly due to milder weather in the autumn and some cyclical slowing in the industrial sector.

Sweden's net import of 2.1 TWh in 2010 was replaced by an export of 7.2 TWh in 2011. This export had a marginal effect on the country's CO_2 emissions. For our neighbouring countries, however, this led to a drop in CO_2 emissions by 3.5–5.5 million tonnes. The Nordic region was a net importer in 2011 with a volume of close to 5 TWh, compared to a net import of 19 TWh in 2010.

With regard to hydropower, the Nordic region went through a tough period before the spring flood at the end of April, when the reservoirs reached very low levels. Norway introduced voluntary power rationing to conserve hydropower supplies and was thus able to avoid a shortage situation.

Abundant rain during the summer and autumn in particular filled the reservoirs to above normal levels. At the end of 2011 the reservoir storage level in both Sweden and the Nordic region as a whole was estimated at 76%. For Sweden, this was approximately 10% above average and 30% higher than at the previous year-end.

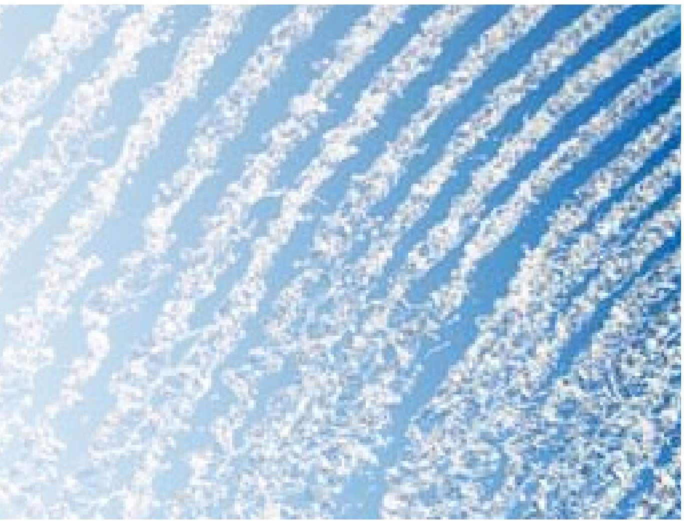
TABLE 1

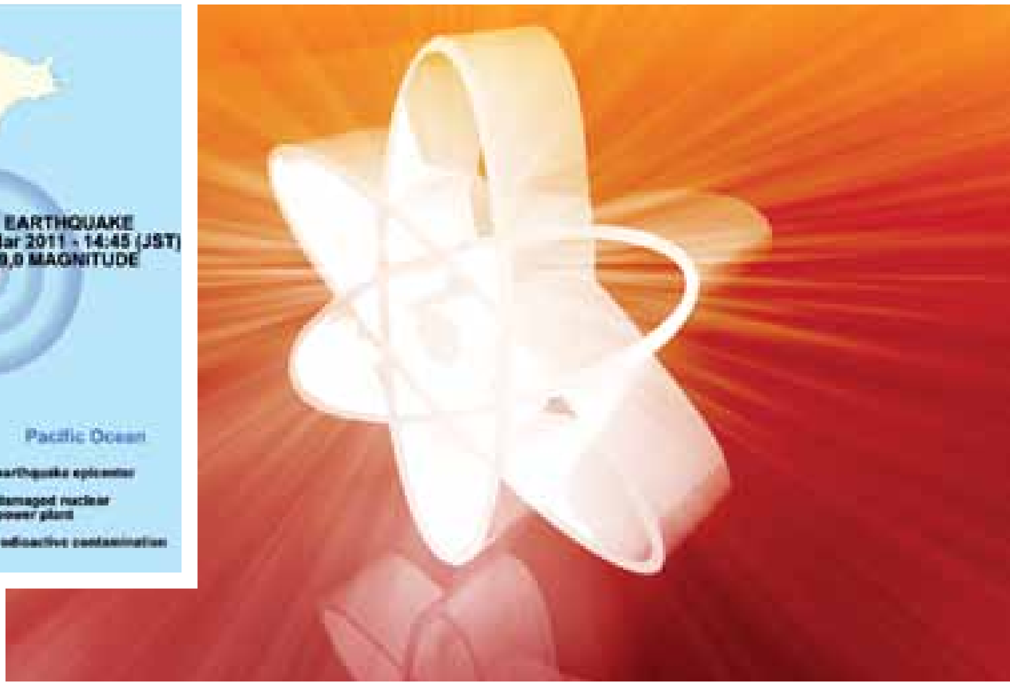
PRELIMINARY ELECTRICITY STATISTICS FOR 2011, TWh

Supply	2010 TWh	2011* TWh	Change from 2010
Hydropower	66.8	66.0	–1.2%
Wind power	3.5	6.1	74.3%
Nuclear power	55.6	58.0	4.3%
Other thermal power	19.1	16.8	–11.9%
Total electrical power output	**144.9**	**146.9**	**1.4%**
Net import/export**	2.1	–7.2	
Total domestic electricity usage	**147.0**	**139.7**	**–5.0%**
Temperature-adjusted electricity usage	144.2	142.5	–1.2%

** Preliminary data from Swedenergy*
*** A negative value is equal to export*

Sources: Swedenergy and Statistics Sweden





LOW DEMAND AND A GOOD SUPPLY OF WATER LED TO LOWER PRICES

Price-wise, the year showed two sides. In the first half of 2011, spot prices in the Nordic electricity market were clearly higher than normal following two years of sub-normal precipitation. With rising storage levels in the reservoirs, higher temperatures and the inhibitory effects of economic uncertainty on demand, spot prices fell to unprecedented low levels during the autumn. Despite monthly prices of SEK 0.62 per kWh at the beginning of the year, the average system price on Nord Pool Spot during 2011 was just over SEK 0.42 per kWh, down by 16% compared to the level of over SEK 0.50 per kWh in 2010.

As a result of the poor water situation, the average price in the Nordic region exceeded that in Germany during 2010. However, the water balance was restored in 2011, particularly in the second half of the year, and resulted in an average price in the Nordic region that was nearly 10% lower than in Germany.

CONSEQUENCES OF THE NUCLEAR DISASTER IN JAPAN

On 11 March 2011, disaster struck at the Japanese nuclear power plant in Fukushima. It started with a high magnitude earthquake that cut off the power supply to all six reactors. The three reactors in operation at the time were automatically shut down and emergency diesel generators were activated to keep the reactor cooling systems running.

The earthquake itself presented an extreme challenge, but it was the subsequent tsunami that caused the really significant problems. It disabled all emergency diesel generators except one serving two reactors that were already offline for maintenance. The damage was severe. Three core meltdowns developed within 60 hours and increased radiations levels were detected already within 24 hours. A great deal of radioactive material was released into both the air and the ocean following the accident.

As a result, the Fukushima accident had more extreme consequences than the meltdown in the American city of Harrisburg in 1979. The conditions were more similar to those following the Chernobyl disaster in 1986. As in the case of Chernobyl, the remediation and clean-up measures at Fukushima will be extensive.

Reactions to the Fukushima incident were not late in coming. Germany made a swift decision to close all nuclear power reactors in the country by 2022. The Swedish nuclear power sector was also affected by the accident in Japan in that all EU member states were ordered to carry out comprehensive risk and safety assessments of their nuclear power plants, so-called stress tests. The nuclear power plants in Sweden submitted their reports on 31 October. The Swedish Radiation Safety Authority (SSM) reviewed the nuclear power industry's analyses and presented a Swedish national report to the EU at year-end 2011.

In its report, the SSM found that the Swedish nuclear power plants are robust and resilient to most kinds of extreme events, but that improvements are necessary for a few events. The nuclear power plants are not fully dimensioned to withstand an accident scenario in which several reactors are put out of commission simultaneously, or for situations with an extended sequence of events. The EU's combined report on stress tests in the European nuclear power plants will be presented in June 2012.

BIDDING AREAS INTRODUCED IN SWEDEN

On 1 November 2011, Sweden was split into four bidding areas by Svenska Kraftnät (the Swedish transmission system operator). Initially, bottlenecks in transmission capacity led to large price differences between bidding areas. The restart of nuclear reactors at Ringhals, and commissioning of the Fenno-Skan 2 submarine power cable, reduced these differences significantly. On average, the difference between bidding area 4 (Malmö) and bidding area 3 (Stockholm) was SEK 0.04 per kWh. The difference between bidding area 4 and bidding areas 1 and 2 (Luleå/Sundsvall) was just over SEK 0.05 per kWh during the two months that the bidding areas existed in 2011.

The area prices in different parts of the country clearly underline the need to build more production capacity in areas where demand exceeds supply and to reinforce the transmission grid. In view of this, Swedenergy has called for a faster permitting process to shorten the currently long lead times, resulting partly from appeals. For some time Swedenergy has also pointed out the need to expand the transmission grid in Sweden and the Nordic region, where the permitting process for transmission networks is also a common cause of long lead times.

A report presented by the Energy Markets Inspectorate (EI) in mid-December 2011 shows among other things how the bidding areas affected contracts between customers and electricity suppliers. A summary on 1 December 2011 indicated that the number of electricity suppliers that offered electricity contracts in bidding area 4 was 64, compared to around 100 in the other bidding areas.

The EI has been assigned the task of monitoring the bidding areas, with the goal of submitting a final report to the Swedish Government in May 2012.

TOWARDS A COMMON NORDIC END-USER MARKET

For several years, a common Nordic end-user market for electricity has been at the top of the agenda for Nordic cooperation in the energy policy area. The Nordic energy ministers see a common Nordic end-user market as a natural continuation of ongoing efforts to harmonize and strengthen the wholesale power market.

In September 2009 the ministers commissioned NordREG (the cooperative organization for Nordic regulatory authorities) to draft a detailed roadmap to a common end-user market. In its final report "Implementation Plan for a Common Nordic Retail Market" from September 2010, NordREG stated that its long-term objective was a Supplier Centric Model (SCM) in which the electricity supplier is the customer's main point of contact, with responsibility for most customer service aside from strictly network-related issues. According to NordREG, a market model based on SCM could be implemented by 2015.

The Swedish minister Anna-Karin Hatt strongly advocated NordREG's position that customers should be able to turn only to their electricity supplier when acting in the electricity market. According to the ministers, the primary role of the DSOs should be to provide information and solve any problems related to the customers' physical connection to the transmission network.

Swedenergy also supports the development of a Nordic end-user market and accepts a market model in which the electricity supplier is the customer's primary point of contact and the DSO handles strictly network-related issues. At the end of the year, Swedenergy took this position for its ongoing activities. Swedenergy sees this work as an important step towards realizing the EU's goal for a common European electricity market.

SWEDISH ELECTRICITY MARKET – GREATER TRANSPARENCY, HOURLY METERING, NET BILLING

In mid-February 2011 the Energy Markets Inspectorate (EI) proposed a list of measures to improve the electricity market. Aside from independent observers on the boards of the nuclear power companies, the proposals included greater transparency on the Nordic power exchange, hourly metering for all customers who use more than 8,000 kWh of electricity per year and investment in smart grids to facilitate the supply of renewable electricity.

On 30 November the Swedish Parliament approved a number of proposals concerning the electricity market – including the implementation of hourly metering for all electricity customers. The objective behind government bill 2010/11:153 "Strengthening the Role of the Consumer for a Developed Electricity Market and Sustainable Energy System", which was presented on 22 June, is to improve the position of electricity customers. Swed-energy supports this direction but is critical to the fact that the hourly metering proposal underestimates the extent of technical changes required in the electricity meters and related systems, as well as the resulting costs for Sweden's DSOs.

The bill also proposed measures that would make it easier for customers to deliver self-generated renewable electricity to the grid, thereby giving customers greater opportunity to take control over their electricity usage while at the same time contributing to transformation of the energy system. The introduction of net billing, i.e. "netting" of electricity inflows and outflows, could facilitate this trend. However, further investigation is necessary before implementing a system of this type.

Swedenergy feels that the DSOs should offer their customers net billing and that this should take place on a monthly basis. While other players in the market will have access to net values for settlement and billing, customers should have access to their hourly values. Although the regulatory conditions for net billing have not yet been worked out, a rising number of local initiatives were taken during the year in which electricity suppliers signed agreements with self-generators of electricity based on net billing.

Increased monitoring of the electricity market is one result of the Regulation of the European Parliament and of the Council on Wholesale Energy Market Integrity and Transparency, which took effect on 28 December 2011. The regulation gave the EI and other European national regulatory authorities greater investigatory powers to enable effective monitoring on the electricity and gas markets.

The new regulation is designed to deter insider trading and market abuse. Among other things, the EI will set up its own department for market monitoring and at the same time extend its cooperation with the Swedish Financial Supervisory Authority, other European regulatory authorities and market places such as Nord Pool Spot.

OVER 6 TWH OF WIND POWER

Wind power capacity was dramatically expanded in 2011. Wind generation benefited from strong winds during December, which led to new wind power records. In 2011, the country's aggregate wind power assets produced more electricity than the average Swedish nuclear reactor. At the same time, the number of appeals of wind power projects to the country's environmental courts increased during the year, and was three times that received five years ago.

JOINT NORWEGIAN/ SWEDISH REC MARKET

At the end of June the then Swedish Minister for Enterprise and Energy Maud Olofsson and the Norwegian Minister of Petroleum and Energy Ola Borten signed a binding agreement for a joint Swedish-Norwegian renewable electricity certificate (REC) market, making it possible, for the first time, to create a common support system for renewable electricity production between two countries. The goal is to boost electricity generation from renewable sources by over 26 TWh, evenly distributed over the years from 2012 to 2020. This is equal to nearly 10% of the electricity generated in both Norway and Sweden during a year.

On 30 November 2011 the Swedish Parliament passed a government bill on rules for expansion of the Swedish REC market to other countries and approved an agreement between Sweden and Norway for a joint REC market. On 19 December 2011 Norway ratified the EU's Renewable Energy Directive. All formal decisions were thus in place for the agreement between Sweden and Norway for the introduction of a joint REC market at year-end 2011.

The system is set to start 1 January 2012 and – regardless of where the new power production is built – will call for both large-scale expansion of generating capacity and new transmission lines. During the year, Swedenergy also pointed out the need to reinforce cross-border connections if the REC market is to include more countries.

It has been speculated that wind power will be built in Norway to a greater extent, since the country offers better wind conditions. However, a study by the Swedish Energy Agency indicates equivalent costs for wind power in both countries. The comparatively better wind conditions in Norway are offset by the higher cost of expanding the grid.

Another much discussed issue is the risk that wind power could be outcompeted by Norwegian hydropower, which is cheaper by comparison. Furthermore, Norway's "right of reversion" contains restrictions on ownership of waterfalls and does not permit owners of hydropower other than the Norwegian state and the country's municipalities.

CRITICISED EU PROPOSAL ON ENERGY EFFICIENCY

The European Council's summit in April 2007 set a target to increase energy efficiency by 20% by 2020. On 8 March 2011 the European Commission presented a new Energy Efficiency Plan and on 22 June adopted a proposal for a revised Energy Efficiency Directive that introduces several legally binding measures.

The directive contains measures of different types to improve energy efficiency in the public, residential, service and industrial sectors, as well as the sectors for energy conversion and distribution. Measures are also proposed to promote development of the internal market for energy services. In addition, the proposal requires each member state to set indicative national targets for primary energy savings by 2020 and to broaden their monitoring and reporting of energy efficiency progress.

One of the key proposals in the directive is that each member state introduce a system of tradable white certificates in which energy distributors or suppliers are obligated to save a certain amount of energy for their customers annually, for example by replacing windows, insulating roofs and walls, distributing low-energy light bulbs, etc. According to assessments by the Swedish Government and the Swedish Energy Agency, this would function poorly in Sweden. Swedenergy is of the same opinion and feels that an alternative system for energy efficiency in Sweden can be built on six principles that have been drawn up together with parties such as the Swedish District Heating Association:

- Allow the end-users themselves to choose energy efficiency measures.
- Help those working on this issue to identify which cost-effective measures are most appropriate.
- Build incentives into the system.
- Set the target for an alternative system so that it supports Sweden's national energy efficiency target.
- Include energy efficiency in all sectors.
- Promote development of the energy services market.

In the spring of 2012 the EU Council of Ministers negotiated on topics such as to what extent the EU's energy savings targets should be made binding for the member states. The EU Parliament has expressed a clear position that in Sweden's case would require the country to reduce its primary energy use by 167 TWh by 2020. At the same time, the Parliament proposes a maximum cap for primary energy use in Sweden of 481 TWh by 2020. Both requirements would be a major challenge to achieve in less than eight years, for example compared to 2010 when primary energy use was 597 TWh. Primary energy is defined as the total amount of energy that is supplied to Sweden.

Swedenergy notes that Minister of Information Technology and Energy Anna-Karin Hatt is opposed to the EU Parliament's proposal to introduce a binding cap for energy usage in each country. In this respect, the power industry is in agreement with her.

REGULATIONS FOR ORIGIN LABELLING OF ELECTRICITY IN PLACE

At the beginning of October the Energy Markets Inspectorate (EI) published regulations for origin labelling of electricity. There have been legal requirements for labelling since 2005, but the industry has not been provided with precise instructions until now. When the new regulations reach full effect in 2013, customers will no longer have to deal with differences in the way electricity suppliers specify the origins and environmental impact of their electricity.

Rules on origin labelling can be found in an earlier EU directive from the early 2000s. The aim of the directive was to enable customers to choose their electricity supplier on the basis of both price and environmental aspects. From the start, Swedenergy has called for these regulations under which labelled electricity must also be verified by certificates of origin. For example, customers who choose wind-generated or nuclear power can be guaranteed that the supplier has "reserved" this specific type of electricity for their use.

EX ANTE REGULATION INTRODUCED – MANY COMPANIES APPEALED

In June 2009 the Swedish Parliament approved amendments to the Electricity Act (1997:857) entailing changes in the way DSO tariffs are regulated. As of 1 January 2012, a DSO's revenue level is approved in advance by the Energy Markets Inspectorate (EI), which sets a so-called revenue cap for a four-year regulatory period.

A debate over DSO tariffs arose in Sweden at the beginning of 2011. Among other things, Swedish Homeowners Association, Villaägarna criticized the tariffs as being high and unfairly differentiated within the country. The explanation is that DSOs with customers far out on the grid where the terrain is rugged have higher costs for the transmission lines, since they are more expensive to both build and maintain.

In September the EI set the rate of return – the so-called WACC (weighted average cost of capital) – at 5.2% for the first regulatory period between 2012 and 2015. The EI had thus failed to take heed of the criticism put forward by the power industry. The rate of return was only slightly higher than the proposed 5% that was opposed by Swedenergy and several member companies at a hearing in June.

On 31 October 2011 the EI announced its decisions on the revenue caps to apply for the period from 2012 to 2015. The majority of Sweden's DSO were assigned lower revenue caps than they requested and at the beginning of 2012, 86 companies had chosen to appeal the EI's decisions. Most of these appeals were handled via the legal representative appointed by Swedenergy, while five companies opted to lodge their appeals independently.

In summary, Swedenergy feels that the basic idea behind the EI's regulation model is reasonable. The model should give the

DSOs stable and long-term financial conditions that provide incentives to maintain high delivery quality in the grid and to offer electricity customers high security of supply at a reasonable price. Swedenergy is critical of the EI's decision to apply the rate of return (WACC) throughout the entire period and that regulation can only take place retroactively. The rate of return is such an important parameter that it should instead be regulated in advance for one year at a time.

Additional cost increases are awaited in pace with new demands on the transmission networks of the future. The customers must be given opportunities to steer their electricity usage more simply and effectively. European ambitions to make the energy system more sustainable are influencing the structure of the grid, which is visible not least in an increased volume of wind power. Furthermore, Europe as a whole is taking steps to optimize its transmission capacity both between and within countries. All of this costs money that will benefit the customers through well functioning networks.

NEW LAW FOR POWER OUTAGES LAUNCHED AND TESTED

Stricter legal requirements for the DSOs went into force on 1 January 2011, after which a power outage may not last longer than 24 hours. According to an earlier decision, the same company is also obligated to pay outage compensation to customers who have been without power for at least 12 hours. Under the provisions in the Electricity Act, the amount of compensation is calculated based on the length of the outage and the customer's estimated annual network cost. The level of compensation is raised for each new 24-hour period up to a maximum of 300% of the estimated annual network cost.

The new law was put to the test during the year. Hurricane Berta tore through southern Sweden in February and left 120,000 customers without power. At the end of the year Sweden was hit by a first advent storm, closely followed by Hurricane Dagmar during the Christmas weekend and Emil in early January 2012. The latter two ravaged central Norrland, Svealand and Götaland, and cut off power to 170,000 and 25,000 customers, respectively.

Following the storms, crews from Sweden's DSOs worked around the clock to restore power. The country's seven electricity cooperation response teams were mobilized and after Hurricane Dagmar it didn't take long before linemen and technicians from around the country volunteered their assistance, some of them flown in with the Swedish Armed Forces' Hercules planes. Power to the last customers was not restored until 9 January 2012.

Many Swedes suffered from outages and the resulting costs for the DSOs were high. Fortum estimates that Dagmar and Emil cost the company around SEK 90 million in repairs and outage compensation. For Vattenfall, the costs for Dagmar alone are estimated at SEK 109 million.

Since the end of the 1990s the Swedish DSOs have invested approximately SEK 40 billion in weatherproofing of the Swedish grid by insulating overhead lines or replacing these with underground cable. The pace of this work was accelerated after Hurricane Gudrun 2005 and Hurricane Per two years later. More than 50,000 km of power line have been converted. For the past few years there is also an extensive cooperation between the DSOs in the event of major disturbances (see above). The affected DSOs are given assistance with manpower and materials from colleagues around the country, and the clearing frequency along the Swedish distribution lines has been doubled compared to the earlier rate.

Delivery reliability in the Swedish grid has normally varied between 99.98% and 99.99%. The decisive factor is the annual number of storms and other major disturbances.

A CLIMATE-NEUTRAL SWEDEN – NEW "2050 STUDY"

The Swedish Government has proposed a vision for Sweden to reach zero net emissions of greenhouse gases (GHGs) by 2050. Based on this vision, Swedenergy commissioned a number of scenario estimates in June 2010 with the help of Profu in Gothenburg to describe the power industry's contribution to achieving a carbon-neutral society.

In 2011 Teknikföretagen and Swedenergy conducted a joint study on the measures needed to meet this goal by 2050. The study focuses on the role of electricity and showed the power industry's own scope to produce zero GHG emissions by 2050, as well as the potential of electricity to contribute to lower emissions in other sectors.

One key conclusion of the report is that political consensus is necessary if Sweden is to achieve emissions-neutrality by 2050. The report also highlights the importance of research and innovation. Long-term playing rules, among other things in the form of a price for carbon dioxide, are important for creating a society with low climate emissions. This also calls for a cross-bloc energy policy agreement.

From a technical standpoint, Sweden needs stronger and smarter grids, regulatable electricity production and continued investment in baseload production of electricity. There is also considerable potential to improve energy efficiency. Conversion from the use of fossil fuels to electricity, for example in cars, would lead to a reduction in both emissions and energy usage.

In 2011 the European Commission presented its roadmap for moving to a competitive low-carbon economy in

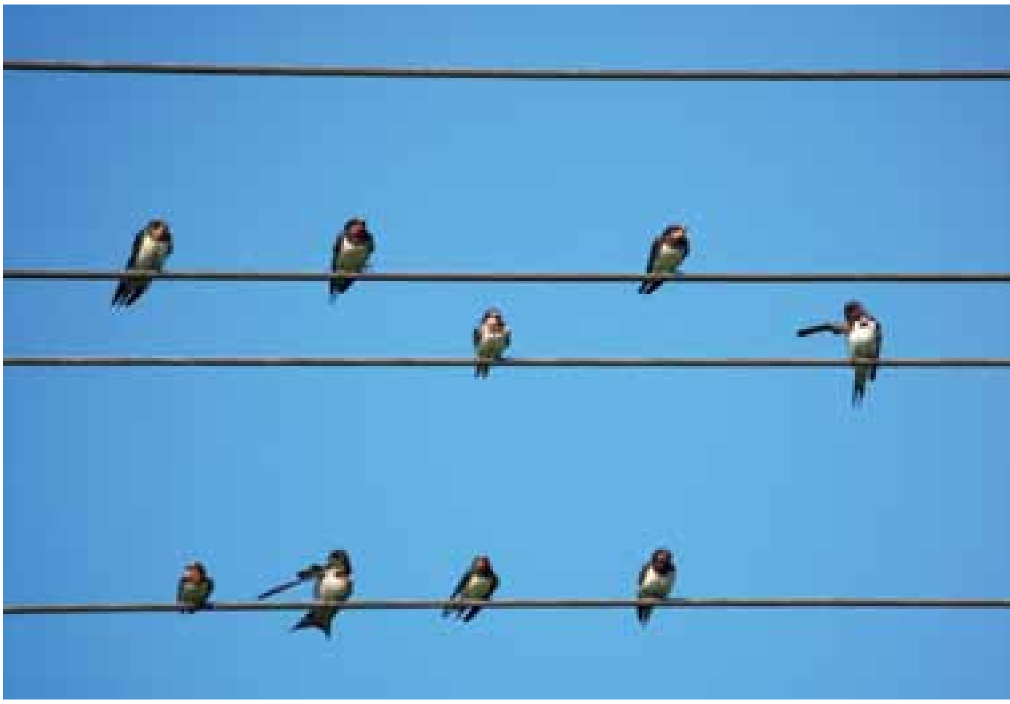
2050, and a roadmap for how the energy sector can contribute to a low-carbon EU. Furthermore, the Swedish Environmental Protection Agency was given the task of producing a roadmap to an emissions-neutral Sweden by 2050. The findings will be reported to the Swedish Government in December 2012.

EXTENDED COOPERATION WITH THE EDUCATIONAL SPHERE

In the summer and autumn of 2011, Swedenergy conducted a survey on the need for new employees with electric power and energy expertise. The survey was answered by all of the industry's major players and by other stakeholders outside Swedenergy that compete for similar skills. The findings that were presented by Swedenergy in November showed that the companies had a need for 8,000 new employees by 2016. These results include major engineering companies such as ABB, Siemens and Volvo and large consulting companies like Rejlers, Sweco and ÅF Consult, as well as companies that have taken over maintenance and operation of electricity networks; Eltel Networks, Infratek and ONE Nordic (formerly E.ON ES). Svenska Kraftnät and the forestry company SCA were also included.

The challenge is big, since the educational system is not capable of meeting this need. The Swedish Association of Graduate Engineers estimates the need for energy competence at 10% of all graduates with a MSc in engineering, 30% of all graduates with a BSc in engineering and 15% of others per year. This gives some idea of the scope of the problem, since not all future engineers are studying energy or electric power. Swedenergy has therefore warned for the risk that recruitment can be a major hidden billion cost for the industry. Professional recruitment is an expensive process, but there is also a cost for the opposite in the form of a shortage of qualified manpower.

Swedenergy hopes for a continued constructive dialogue with politicians and decision-makers to further ensure the availability of educational programs for energy and electric power expertise. In the autumn of 2011 the industry launched a BSc program in engineering with a focus



on electric power in collaboration with Sweden's three northernmost universities.

At the end of December the energy industry welcomed an educational package from the Swedish Government to meet the educational needs arising in the wake of SAAB's bankruptcy. This was an important decision that will enable a continued electric power program at University West in Trollhättan. Those who complete the program are welcome to work in the energy industry.

NEW TAX LEVELS FOR 2012

In 2011 the Swedish Government decided to raise the energy tax levels for 2012. For the majority of households in Sweden, this will result in an increase of SEK 0.007 to SEK 0.29 per kWh. Another new feature is that seagoing vessels can utilize low-tax shoreside electricity while in port, which has environmental advantages.

After indexation, the following tax rates for electricity apply as of 1 January 2012:

- SEK 0.005 per kWh hour for electric power for electricity used in industrial operations, in the manufacturing process or in professional greenhouse cultivation.
- SEK 0.005 per kWh for electric power used in seagoing vessels with a gross tonnage of at least 400, when the vessel is lying at berth in a port and the voltage of the electric power transmitted to the vessel is at least 380 volts. This does not apply when the vessel is used for private purposes, nor when the vessel has been laid up or otherwise taken out of service for an extended period of time.
- SEK 0.192 per kWh for electric power other than that referred to under the previous points and which is used in certain municipalities that are specified in Chapter 11, Section 4 of the Energy Tax Act. The increase will be SEK 0.005 per kWh.
- SEK 0.290 per kWh for electric power used for other purposes. This means that the tax rate for most households in Sweden will be raised by SEK 0.007 per kWh.

The Electricity market

Access to a neutral marketplace is essential for achieving a well functioning electricity market. Physical power trading in the Nordic electricity market takes place on Nord Pool Spot, while financial products are offered via NASDAQ OMX Commodities. Trading in the spot market enables players to plan their physical balance for the coming 24-hour period, while trading in the financial market is used for price hedging of future power volumes. Price formation in these marketplaces provides a basis for all power trading in the Nordic electricity market. In addition to trading via these two marketplaces, buyers and sellers can also enter into bilateral contracts.

LOWER USAGE LED TO REDUCED TRADING

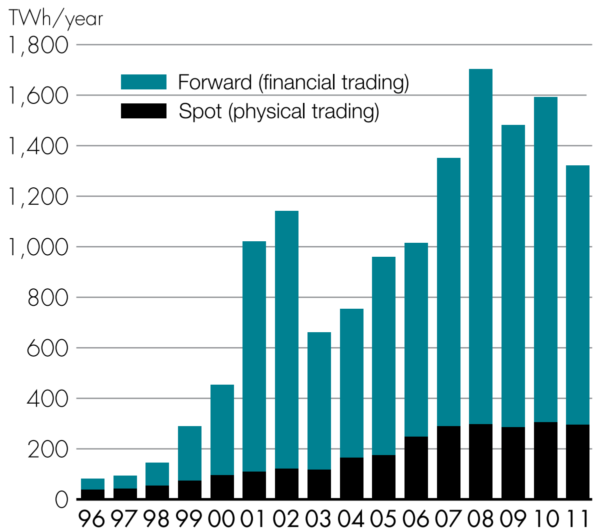
The Nordic power exchange Nord Pool Spot conducts day-ahead and intra-day trading for physical delivery of electricity, enabling market participants to maintain a supply-demand balance in their obligations as electricity suppliers or producers. Elspot conducts daily auction trading of hourly power contracts for physical delivery in the next 24-hour period, while Elbas is a continuous cross-border intra-day market that allows market participants to adjust their balances up to one hour before delivery. Financial trading, also known as the forward market, provides opportunities to trade with a horizon of up to five years and gives an indication of long-term spot price development. In addition, financial trading functions as an instrument for risk management. Furthermore, NASDAQ OMX Commodities is also able to clear bilateral contracts.

The volume of spot market trading in 2011 declined to 297 TWh (*see Diagram 1*), which can be compared to 307 TWh in 2010. The drop in turnover is attributable to decreased electricity usage in the Nordic region, at the same time turnover as a share of the Nordic region's total electricity usage rose to 79%. The traded volume in the forward market declined by 20% to 1,028 TWh, down from 1,287 TWh the year before. The total volume of cleared contracts fell from 2,090 TWh to 1,723 TWh.

2011 started with system prices of around SEK 0.70 per kWh, resulting from high temperatures and a weak hydrological balance. An abundant spring flood brought reservoir levels up to normal at mid-year and a warm and wet autumn turned the deficit of over 30 TWh in the Nordic reservoirs to a surplus of 10 TWh (compared to the mean) at year-end. With an improved hydrological balance, spot prices fell to a level of

DIAGRAM 1

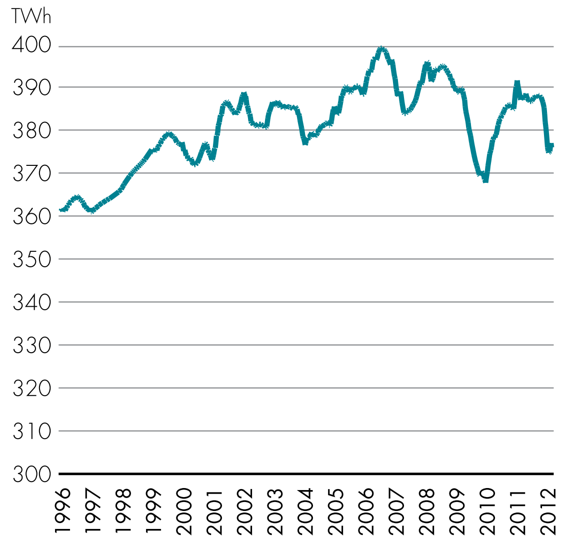
TRADING ON THE SPOT AND FORWARD MARKETS



Source: Nord Pool Spot

DIAGRAM 2

ELECTRICITY USAGE IN THE NORDIC REGION SINCE 1996, TWh



Source: Nord Pool Spot

around SEK 0.25 per kWh at the end of the year. The average system price in week 40 was SEK 0.091 per kWh.

Warmer weather and economic unrest in the Eurozone led to a weak industrial market and decreased demand for electricity in the Nordic region. Nordic demand for electricity in December 2010 amounted to 390 TWh, as a 52-week total, but by January 2012 had dropped to 375 TWh (*see Diagram 2*). Electricity usage in Sweden during the corresponding period decreased from 147.0 TWh to 139.7 TWh, or from 144.2 to 142.5 TWh on a temperature-adjusted basis.

The average system price on Nord Pool Spot was SEK 0.423 per kWh, down by 16% compared to 2010 when the average price was SEK 0.506 per kWh. The price on the German power exchange (EEX) was around SEK 0.46 per kWh, i.e. nearly 9% higher than the Nordic price calculated as an annual average. The Nordic system price reached a high of SEK 0.82 per kWh and a low of SEK 0.13 per kWh during the year. The corresponding hourly prices on EEX were a high of SEK 1.05 and a low of SEK -0.33 per kWh.

ELECTRICITY PRICE INFLUENCED BY MANY FACTORS

From a historical standpoint, prices in the Nordic electricity market have been primarily determined by the amount of precipitation. Access to cheap hydropower in the Nordic power system has been decisive for the extent to which other and costlier production capacity has been used to meet demand. The Nordic region's rising demand for electricity has necessitated increased operation of coal-fired condensing power plants, above all in Denmark and Finland. Low precipitation or temperatures mean greater utilization of coal-fired power, while the opposite is true in years with ample runoff and high temperatures. This, in turn, affects the average price over the year.

With a growing volume of cross-border electricity trade outside the region, the Nordic market is increasingly exposed to electricity prices on the continent. This means that Nordic prices are now also shaped by factors such as shrinking margins in the European power balance, cold weather on the continent and runoff in countries like Spain. *Diagram 3* shows the spot price trend in the Nordic and German markets expressed as a weekly average.

Continental electricity prices are closely tied to production costs in coal-fired condensing power plants. Following implementation of the EU Emissions Trading Scheme (EU ETS) on 1 January 2005, the price of emission allowances must be added to the production cost for fossil-based electricity generation. Because of this, the price of emission allowances has a direct impact on both the spot and forward price of electricity.

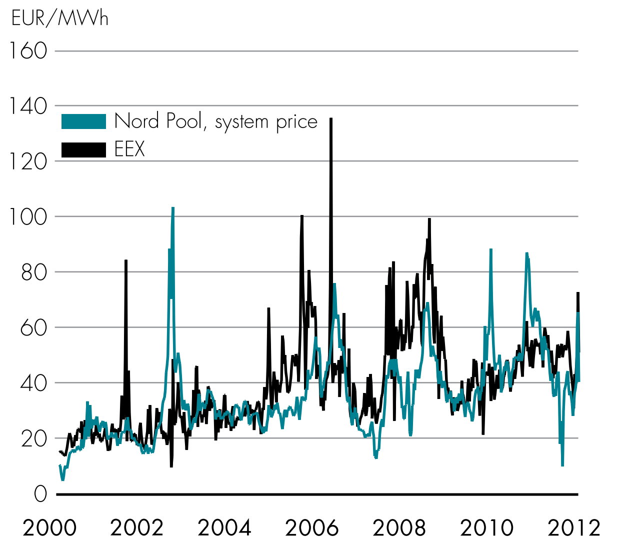
Diagram 4 shows that the price of emission allowances has a clearly formative effect on Nord Pool's forward price, while the link to the spot price varies mainly with respect to runoff and water supplies. In periods with high runoff, for example, it is not possible to store water and the producers are forced to either generate electricity or spill excess water, with direct implications for the spot price.

FALLING PRICES FOR EMISSION ALLOWANCES

Emission trading is one of the so-called flexible mechanisms defined in the Kyoto Protocol. The goal of this trading is to enable countries and companies to choose between carrying out their own emission-reducing measures or buying emission allowances which then generate emission reductions somewhere

DIAGRAM 3

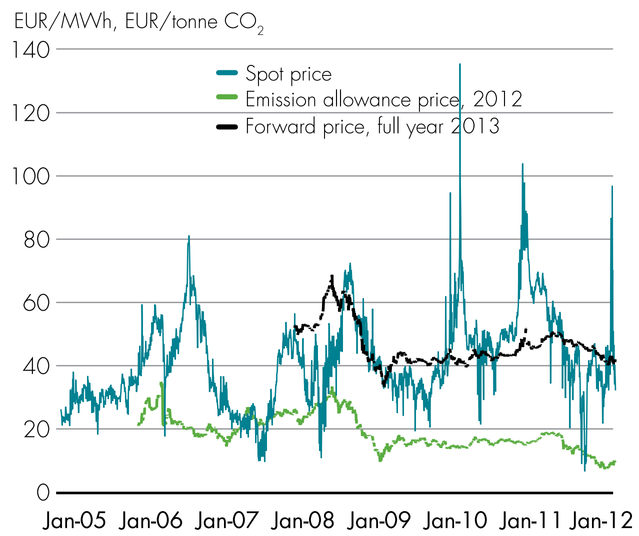
ELECTRICITY SPOT PRICES ON NORD POOL SPOT AND EEX (GERMAN ELECTRICITY PRICE)



Sources: Nord Pool Spot, EEX

DIAGRAM 4

ELECTRICITY SPOT PRICE, FORWARD PRICE AND PRICE OF EMISSION ALLOWANCES



Source: Nord Pool Spot

else. The idea is for the least expensive measures to be taken first, thus keeping the total cost of the Kyoto targets as low as possible. Allocation of emission allowances is determined nationally, but must be approved by the European Commission.

The current trading scheme (EU ETS) covers two so-called budget periods. The first ran from 2005 to the end of 2007 and was a trial period, while the other runs from 2008 to the end of 2012, concurrent with the Kyoto Protocol's commitment period. Over 700 installations in Sweden are covered by the scheme. In the energy industry, EU ETS includes all individual installations with a capacity of more than 20 MW or district heating systems with a combined capacity exceeding 20 MW.

With regard to actual trading of emission allowances, it is not possible to transfer (bank) these allowances between budget periods. Furthermore, the players covered by the scheme must report the previous year's emissions data by March at the latest. As a result, differences in the allowance price arise depending on the time period. In general, a price of EUR 10 per tonne can be said to add just over SEK 0.07 per kWh to the wholesale power price. As a result of events in the Eurozone and the weak industrial market, the allowance price fell sharply during the year (*see Diagram 5*).

Due to the high proportion of fossil-fired power in Germany, there is a significantly stronger link between the German spot price and the emission allowance price. *Diagram 6* shows the difference between Nordic and German spot and forward prices, as well as the price of emission allowances. As the allowance price rises, the gap between the spot price on Nord Pool and EEX has also widened in favour of the Nordic spot price.

The Nordic region's abundant supply of hydropower results in a lower price relative to Germany. The difference can be equated with the price gap between forward contracts on the respective exchanges, which in February 2012 was SEK 0.11 per kWh for low load and SEK 0.21 per kWh for high load factor usage for the full year 2013.

BIDDING AREAS ON NORD POOL SPOT

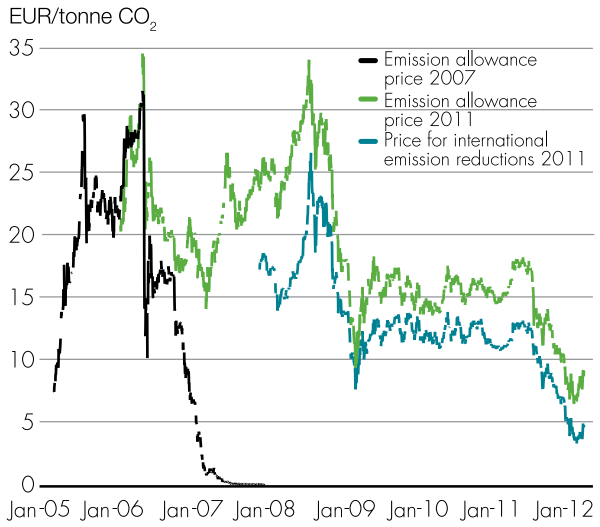
The system price on Nord Pool Spot serves as a price reference for the financial electricity market and is a price that is calculated for the entire Nordic power exchange area, assuming that no transmission constraints exist. However, because all transmission grids are subject to physical limitations, situations can arise when transmission capacity is not adequate to meet market demand for inter-area trading.

To manage these transmission bottlenecks, Nord Pool's power exchange area has been divided into so-called bidding areas. Historically, Sweden and Finland have each formed separate areas, while Denmark has been divided into two and the number of areas in Norway has varied between 2 and 5. When transmission capacity is insufficient to ensure equal prices throughout the power exchange area, separate area prices are calculated. A price area can consist of one or several bidding areas. Over the years, Sweden has very rarely constituted a separate price area. In 2010, for example, Sweden was a separate price area for only one of the year's total of 8,760 hours.

Table 2 shows area prices since deregulation in 1996. The differences between the various bidding areas are primarily dependent on the generation capacity available in each area. Price differences are caused mainly by large variations in the supply of hydropower, which is also reflected in the system price. Unusually low or high runoff also increases the frequency of fragmentation into separate price areas. In a wet year, the price will be lowest in Norway and then Sweden, while the opposite is true in periods with lower runoff.

DIAGRAM 5

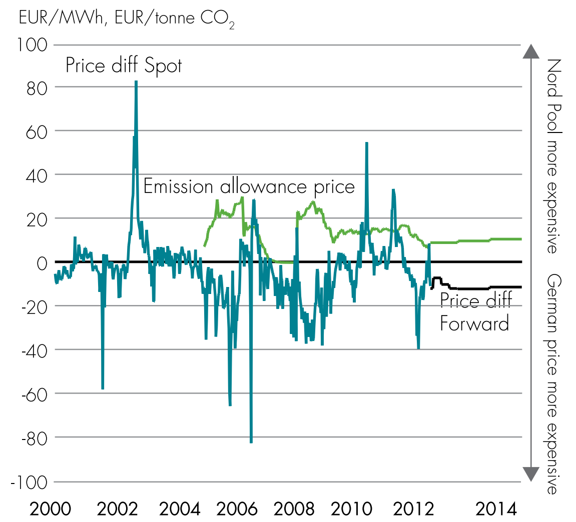
PRICE OF EMISSION ALLOWANCES ON NASDAQ OMX COMMODITIES



Source: Nord Pool Spot

DIAGRAM 6

PRICE OF EMISSION ALLOWANCES AND PRICE DIFFERENCES BETWEEN THE NORDIC REGION AND GERMANY



Sources: Nord Pool Spot, EEX

In November 2011 Sweden was divided into four bidding areas (Luleå, Sundsvall, Stockholm and Malmö). The introduction coincided with a drop in temperature to more normal levels and a standstill in all reactors at Ringhals, which meant that the initial price differences were relatively large. Towards the end of November, two reactors at Ringhals were back online and the Fenno-Skan 2 submarine cable was taken into operation. Since then, the price differences have been significantly smaller (*see Diagram 7*). As expected beforehand, the prices for Malmö were virtually identical to those for Copenhagen.

GREATER CUSTOMER MOBILITY IN THE MARKET

Since April 2004 Statistics Sweden compiles monthly statistics on the number of supplier switches (changes of electricity supplying company) and the spread of customers between different contracts (*see Diagrams 8 and 9*).

The ability to change supplier depends on contracts in force, which means that not all customers have the opportunity to switch any time of the year. It is therefore difficult to draw any real conclusions due to the relatively short time span for data on supplier switches.

The number of supplier switches increased compared to 2010, but was lower than in 2009. The average number of switches in 2011 was just under 44,500 per month, of which household customers accounted for more than 38,700. This can be compared to an average of 38,500, including 32,100 households, since the start. The average total volume in 2011 was more than 1,200 GWh (1 gigawatt hour = one million kilowatt hours), of which around 390 GWh was attributable to household customers. The corresponding averages for the entire period are 1,000 and 300 GWh, respectively.

In 2011 the share of customers with standard rate contracts, i.e. those who have not made an active choice, continued to decrease. At the same time, it must be considered likely that some of these customers have deliberately not made a choice. The range of contracts has grown over time and the newer types do not fit into the traditional model, such as contracts that contain a mix of fixed and variable rates. Since January 2008, Statistics Sweden includes these in the category "Other".

CONSUMER PRICES FOR ELECTRICITY

Consumer prices for electricity vary between customer categories, between rural and urban areas and between the Nordic countries. They are influenced by varying distribution costs, differences in taxation, subsidies, government regulations and the structure of the electricity market.

Consumer electricity prices basically consist of three main components:

- A supply charge for the use of electricity, the portion of the electricity bill that is subject to competition.
- A distribution charge to cover the cost of network services, i.e. power distribution.
- Taxes and charges such as energy tax, VAT and fees to government agencies.

The example in *Diagram 10* shows the development of electricity prices (single-family home with electrical heating) for a "variable rate" contract, one of many contract types. One observation is that in 1970, less than 7% of the consumer price went to the government as tax. In January 2012, energy tax, VAT and REC charges made up 46% of the consumer price. Large fluctuations in the electricity price cause these percentages to vary proportionately. It should also be noted that producer surcharges now account for part of the supply charges, such as the cost of emission allowances.

TABLE 2

AVERAGE AREA PRICES ON NORD POOL. SEK 0.01 PER kWh

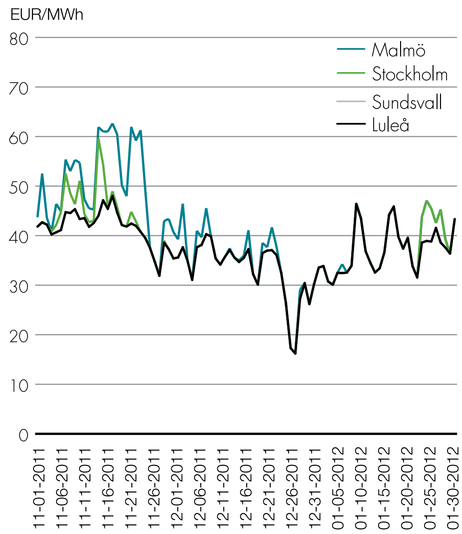
	Oslo	Stockholm*	Finland	Jutland	Zealand	System
2011	41.75	43.08	44.42	43.26	44.59	42.34
2010	51.74	54.25	54.07	44.26	54.36	50.59
2009	35.90	39.28	39.24	38.28	42.26	37.22
2008	37.85	49.15	49.05	54.14	54.50	43.12
2007	23.82	28.01	27.78	29.98	30.55	25.85
2006	45.56	44.53	44.95	40.89	44.93	44.97
2005	27.05	27.64	28.36	34.63	31.43	27.24
2004	26.83	25.62	25.25	26.28	25.87	26.39
2003	33.87	33.29	32.22	30.74	33.58	33.48
2002	24.27	25.23	24.92	23.28	26.12	24.59
2001	21.30	21.09	21.07	21.92	21.73	21.36
2000	10.21	12.04	12.58	13.86		10.79
1999	11.52	11.94	12.00			11.84
1998	12.21	12.04	12.26			12.26
1997	14.86	14.37				14.59
1996	26.61	26.00				26.30

* In connection with the implementation of bidding areas in Sweden, the definition of the Stockholm area was changed as of 1 November 2011.

Source: Nord Pool Spot

DIAGRAM 7

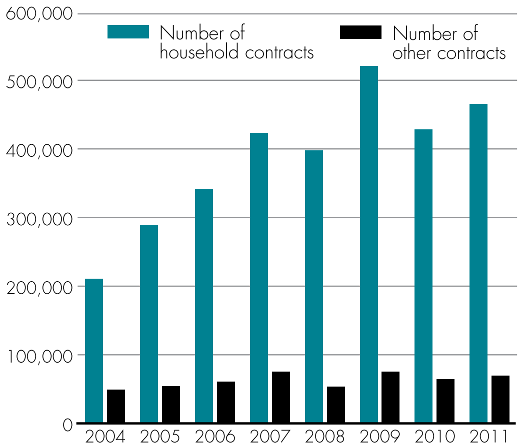
HOURLY AREA PRICES IN SWEDEN



Source: Nord Pool Spot

DIAGRAM 8

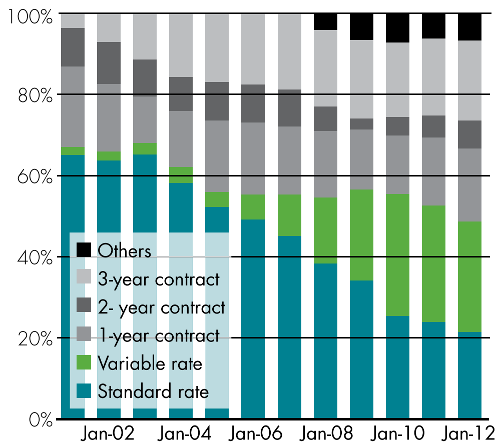
NUMBER OF SUPPLIER SWITCHES PER YEAR



Source: Statistics Sweden

DIAGRAM 9

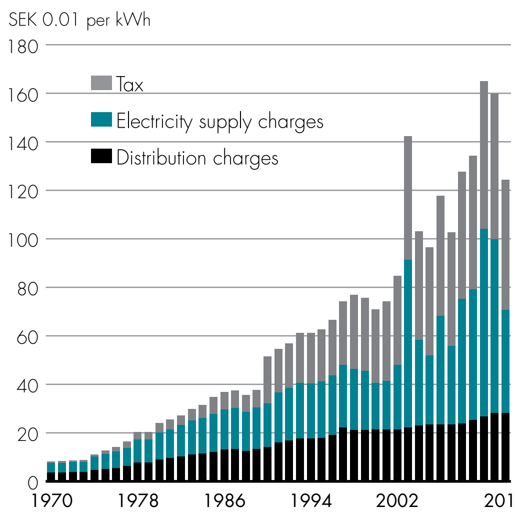
ALLOCATION OF CONTRACTS, JANUARY 2001–2012



Source: Statistics Sweden

DIAGRAM 10

BREAKDOWN OF TOTAL ELECTRICITY COST FOR A SINGLE-FAMILY HOME WITH ELECTRICAL HEATING AND A VARIABLE RATE CONTRACT, CURRENT PRICES, IN JANUARY OF EACH YEAR



Sources: Swedish Energy Agency, Statistics Sweden

Sweden's total energy supply

ENERGY SUPPLY

Sweden's energy requirements are covered partly by imported energy sources – mainly oil, coal, natural gas and nuclear fuel – and partly by domestic energy in the form of hydropower, wood, peat and wood waste from the forest products industry (bark and lignin). Development of the energy supply since 1973 is shown in *Diagram 11*. The most significant changes between 1973 and 2011 are that the share of oil in the energy mix has fallen from 71% to around 25% and that nuclear power has increased from 1% to more than 30%. With normal availability, the share of nuclear power is over 35%. Sweden's total energy supply in 2011 amounted to a preliminary 570 TWh, compared to 587 TWh the year before.*) The decrease in energy supply is mainly due to a milder winter and a weak economy resulting from factors such as financial instability in the Eurozone.

ENERGY USAGE

Steady growth in society's demand for goods and services has historically generated stronger demand for energy. *Diagram 12* shows energy usage in relation to gross national product (kWh/GNP SEK). Although the Swedish statistics previously disregarded conversion losses in the nuclear power plants, Sweden now applies the standard international method based on the energy content of the fuel.

*) Excluding net electricity imports, bunkering for international shipping and usage for non-energy purposes.

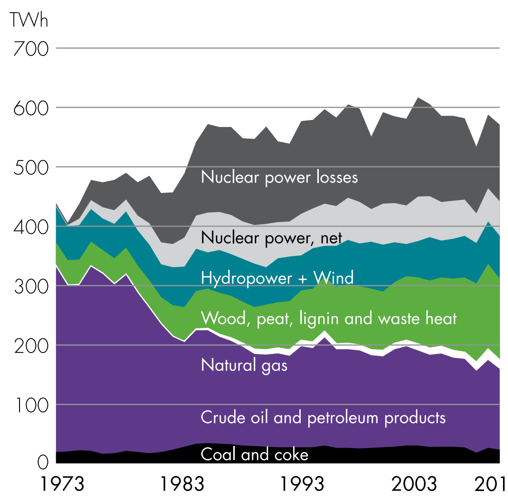
It can be noted that energy usage calculated according to the older Swedish method has fallen since 1973, but did not start to decrease according to the international method until the mid-1990s. Higher economic activity, particularly in the electricity-intensive industries, severe winter weather and a weak hydrological balance led to an increase for all energy types during 2010, but this was also due to higher nuclear power production and a resulting rise in conversion losses (cooling water).

In absolute terms, energy usage among end-users has been relatively constant since 1973. At the same time, usage in relation to GNP has fallen by over 40% according to the international calculation method. Excluding conversion losses in nuclear power plants, this is equal to an improvement in energy efficiency by nearly 60%. This is partly due to greater usage of processed energy in the form of electricity and district heating, and partly to better energy-efficiency in general. The oil share of energy usage has fallen sharply in the industrial, residential and service sectors, etc., while oil-dependency is still considerable in the transport sector.

According to preliminary figures from Statistics Sweden, final energy usage in 2011 was down by 5% to 392 TWh. Electricity usage decreased by 5% and usage of district heating by 16%. While the use of oil and gas products declined by 5% and 3%, respectively, use of biomass and peat, etc., fell by close to 1%.

DIAGRAM 11

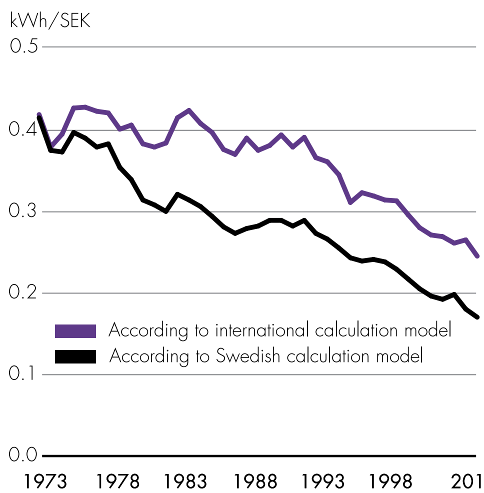
TOTAL ENERGY SUPPLY IN SWEDEN 1973–2011



Source: Statistics Sweden

DIAGRAM 12

TOTAL SUPPLIED ENERGY IN RELATION TO GNP 1973–2011 (1995 PRICES)



Source: Statistics Sweden

Electricity usage

Total electricity usage including transmission losses and large electric boilers in industries and heating plants during 2011 amounted to a preliminary 139.7 TWh, compared to 147.0 TWh in 2010.

Sweden has a relatively high proportion of electrical heating, more than 30 TWh in total, of which two-thirds are dependent on the outdoor temperature. Temperature variations must therefore be taken into account when making year-on-year comparisons. Temperature-adjusted usage in 2011 amounted to a preliminary 142.5 TWh, compared to 144.2 in 2010.

Electricity usage trends are closely linked to economic growth. *Diagram 13* shows development from 1970 onwards. Until 1986, the rise in electricity usage outpaced growth in GNP. During the years 1974–1986 this was largely attributable to increased use of electrical heating. Since 1993, however, electricity usage has increased at a slower rate than GNP.

INDUSTRIAL ELECTRICITY USAGE

Diagram 14 shows that electricity usage in the industrial sector rose dramatically between 1982 and 1989 in conjunction with an extended economic boom. Devaluation of the Swedish krona in 1982 gave the electricity-intensive base industries, particularly pulp and paper, favourable conditions for growth. Usage then declined during the economic recession and structural transformation of the early 1990s. At mid-year 1993 electricity utilization began rising again and continued upwards through the end of 2000. For the next three years industrial usage of electricity then decreased somewhat – an effect of economic slowing and higher electricity prices. Since then, industrial electricity usage grew at a moderate rate until the financial crisis in the second half of 2008. Following a certain recovery in 2010, usage has once again fallen somewhat.

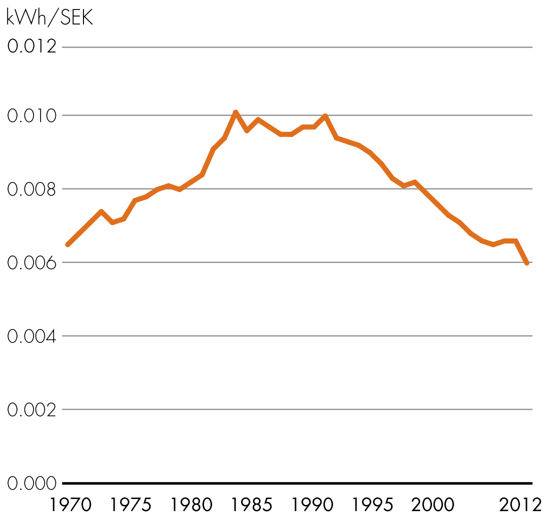
Diagram 15 illustrates how the industrial sector's specific electricity usage, expressed in kWh per SEK of value added, has developed since 1970. Since 1993, industrial usage in relation to value added has fallen sharply. This is due to the heterogeneous industrial structure in Sweden, where a handful of sectors accounts for a large share of electricity usage (*see Table 3*). From 1993 onwards, the strongest growth has been seen in the engineering industry, where the production value has more than doubled during the period while electricity usage has increased by less than 10%. In the energy-intensive industries, production value has grown by close to 50% at the same time that electricity usage has climbed by nearly 20%.

ELECTRICITY USAGE IN THE SERVICE SECTOR

Electricity usage in the service sector (offices, schools, retail, hospitals, etc.) increased rapidly during the 1980s, particularly with regard to lighting, ventilation, office equipment and electrical space heating. This growth was generated by a considerable rise in standards for renovation, rebuilding and new construction of service industry premises, as well as a massive increase in the volume of computers and other equipment. The late 1980s saw a huge increase in the number of new buildings. However, few new construction projects were undertaken during the economic slump of the early 1990s, which together

DIAGRAM 13

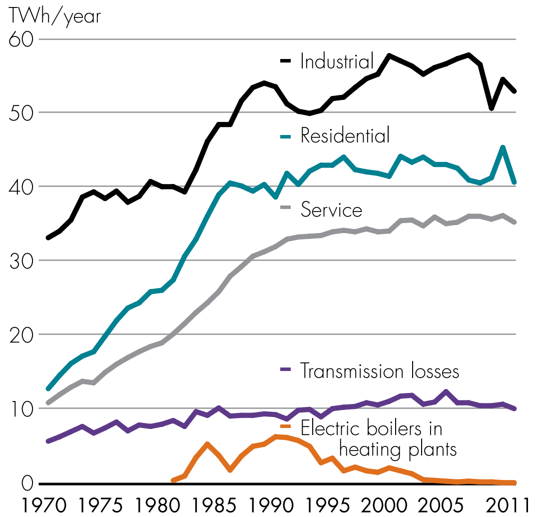
ELECTRICITY USAGE PER GNP 1970–2012 (1995 PRICES)



Source: Statistics Sweden

DIAGRAM 14

BREAKDOWN OF ELECTRICITY USAGE BY SECTOR 1970–2011



Source: Statistics Sweden

with more efficient appliances and equipment has caused electricity usage excluding large electric boilers to stabilize at 33–34 TWh per annum. The high electricity prices of recent years have contributed to a slight drop in usage.

Most buildings in the non-residential sector use district heating. Electrical heating as the principal heat source is used in around 9% of the total building area, but accounts for around 20% of the total heating energy due to widespread use of electrical heating as a complement.

The service sector also includes technical services such as district heating plants, water utilities, street and road lighting and railways. These areas also underwent powerful growth during the 1980s, when the district heating plants introduced large heat pumps that used over 2 TWh of electricity in 2000. Usage in this sector has levelled out at around 0.5 TWh since 2003, with high electricity prices as one of the contributing factors.

RESIDENTIAL ELECTRICITY USAGE

The residential sector includes single-family homes, farms, multi-dwelling units and holiday/summer homes. Electricity for agricultural activities is attributed to the service sector. Electricity usage, excluding electrical heating, has increased at an even pace since the 1960s, with the exception of the oil crisis in 1973–74 and a temporary conservation campaign in 1980–81 when the upward trend was temporarily curbed.

Usage of household and operating electricity for multi-dwelling units has risen steadily, partly due to the growing number of homes and partly to a higher standard of electrical appliances and equipment. However, the rate of increase has slowed in recent years and is today essentially linked to the renovation of old apartment buildings and the fact that households are acquiring more appliances such as dishwashers, freezers, and home computers. In all housing types, the replacement of old equipment, like refrigerators and washing machines, with more modern and energy-efficient models is offsetting the increase. *Diagram 16* provides a breakdown of household electricity usage.

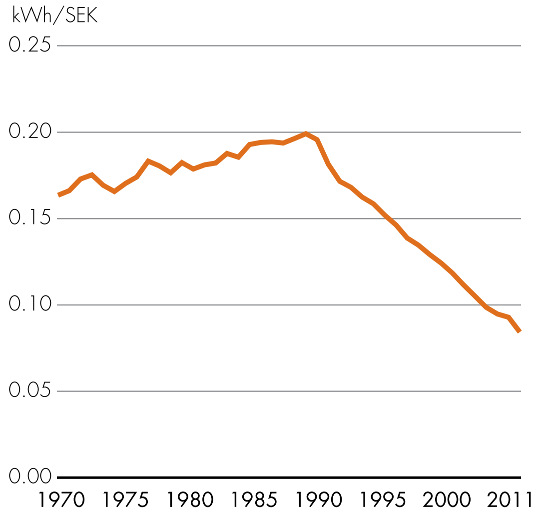
Electrical heating accounts for 30% of all heating energy used in the residential sector, primarily in single-family homes. A large number of single-family homes with electrical heating were built during 1965–1980. After 1980 the majority of newly built single-family homes have been equipped with electric boilers for hot water systems. In order to reduce oil-dependency after the second oil crisis in the early 1980s, a very large number of single-family homes converted from oil-fired to electric boilers during 1982–1986. In recent years, the number of heat pumps has risen dramatically, thereby reducing the need to purchase energy for residential heating and hot water.

The preferred choice in new construction and conversion of apartment buildings has been district heating, where available. Outside the district heating networks, however, electrical heating has been installed, primarily in new construction. Electrical heating as a complement to other forms of heating is also widespread, and around 4% of the surface area in apartment buildings relies mainly on electrical heating.

Table 4 shows the number of subscribers and average usage for various categories in the residential sector. The table excludes homes in the agriculture, forestry and similar sectors since it is not possible to distinguish residential usage from that for commercial activities.

DIAGRAM 15

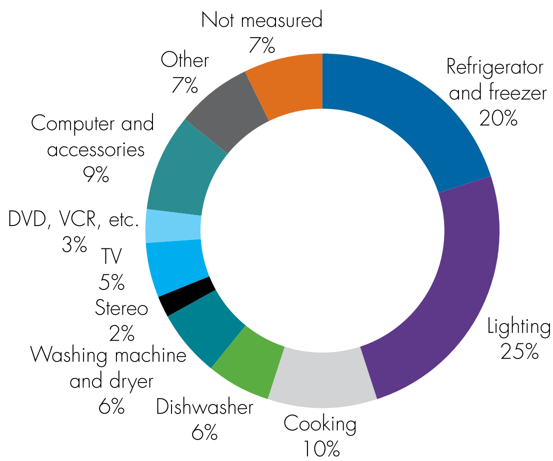
INDUSTRIAL ELECTRICITY USAGE IN RELATION TO VALUE ADDED 1970–2011 (1991 PRICES)



Source: Statistics Sweden

DIAGRAM 16

HOUSEHOLD ELECTRICITY USAGE BY APPLICATION (RESULTS FOR 2007)



Source: Swedish Energy Agency

TABLE 3

INDUSTRIAL ELECTRICITY USAGE BY SECTOR 2000–2011, TWh

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011 prel.
Mining	2.6	2.5	2.6	2.6	2.5	2.6	2.5	2.7	2.8	2.4	3.2	3.3
Food and beverages	3.0	2.8	2.7	2.5	2.4	2.4	2.4	2.6	2.5	2.4	2.5	2.5
Textiles and clothing	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Wood products	2.3	2.2	2.3	2.2	2.2	2.2	2.2	2.2	2.2	2.1	2.1	1.8
Pulp and paper, graphics industry	24.1	23.2	23.4	23.2	23.6	24.2	24.5	24.6	24.2	22.6	23.0	21.7
Chemicals	7.6	7.7	7.7	8.0	7.9	7.6	7.4	7.3	7.1	6.6	7.1	7.2
Soil and stone products	1.2	1.4	1.2	1.1	1.0	1.1	1.1	1.1	1.1	1.0	1.0	1.0
Iron, steel and metalworking	8.2	7.9	7.8	7.5	8.6	8.5	8.4	8.4	8.0	6.0	7.4	7.6
Engineering industry	7.5	7.6	7.4	6.9	7.0	6.9	7.4	7.0	6.7	5.4	5.7	6.3
Small industries, craftsmen, etc.	1.0	1.2	1.0	0.9	0.7	1.0	1.5	1.8	1.7	2.1	2.5	1.4
TOTAL. incl. disconnectable electric boilers	**57.8**	**57.1**	**56.4**	**55.3**	**56.2**	**56.7**	**57.7**	**57.9**	**56.5**	**50.7**	**54.5**	**52.9**

Source: Statistics Sweden

TABLE 4

NUMBER OF SUBSCRIBERS AND AVERAGE HOUSEHOLD ELECTRICITY USAGE IN 2011

	No. of subscribers	GWh*	MWh/s
Single-family homes with usage of > 10 MWh	1,196,247	22,729	19.0
Single-family homes with max. usage of 10 MWh	700,256	4,902	7.0
Multi-dwelling units, direct delivery, with usage of > 5 MWh	163,805	1,474	9.0
Multi-dwelling units, direct delivery, with max. usage of 5 MWh	1,951,415	3,903	2.0
Multi-dwelling units, aggregate deliveries	8,463	505	59.6
Holiday/summer homes	509,734	3,058	6.0
Total, residential according to the above	**4,529,920**	**36,571**	**8.1**
Share of total number of subscribers	86.8%	26.5%	30.6%
Total number of subscribers	**5,219,403**	**137,844**	**26.4**

* 1 GWh = 1/1,000 TWh

Source: Statistics Sweden

Electricity production

Electricity production in Sweden is dominated by CO_2–free hydro and nuclear power. The rate of wind energy expansion has accelerated in recent years and wind-generated power currently makes up 4% of Sweden's total electrical output. The rate of expansion for thermal power may not be as high as for wind power percentage-wise, but the change is greater in terms of generated electricity. Thermal power produced with biomass fuels has accounted for 7–9% of total electrical output and fossil-fired production for 3–5% of total Swedish electricity production the last year.

Sweden's aggregate domestic electrical output in 2011 amounted to 146.9 TWh (144.9 in 2010), an increase of just over 1.4% compared to the prior year.

The country's electricity generation by power type during the period from 1951 to 2011 is shown in *Diagram 17.*

The Nordic electricity market and the exchange of electricity between neighbouring countries are of crucial importance for Sweden's electricity supply. Sweden's production mix differs from that in the neighbouring countries, whose conditions for power generation also vary from one another, *see Diagram 18.* For many years the Nordic countries have cooperated by utilizing their different production potentials. In good hydropower years, the import of hydropower to Finland and Denmark enables these countries to reduce their production of condensing power, and the reverse is true in dry years when they can export condensing power to compensate for the decrease in hydropower output. In recent years Germany has also participated equally in these flows in both directions.

In the 1960s Sweden decided to develop nuclear technology and was thus able to phase out fossil-based (coal, oil) condensing power from the system. Nuclear and thermal power, together with much of the country's hydropower capacity, today supply baseload power in the Swedish system. In addition to its baseload function, hydropower also plays an important role as regulating power.

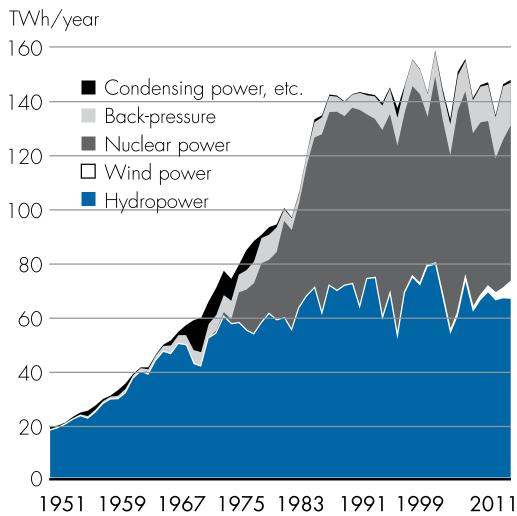
The term "regulatable hydropower" means that water can be stored in reservoirs to be drawn down at a later time when the need for power is greater. The regulatability of hydropower fluctuates over the year, for example at times of high runoff in the system there is little opportunity to regulate hydropower. The greatest regulatability normally arises during the winter when runoff is lower, which provides greater opportunity to decide on the draw-down level. Regulatability is also limited by the speed at which production levels must be adjusted from one day to the next, since the flow rates of water in the long Swedish waterways must be taken into account.

If Sweden has 20 TWh of wind power in 2025, this will tangibly affect the power system and will require capacity for effective handling. This poses no problem from an energy standpoint, since the annual production profile closely matches that for electricity usage (*see Diagram 25*). The challenge instead lies in the short-term perspective, from hours up to a few days. 20 TWh of wind power corresponds to an installed capacity of around 8,000 MW (*see Table 5)* that is assumed to be spread throughout Sweden. Despite aggregation effects, it can be assumed that output will fluctuate between 5% and 80%, i.e. 400–6,400 MW in steps of 400–1,000 MW per hour.

One of the distinctive characteristics of wind power is that it is intermittent and will nearly always require some kind of regulation (to stop, start, increase or decrease production) in another power type or in the future's smart energy services

DIAGRAM 17

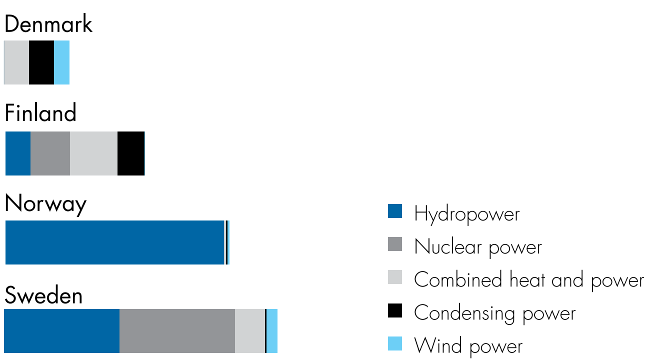
TOTAL ELECTRICITY SUPPLY IN SWEDEN 1951–2011



Source: Swedenergy

DIAGRAM 18

NORMALIZED ELECTRICITY PRODUCTION MIX IN THE NORDIC REGION



Source: Swedenergy

that adapt electricity usage to the available supply of electricity. This in itself is nothing new, since the power load also varies from hour to hour and with larger voltage steps, though with the difference that it is easier to forecast varied electricity usage in the short and long term.

What scope does Sweden have to manage this regulation of wind power? The first step is taken through the spot market (day-ahead), since supply and demand set prices that result in measures to increase or decrease generation other than wind power. The next step is the regulating power market (intra-day), which handles forecast errors for production, usage and other imbalances. At the domestic level, Sweden has capacity for regulation with hydropower during much of the year. It is not easy to assess how much wind power can be handled by the hydropower plants, since many parameters must be taken into account. These include variations in wind power amplitude and wind speed from one hour to the next, the amount of surplus wind power from other countries, the level of electricity usage and runoff levels in the waterways.

ELECTRICITY PRODUCTION CONTROLLED BY WEATHER

Weather conditions have a major influence on Sweden's power supply. Outdoor temperatures affect electricity usage, particularly for heating of homes and other premises.

The amount of precipitation, and subsequently also runoff to the reservoirs and hydropower stations, is decisive for hydropower production. With an increased share of wind power, variations in wind speed will also be of greater importance. There is a certain correlation between precipitation and wind speed.

2011 was the ninth consecutive year of above-normal temperatures – a warm and wet year with many thunderstorms. Weather-wise, the past year showed a temperature surplus for the entire country. Certain regions set new precipitation records, while others appear to have had less precipitation than in a normal year. A number of new weather records were set in 2011, such as the number of lightning strikes.

The largest deviations were seen in northern Sweden, where the average temperature was 2 degrees above normal. In southern Sweden, the average annual temperature was between 1–2 degrees above normal compared to the period 1961–1990.

Aside from February, all months of the year were dominated by surplus temperatures. Of these, April and November stood out in particular and broke several earlier records for average temperatures.

In the central parts of northern Sweden, 2011 will be seen as a very wet year with over 50% more precipitation than normal compared to the period 1961–1990. The wettest months included August and September, when new rainfall records were set in several areas.

November also marked a new low in terms of snowfall, or rather, a lack of it. Virtually the entire country had zero snow cover until 18 November, which is uniquely late in the season. For the country as a whole, the average annual temperature was around one degree lower than normal and precipitation was higher than normal.

RUNOFF AND RESERVOIR LEVELS

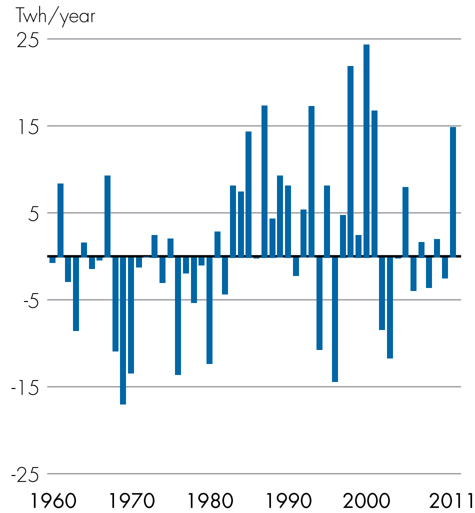
Total runoff in 2011 was 81.2 TWh (not adjusted for spill), and was thus above the average for the past 51 years.

Annual runoff variations in relation to the median value for the period 1960–2011 are shown in *Diagram 19.*

Runoff variations in 2011 are shown in *Diagram 20.* The grey field shows runoff with a probability rate of between 10% and 90%. There is a 10% probability that runoff will exceed the upper limit, and 90% probability that it will exceed the lower limit in the grey field. The thinner black curve represents normal runoff (50% probability) and the green curve shows actual weekly runoff during 2011.

DIAGRAM 19

RUNOFF VARIATIONS IN RELATION TO MEDIAN VALUE 1960–2011



Source: Swedenergy

TABLE 5

INSTALLED CAPACITY IN SWEDISH POWER PLANTS TODAY AND SCENARIO IN 13 YEARS, MW

	31 Dec. 2011	31 Dec. 2024*
Hydropower	16,197	17,000
Wind power	2,899	8,000
Nuclear power	9,363	9,000
Other thermal power	7,988	9,000
– CHP, industrial	1,240	1,800
– CHP, district heating	3,551	5,200
– condensing power	1,623	500
– gas turbines, etc.	1,574	1,500
Total	**36,447**	**43,000**

**Estimated scenario at 3 April 2010*

Source: Swedenergy

As seen in *Diagram 20*, runoff during the winter and up to the spring flood was close to or below the median value. The spring flood started around three weeks earlier than normal, and was very welcome in view of the highly strained power balance in both Sweden and Norway. The spring flood itself was fairly normal in terms of intensity and volume. The summer runoff was modest and fell short of the median value, but the rains arrived in earnest starting in the second half of August. For the period thereafter until the end of the year, precipitation was far higher than normal and runoff reached record levels especially in September.

The country's aggregate reservoir storage is shown in *Diagram 21*. At the beginning of the year the storage level was 42%, which is around 20% below the average for the comparison period 1960–2010. There was a long wait for the spring flood and when the level dropped to 12% in week 14, this triggered tangible alarm since it would normally take a few weeks until the reservoirs were filled.

Because the spring flood does not start simultaneously throughout the country (*see diagram 22*), it is not possible for all reservoirs to be drawn down during the spring flood since there are always some reservoirs in the process of being either filled or emptied at any given time. At year-end 2011 the storage level was just over 76%, which is roughly 11% higher than average.

Overall, the water year 2011 can be characterized as fairly dramatic as the country struggled with low reservoir levels from the prior year and moderate runoff in the first six months. In contrast, the second half of the year brought ample precipitation that both restored storage levels in the Swedish reservoirs and resulted in high hydropower production.

INVESTMENTS IN ELECTRICITY PRODUCTION

Investments in electricity production and other parts of the energy industry's infrastructure are almost always of a very long-term nature, up to 50 years, and typically demand substantial

TABLE 6

HYDROPOWER PRODUCTION

Breakdown by river in 2011, TWh

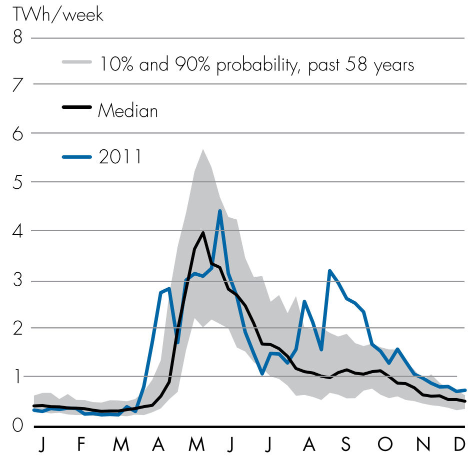
River	Net production	
Lule älv	12.9	(12.7)
Skellefte älv	3.9	(4.3)
Ume älv	8.0	(7.6)
Ångermanälven	7.5	(7.8)
Faxälven	4.2	(3.6)
Indalsälven	10.0	(9.8)
Ljungan	2.1	(2.1)
Ljusnan	4.1	(4.2)
Dalälven	4.8	(5.5)
Klarälven	1.7	(1.8)
Göta älv	1.7	(1.9)
Other rivers	5.1	(5.5)
Total production	**66.0**	**(66.8)**

(Data for 2010 in brackets)

Source: Swedenergy

DIAGRAM 20

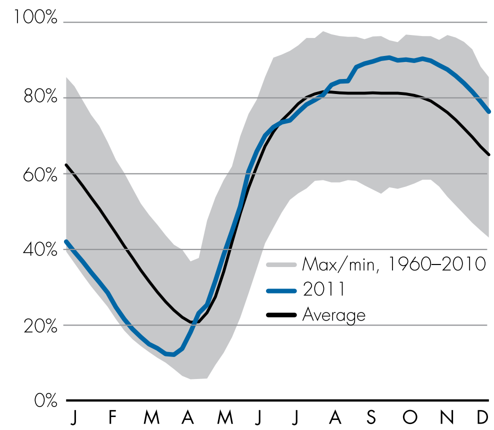
RUNOFF VARIATIONS IN THE POWER-GENERATING RIVERS



Source: Swedenergy

DIAGRAM 21

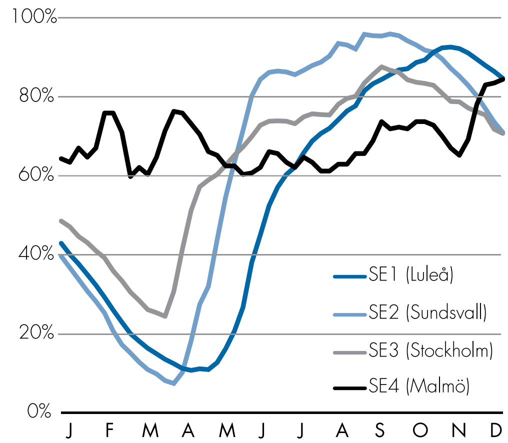
STORAGE LEVELS IN THE REGULATING RESERVOIRS



Source: Swedenergy

DIAGRAM 22

STORAGE LEVELS IN THE REGULATING RESERVOIRS BY BIDDING AREAS



Source: Swedenergy

capital. *Diagram 23* shows the energy industry's gross investments in current prices starting in1985. The data comes from SCB (Statistics Sweden) and presents total investment spending by the energy industry but with no breakdown among the individual players, which are classified for example as real estate companies, or between investments in wind power, etc. Furthermore, the forestry industry's investments, which affect electricity production, are not included in the investment amounts.

The tendency has been for the energy industry to increase its investments in recent years. An independent survey conducted by Swedenergy in 2008 indicated a total investment volume of SEK 300 billion during the period to 2018, conditional on the continued expansion of wind power to a level of around 17 TWh by 2020. Wind power accounts for around one third of the total volume.

The investments are made up of different parts:

- Modernization of existing power stations.
- Whole new power stations.
- Modernization of transmission, regional and distribution networks.
- Heat generation and heat distribution.

The network system is of critical importance in bringing the generated electricity to electricity customers. In today's more international electricity market there is a greater need for multiple connections, but also new potential to handle different power balance situations such as dry years, wet years, etc. A higher share of wind power, solar power and other varying electricity production is also increasing the need for capacity to move electric power in many directions in the network system.

MODERNIZATION OF POWER STATIONS

Sweden's hydropower production in 2011 amounted to 66.0 TWh (66.8 in 2010), which is 1.2% less than in the previous year and close to normal year production. Hydropower accounted for 46% of Sweden's total electrical output in 2011.

The spread of hydropower production among the country's main rivers is shown in *Table 6*. The four largest rivers – Luleälven, Umeälven, Ångermanälven including Faxälven, and Indalsälven – together represented 64.5% of total hydropower production.

At the end of 2011, the maximum quantity of water that could be stored if the regulation reservoirs were used at full capacity corresponded to an energy volume of 33.7 TWh – which was largely on par with 2010. The electricity production capacity of the country's hydropower stations in a normal year is 65.5 TWh, according to calculations based on runoff data for the years 1960–2010.

Although no major hydropower stations were built during the year, extensive reinvestment programs are being carried out in existing facilities.

The installed capacity in the country's hydropower stations at year-end 2011 was approximately 16,200 MW. Many smaller power plants were built during the year. *Table 7* provides more detailed information about the installed hydropower capacity per river.

TABLE 7

HYDROPOWER, INSTALLED CAPACITY ON 31 DECEMBER

	Output, MW		
Waterway	2009	2010	2011
Upper Norrland	**7,143**	**7,138**	**7,138**
Lule älv	4,196	4,196	4,196
Pite älv	50	50	50
Skellefte älv	1,026	1,016	1,016
Rickleån	10	10	10
Ume älv excl. Vindelälven	1,758	1,765	1,765
Öreälven	6	6	6
Gideälv	70	70	70
Moälven	6	6	6
Nätraån	12	12	12
Small rivers	9	8	8
Central and och lower Norrland	**6,122**	**6,126**	**6,128**
Ångermanälven incl. Faxälven	2,586	2,578	2,589
Indalsälven	2,099	2,107	2,095
Ljungan	600	601	603
Delångersån	16	19	19
Ljusnan	817	817	817
Small rivers	4	4	4
Gästrikland, Dalarna and Mälardalen region	**1,292**	**1,294**	**1,294**
Gavleån	24	24	24
Dalälven	1,148	1,149	1,149
Eskiltunaån	9	9	9
Arbogaån	33	35	35
Hedströmmen	8	7	7
Kolbäcksån	57	57	57
Nyköpingsån	5	6	6
Small rivers	8	8	8
Southeastern Sweden	**420**	**416**	**415**
Vättern-Motala ström	163	163	163
Emån	23	23	23
Alsterån	8	7	7
Ronnebyån	14	14	14
Mörrumsån	21	21	21
Helgeån	35	33	32
Lagan	133	134	134
Small rivers	23	22	22
Western Sweden	**1,226**	**1,226**	**1,222**
Nissan	55	55	55
Ätran	68	68	64
Viskan	28	28	28
Upperudsälven	25	25	25
Byälven	73	72	72
Norsälven	126	126	126
Klarälven	388	388	388
Gullspångsälven	128	128	128
Tidan	8	8	8
Göta älv	301	303	303
Small rivers	26	27	27
Entire country	**16,203**	**16,200**	**16,197**

Source: Swedenergy

TABLE 8

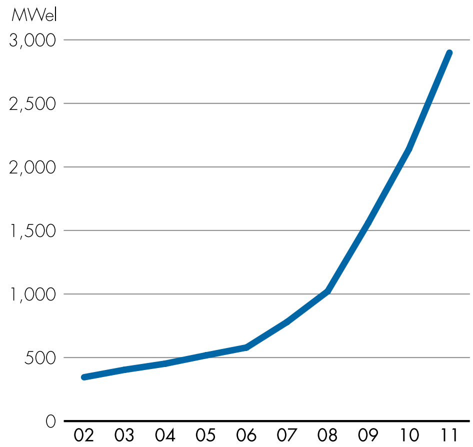
WIND POWER PLANTS IN 2011

Plant	Owner	Installed capacity MWel 2011	Total
Lillgrund	Vattenfall AB		110
Havsnäs	Havsnäs Vindkraft AB		95
Töftedal 1-24	Flera	+48	48
Ytterberg	Vindkraft i Ytterberg AB	+44	44
Stor Rotliden	Vattenfall AB		37
Bodön 1-14	Bodön Vindkraftpark		35
Näsudden	Brattön Vind AB	+30	33
Bliekevare Vind	Bliekevare Vind AB		32
Gässlingegrund	Flera		30
Hedbodberget Vind	Flera	+4	30
Storrun	Storrun Vindkraft AB		30
Uljabuouda	Skellefteå Kraft AB		30
Stugyl 1-9	Stugyl AB	+27	27
Hörnefors	Flera		25
Dragaliden	Flera		24
Oxhult 1-12	Arise Windpower AB		24
Fröslida	Arise Windpower AB		22
Tolvmanstegen 1-12	Eolus Vind AB	+22	22
Korpfjället	Korpfjället Vind AB	+21	21
Others, not specified		+558	2,180
Decommissioned (mothballed, scrapped or sold)		−18	
Total		**+736**	**2,899**

Sources: Swedish Energy Agency, Swedenergy

DIAGRAM 24

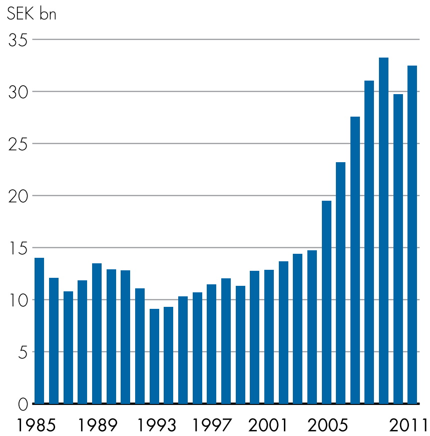
INSTALLED WIND POWER CAPACITY IN MW FOR THE PAST TEN YEARS



Source: Swedenergy

DIAGRAM 23

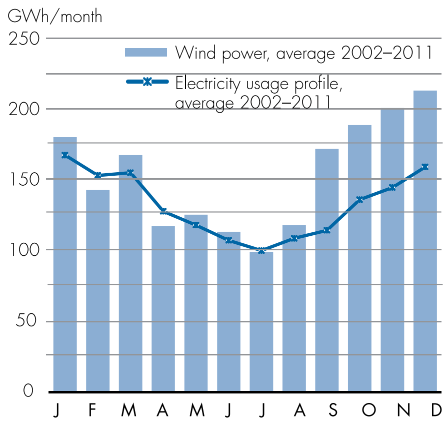
ENERGY INDUSTRY GROSS INVESTMENT IN CURRENT PRICES



Source: Statistics Sweden

DIAGRAM 25

AVERAGE MONTHLY GENERATION OF WIND POWER FOR THE PAST TEN YEARS IN RELATION TO THE ANNUAL ELECTRICITY USAGE PROFILE



Source: Swedenergy

TABLE 9

NUCLEAR POWER PLANT ENERGY AVAILABILITY FACTOR AND PRODUCTION

Reactor	Net capacity MW	Start-up	Energy availability 2007 %	2008 %	2009 %	2010 %	2011 %	Production 2007 TWh	2008 TWh	2009 TWh	2010 TWh	2011 TWh	Total production from start-up to 2011 TWh
Barsebäck 1	(600)	1975											92.7
Barsebäck 2	(600)	1977											107.6
Forsmark 1	984	1980	81.3	81.4	90.1	93.8	79.2	7.0	7.0	7.6	8.0	6.8	212.7
Forsmark 2	996	1981	85.7	79.7	64.1	38.5	93.9	7.5	6.9	5.5	3.3	8.1	202.7
Forsmark 3	1,170	1985	88.2	69.7	86.1	81.4	85.4	9.0	7.1	8.8	8.3	8.7	225.7
Oskarshamn 1	473	1972	64.1	88.3	70.5	79.0	73.3	2.6	3.5	2.8	3.2	3.0	99.1
Oskarshamn 2	638	1974	77.7	88.7	77.9	92.0	76.6	4.0	4.5	3.9	5.0	8.3	152.4
Oskarshamn 3	1,400	1985	89.5	71.4	15.2	32.0	70.3	8.8	7.1	1.7	3.8	4.2	204.8
Ringhals 1	854	1976	81.4	62.0	17.4	48.7	81.6	6.0	4.5	1.3	3.6	6.0	167.6
Ringhals 2	865	1975	85.0	79.6	39.1	80.3	24.9	6.4	5.7	2.8	5.6	1.7	181.6
Ringhals 3	1,048	1981	66.7	88.5	91.3	83.7	79.3	6.0	7.6	8.1	7.6	7.1	186.9
Ringhals 4	934	1983	90.8	91.0	92.8	89.3	50.1	7.2	7.3	7.5	7.2	4.1	179.4
	9,363		**83.3**	**79.0**	**64.0**	**70.1**	**72.0**	**64.3**	**61.3**	**50.0**	**55.6**	**58.0**	**2,013.3**

Sources: OKG, Ringhalsgruppen, Forsmarks Kraftgrupp

INSTALLATION RECORD FOR WIND POWER

The contribution of wind power to Sweden's electricity production in 2011 was 6.1 TWh, up by approximately 74% over the preceding year and equal to 4.2% of the country's annual electrical production. More than 350 new wind power plants went into operation during the year and at the end of 2011 there were over 2,000 wind turbines in the country with an output of more than 50 kW each. Net generating capacity of more than 736 MW was added and the total installed wind power capacity at year-end 2011 was approximately 2,899 MW. Wind generating capacity has grown at rate of around 10% annually in recent years, but increased significantly more during 2011. The major wind power farms and data on changes in 2011 are shown in *Table 8*. *Diagram 24* shows the trend over the past ten years.

The average monthly values for wind-generated power during the period 2002–2011 show how closely wind power production matches the electricity user profile during the year (*see Diagram 25*). Wind power production is somewhat higher at the end of the year when all of the year's new generation capacity is included in the total.

In a future system with increased wind power production, it will be necessary to have a greater interplay with other power types and an exchange of electricity with neighbouring countries. It is primarily in the short-term perspective (hours, up to a few days) that wind power must be coordinated with other electricity generation, of which hydropower will play a key role.

NUCLEAR POWER – A YEAR OF MAJOR REINVESTMENTS

Sweden's nuclear power production in 2011 reached 58.0 TWh (55.6 TWh in 2010). *Table 9* shows the nuclear power plants' Energy Availability Factor (EAF) and output for the years 2007–2011, as well as total production per reactor from the year of start-up.

The average EAF at the ten Swedish reactors in 2010 was a low 72.0%, but was higher than in 2010. The curve is moving in the right direction and when the majority of modernizations are completed, EAF is expected to rise further to the level of over 80% that was previously the norm. This can be compared to a global average of 75% for nuclear power plants of similar types. The country's installed nuclear power capacity was 9,151 MW at the beginning of 2011 and 9,363 MW at the end of the year.

Barsebäck

For the new few years Barsebäck will be in service operation, i.e. a situation in which the owners are managing the plant in the safest possible manner until it can be demolished. According to plans, the demolition will begin around 2020 at the earliest.

Forsmark

In 2011 Forsmark had a total electrical production of 23.6 TWh, which is the best production result for the nuclear power plant since 2005. Forsmark met its goal – safe and secure production.

Forsmark's three reactors enjoyed reliable and stable operation during 2011 and the production for all three was higher than planned.

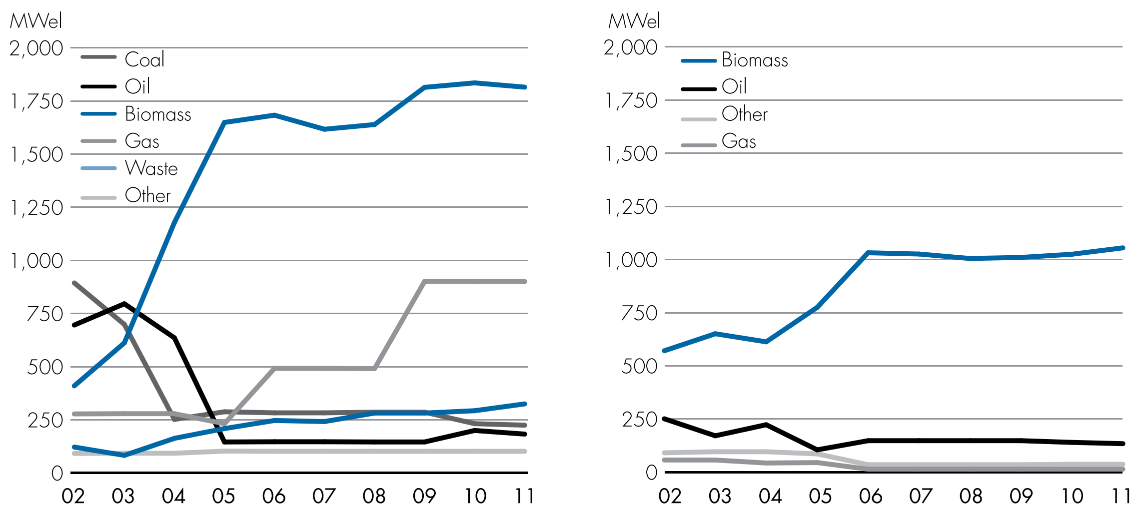
Forsmark had an EAF of 86.2%. The Energy Availability Factor (EAF) is a performance indicator that describes the actual energy generation in a power plant during a given period in relation to the maximum energy that could have been produced. Planned shutdowns and production disturbances have a negative impact on EAF and production.

One key reason why Forsmark has once again taken a strong international position is that the strategic program of modernizations and service life extension in Sweden's reactors is now starting to have positive effects.

Production at the Forsmark nuclear power plant accounts for one sixth of Sweden's annual electricity usage.

DIAGRAM 26

INSTALLED POWER GENERATION CAPACITY IN COGENERATION DISTRICT HEATING (AT LEFT) AND INDUSTRIAL BACK-PRESSURE PLANTS 2002–2011



Source: Swedenergy

Oskarshamn

Electricity deliveries from OKG during 2011 rose compared to 2009 and 2010 and reached 15.5 TWh, but were still substantially lower than the record production of 17.5 TWh in 2004. The combined EAF for 2011 was 72.5%, compared to 56% in 2010.

Expectations for high and reliable reactor safety at OKG were realized in the past year. However, problems with the conventional turbine equipment in all three reactors meant that electricity deliveries did not reach the planned levels.

Oskarshamn 1 produced close to 3.0 TWh. If the unit had not been forced to shut down in the last two months of the year due to vibration problems in the turbine, 2011 might have been one of the best production years in the reactor's nearly 40-year history.

In mid-August the management at Oskarshamn 2 decided to follow the turbine supplier's recommendation to interrupt operation in order to inspect the equipment's rotor blades. The background was the established problems in an identical rotor-blade design at a British gas-fired combined cycle plant. This additional month-long standstill, plus the fact that the measures taken in the turbine led to a temporary drop in production, meant that the delivery volume in 2011 was limited to 4.2 TWh.

The first half of 2011 saw a continuation of the problematic running in of the turbine equipment installed at Oskarshamn 3 in the autumn of 2009. On 23 September, however, the facility produced at its new installed maximum output level of 1,450 MW for the first time. This milestone in the history of the facility contributed to raising electricity supplies from Oskarshamn 3 to 8.3 TWh during the year.

Ringhals

In 2011 Ringhals produced a combined 18.9 TWh and accounted for one sixth of Sweden's total electrical output during the

TABLE 10

COMMISSIONED COGENERATION PLANTS IN DISTRICT HEATING SYSTEMS 2011

Plant	Owner	Installed capacity, MWel
HVC Bergbacken	Hedemora Kraft och värme	+2
HVC Hamre	Hedemora Kraft och värme	+3
Händelöverket	E.ON Värme	+29
Munkfors	Munkfors Energi AB	+2
Sävenäs HP3	Göteborg Energi AB	+13
Other unnamed changes		+13
Decommissioned (reduced, mothballed, scrapped or sold)		–71
Total		**–10**

Source: Swedenergy

TABLE 11

COMMISSIONED COGENERATION PLANTS IN INDUSTRIAL PROCESSES 2011

Plant	Owner	Installed capacity, MWel
Husum	M-Real	+23
Other unnamed changes		+0
Decommissioned (mothballed, scrapped or sold)		+0
Total		**+23**

Source: Swedenergy

TABLE 12

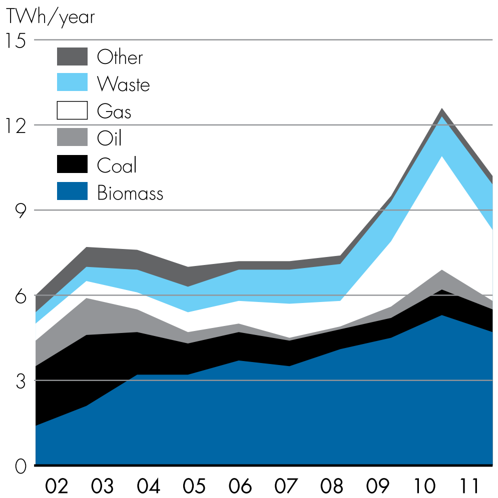
CONDENSING POWER PLANTS IN 2011

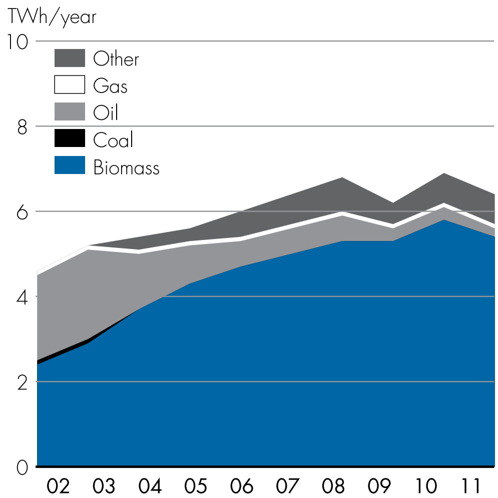
Plant	Owner	Installed capacity, MWel	Fuel
Bråvalla	E.ON Värme	–178	Oil
Total		**–178**	

Source: Swedenergy

DIAGRAM 27

POWER PRODUCTION BY FUEL TYPE IN COGENERATION DISTRICT HEATING AND INDUSTRIAL BACK-PRESSURE PLANTS 2002–2011





Source: Swedenergy

TABLE 13 A

INSTALLED CAPACITY IN SWEDISH POWER PLANTS, MW

	31 Dec. 2010	31 Dec. 2011
Hydropower	16,200	16,197
Wind power	2,163	2,899
Nuclear power	9,151	9,363
Other thermal power	8,185	7,988
- CHP, industrial	1,216	1,240
- CHP, district heating	3,561	3,551
- condensing power	1,801	1,623
- gas turbines, etc.	1,607	1,574
Total	**35,713**	**36,447**
Added	+1,578	+1,072
Subtracted	–46	–329

Source: Swedenergy

TABLE 13 B

INSTALLED CAPACITY IN SWEDISH POWER PLANTS BY FUEL TYPE, MW

	31 Dec. 2010	31 Dec. 2011
Nuclear power	9,150	9,363
Fossil power	5,035	4,793
Renewable power	21,516	22,291
- hydropower	16,200	16,197
- waste	293	325
- biomass	2,860	2,870
- wind power	2,163	2,899
Totalt	**35,713**	**36,447**
Added	+1,578	+1,072
Subtracted	–46	–329

Source: Swedenergy

TABLE 14

MEMBER COMPANY POWER ASSETS IN SWEDEN, MW, 1 JANUARY 2012

Company	Hydropower	Nuclear power	Wind power	Other thermal power	Total
Vattenfall AB	7,946	4,687	241	928	13,802
E.ON Sverige AB	1,814	2,774	47	2,051	6,686
Fortum Power and Heat AB	3,136	1,787	0	947	5,870
Statkraft Sverige AB	1,261	0	0	1	1,262
Skellefteå Kraft AB	655	62	42	77	836
Mälarenergi AB	56	0	0	513	569
Göteborg Energi AB	0	0	34	321	355
Jämtkraft AB	211	0	34	46	291
Holmen Energi AB	253	0	0	0	253
Tekniska Verken i Linköping AB	93	0	0	156	249
Umeå Energi AB	153	0	23	57	233
Arise Elnät AB	0	0	139	0	139
Öresundskraft AB	3	0	0	125	128
Karlstads Energi AB	24	53	0	34	111
Söderenergi AB	0	0	0	94	94
LuleKraft AB	0	0	0	90	90
Sundsvall Elnät AB	0	0	0	74	74
Växjö Energi AB	0	0	0	50	50
Sollefteåforsens AB	49	0	0	0	49
Borås Elnät AB	12	0	0	34	46
Wallenstam NaturEnergi AB	0	0	46	0	46
Övik Energi AB	0	0	0	40	40
Jönköping Energi Nät AB	20	0	0	20	40
Gävle Energi AB	15	0	1	23	39
Eskilstuna Energi & Miljö AB	0	0	0	39	39
Other member groups	118	0	59	173	351
Total	**15,819**	**9,363**	**666**	**5,893**	**31,742**
NON-MEMBER COMPANIES					
Svenska Kraftnät	0	0	0	640	640
Södra Cell	0	0	0	235	235
Billerud	0	0	0	150	150
Stora Enso	0	0	0	150	150
SCA	0	0	0	97	97
Holmen	0	0	0	90	90
Others	378	0	2,233	733	3,530
Total Sweden	**16,197**	**9,363**	**2,899**	**7,988**	**36,447**

Source: Swedenergy

year. The focus during the year was on comprehensive maintenance and ongoing safety enhancements.

Ringhals 1 had its best year since 2006 and Ringhals 3 once again recorded an annual output of over 7 TWh. Ringhals 2 got off to a good start in 2011, but cleanup activities after a fire that broke out towards the end of a maintenance shutdown meant that the reactor was offline throughout the remainder of the year. In 2011 Ringhals 4 carried out the most extensive modernization of all time with good results but with an extension of the maintenance shutdown by around two months.

January was the best month of the year for Ringhals, when the four reactors produced a combined total of 2,724 GWh. In contrast to January, October saw a production of only 237 GWh and all of the reactors were shut down simultaneously for several weeks.

FUEL-BASED PRODUCTION UP SLIGHTLY

Fossil fuels include oil, coal and natural gas. Peat is normally also regarded as a fossil fuel but is classified separately in Sweden. Biomass fuels include wood waste, energy forest, one-year crops, agricultural waste and recycled lignin (a by-product extracted from wood chips during cooking of pulp in the cellulose industry).

Combustion of biomass fuels offers environmental advantages in that the amount of carbon dioxide stored in trees and other plants as they grow is equal to the amount they release when burned. Provided that this balance is maintained, biomass fuels make a zero contribution to the greenhouse effect.

In 2011 electricity generated from other thermal power (fossil and biomass fuels) amounted to 16.8 TWh (19.1 in 2010), equal to 11.4% of Sweden's total electrical output. Of this, 9.4 TWh (6.4) was produced in cogeneration district heating plants and 6.4 TWh (6.2) in industrial CHP (back-pressure) plants.

Diagrams 26 and 27 show the installed capacity and power generation by fuel type used in cogeneration district heating and industrial back-pressure plants. As a rule, the installed capacity (*Diagram 26*) is determined by the primary fuel type used in the plant. The energy statistics can be somewhat misleading, depending on how the fuel is allocated between electrical power and heat generation. Prior to the introduction of renewable energy certificates (RECs), a large share of fossil fuels was allocated to power production. In other words, the trends are reinforced by the fact that statistics providers must take other steering instruments into account.

The condensing power plants and gas turbines, which generate only electricity, produced a total of 1.0 TWh (0.7) in 2011.

A few new power plants were commissioned during 2011, two owned by companies with no previous ownership in electricity generation. The decrease in installed capacity, as shown in *Diagram 26*, can be explained either by the fact that existing plants are using fuels other than those they were originally designed for, or that they have been mothballed. *Table 10* shows capacity additions and other changes during the year. A few major plants are under construction and are expected to go into operation during 2012, such as the Åby plant in Örebro (26 MWel), Bubbetorp in Karlskrona (12 MWel), Energiknuten in Landskrona (8 MWel) and the Filborna plant in Helsingborg (17 MWel).

The Swedish forestry industry's previously ambitious investment spending on new turbines and generators has decreased. The only plant to be completed in 2011 was that in Husum owned by M-real (*see Table 11*). A new turbine is under construction at Holmen's facility in Iggesund (75 MWel).

Table 12 shows changes in condensing power plants during the year.

INSTALLED CAPACITY

The aggregate installed capacity in the country's power stations at the end of the year was 36,447 MW (excluding diesel backup generators in hospitals, water purification plants, etc.), divided between the various types listed in *Table 13A*, or by fuel type according to *Table 13B*. The total installed capacity consists of 44% hydropower, 8% wind power, 26% nuclear power and 22% other thermal power.

Table 13B, showing installed capacity by fuel type, is somewhat misleading since the primary fuel is denoted for the entire capacity while in reality many plants use several different fuels simultaneously.

Due to hydrological limitations, etc., it is not possible to utilize the entire installed hydropower capacity at the same time. During certain parts of the year, there are also constraints in physical grid transmission from northern to central and southern Sweden. Furthermore, some capacity must be reserved to regulate voltage in the power grid and deal with disturbances.

In order to continuously secure the power supply and avoid power shortages, reserve power at least equivalent to the output of one of the country's largest power plants must always be available. International connections enable neighbouring countries to quickly assist each other in the event of contingencies.

Table 14 also shows how the installed capacity in the country's power stations is divided between the member companies in Swedenergy and other companies.

RENEWABLE ELECTRICITY GENERATION

Diagram 28 shows that the percentage of renewable electricity generation in the form of hydro, wind and biomass-based thermal power (blue bar) in Sweden is clearly over 50%. If nuclear power is included the percentage of CO_2-free electricity generation is 95%, which means that only 5% of Sweden's electricity generation utilizes fossil-based or other fuels. This percentage is difficult to reduce since the fuel is used mainly in gas turbines, condensing power plants and as support fuels for start-up of cogeneration plants, of which the first two belong to the category of disturbance and capacity reserves.

ELECTRICITY PRODUCERS

In total, the Swedish state owns approximately 40% of the country's installed power generation capacity, non-Swedish owners around 40%, municipalities around 12% and others roughly 8% (*see Diagram 29*). *Diagram 30* shows that the earlier rising trend in foreign ownership has been replaced by an increase in municipal and other ownership.

TABLE 15

LARGEST ELECTRICITY PRODUCERS IN SWEDEN – PRODUCTION IN SWEDEN 2000–2011, TWh

	2000	2002	2004	2006	2007	2008	2009	2010	2011
Vattenfall	69.3	70.3	70.4	63.8	64.4	66.0	58.7	61.5	59.9
Fortum, Sverige	27.8	24.5	24.0	27.1	26.0	27.9	25.1	26.7	28.9
Birka Energi	21.4								
Stockholm Energi									
Gullspång Kraft									
Stora Kraft	6.4								
E.ON	30.4	30.9	33.9	30.0	31.9	29.8	22.3	27.7	27.4
Sydkraft	27.2	28.5							
Graninge	3.2	2.4							
Statkraft Sverige				1.2	1.3	1.3	5.3	5.4	5.5
Skellefteå Kraft	2.9	3.4	3.1	3.1	3.4	3.3	3.3	3.2	3.4
Total	**130.4**	**129.1**	**131.4**	**125.2**	**127.0**	**128.3**	**114.7**	**124.5**	**125.1**
Share of total	91.9%	90.1%	88.3%	89.2%	87.6%	87.9%	85.8%	85.9%	85.2%
Total output	**141.9**	**143.3**	**148.8**	**140.4**	**145.0**	**146.0**	**133.7**	**145.0**	**146.9**

Generation in wholly owned, partly owned with a deduction for minority shares and addition/subtraction of replacement power.

Source: Swedenergy

TABLE 16

LARGEST ELECTRICITY PRODUCERS IN SWEDEN – PRODUCTION IN NORDIC REGION 2000–2011

	2000	2002	2004	2006	2007	2008	2009	2010	2011
Vattenfall		70.6	70.9	68.3	72.7	73.5	67.0	70.3	66.8
Fortum		46.5	50.7	51.8	49.3	49.9	46.2	48.5	47.0
Statkraft		–	26.2	38.6	35.8	41.9	42.0	45.0	39.7
E.ON		30.9	34.0	30.1	32.4	30.2	22.6	28.1	28.8
Skellefteå Kraft		3.5	3.5	3.5	3.9	3.8	4.1	3.6	3.8
Total		**151.5**	**185.3**	**192.3**	**194.1**	**199.3**	**181.9**	**195.5**	**186.1**
Share of total		39.6%	48.9%	50.8%	48.8%	50.1%	49.3%	51.0%	49.2%
Total output	**383.5**	**382.8**	**379.2**	**383.9**	**397.3**	**397.5**	**368.8**	**383.1**	**378.6**

Generation in wholly owned, partly owned with a deduction for minority shares and addition/subtraction of replacement power.

Source: Swedenergy

TABLE 17

ELECTRICAL BALANCE 2007–2011, NET TWh, ACCORDING TO STATISTICS SWEDEN

	2007	2008	2009	2010	2011*
Domestic production	145.0	146.0	133.7	144.9	146.9
Hydropower	65.6	68.6	65.3	66.8	66.0
Wind power	1.4	2.0	2.5	3.5	6.1
Nuclear power	64.3	61.3	50.0	55.6	58.0
Other thermal power	13.7	14.1	15.9	19.1	16.8
CHP, industrial	6.1	6.2	5.9	6.2	6.4
CHP, district heating	7.1	7.2	9.3	12.4	9.4
Condensing power	0.5	0.7	0.7	0.5	1.0
Gas turbine, diesel, etc.	0.03	0.02	0.02	0.03	0.01
Pump power	-0.03	-0.03	-0.03	-0.02	-0.05
Domestic usage	146.3	144.0	138.4	147.0	139.7
Transmission losses	10.7	10.5	10.2	10.7	11.0
Electricity from neighbouring countries	18.5	15.6	16.4	17.6	14.8
Electricity to neighbouring countries (-)	-17.2	-17.6	-11.7	-15.6	-22.0
Net exchange with neighbouring countries **	1.3	-2.0	4.7	2.1	-7.2

** Preliminary data from Swedenergy, **Negative values are equivalent to export.*

Sources: Swedenergy, Statistics Sweden

Acquisitions and mergers have progressively reduced the number of major electricity producers over the past 20 years, a structural rationalization that has led to a strong concentration of power generation assets. The Nordic region's five largest electricity producers with operations in Sweden accounted for around 125 TWh, or 85.2%, of Sweden's total electrical production in 2011.

In the production figures shown in *Table 15*, minority shares have been omitted and leased electricity production is included only for the company utilizing this production. *Table 16* shows the same companies from a Nordic perspective. Their share of total Nordic electricity generation is 49.2%.

Diagram 31 shows the five largest electricity producers active in Sweden and their total output in the Nordic region during 2011. These account for close to 50% of Nordic electricity generation.

THE POWER BALANCE

The weekly power balance for the years 2009–2011 is shown in *Diagrams 32 and 33*. Production is divided between hydropower, wind power, nuclear power and other thermal power. Development since 2007 is shown in *Table 17*.

Diagram 32 shows the spread of electricity production over the past three years to cover the domestic power requirement and variations in Sweden's net electricity exchange with neighbouring countries during the year. The difference between electricity usage and total electricity production represents the net inflow of electricity to Sweden (when electricity usage exceeds total production) or the net outflow of electricity from Sweden (when total production exceeds usage).

Hydropower is utilized relatively evenly over the year in that the reservoirs are filled during the spring and summer and the energy stored in the reservoirs is used throughout the winter until the next year's spring flood. Maintenance shutdowns at the nuclear power plants are carried out during the summer, when electricity usage is low. Other thermal power consists almost entirely of CHP plants with the bulk of production during the winter when the district heating requirement is high.

Of total electricity production in 2011, hydropower accounted for 45%, wind power for around 4.2%, nuclear power for 39% and other thermal power for just under 12%.

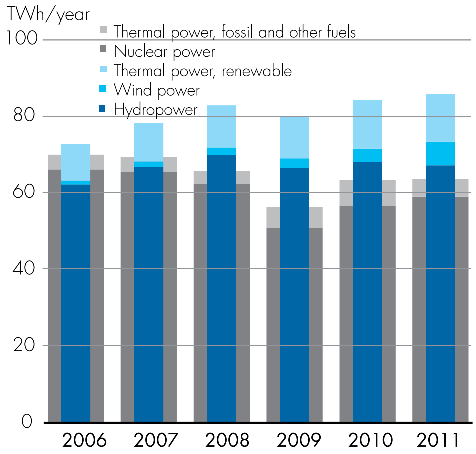
Diagram 33 shows how electricity production is spread over the year in order to cover the power requirement in the Nordic market. The most significant differences in the production mix compared to Sweden are a larger share of other thermal power and a proportionately higher share of wind power in the Nordic region.

The peak hourly load in the electricity system during 2011 was recorded on 23 February 2011 between 8 and 9 a.m. and reached approximately 26,000 MWh per hour, which can be compared to the previous year's peak of 26,700 MWh per hour.

The weighted average daily temperature in the country on 23 February 2011 was -13.1 °C, which is 9.8 °C colder than normal. The hourly load profile for 23 February 2011 is shown in *Diagram 34*, where two typical 24-hour periods, one winter and one summer, are presented for the sake of comparison.

DIAGRAM 28

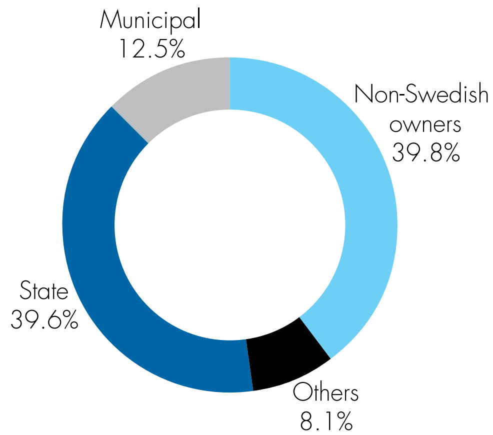
DEVELOPMENT OF RENEWABLE ELECTRICITY GENERATION



Source: Swedenergy

DIAGRAM 29

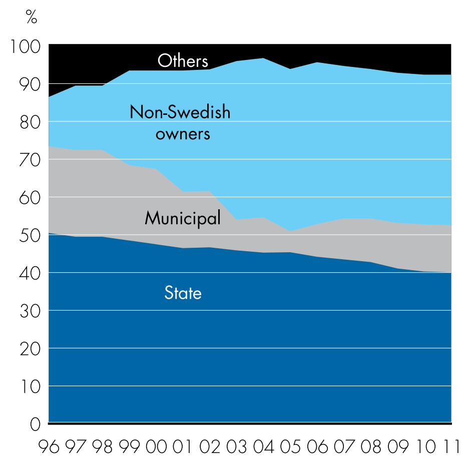
OWNERSHIP OF GENERATION CAPACITY, VALUES FOR 2011



Source: Swedenergy

DIAGRAM 30

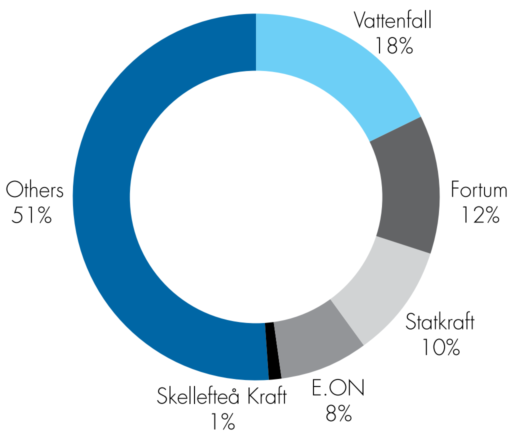
CHANGES IN OWNERSHIP OF ELECTRICITY GENERATION 1996–2011



Source: Swedenergy

DIAGRAM 31

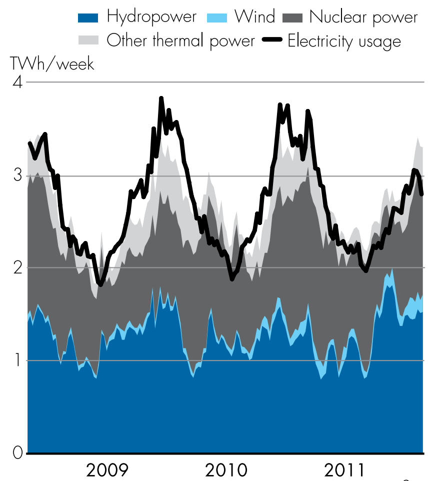
FIVE LARGEST ELECTRICITY PRODUCERS IN SWEDEN – PRODUCTION IN NORDIC REGION IN 2011



Source: Swedenergy

DIAGRAM 32

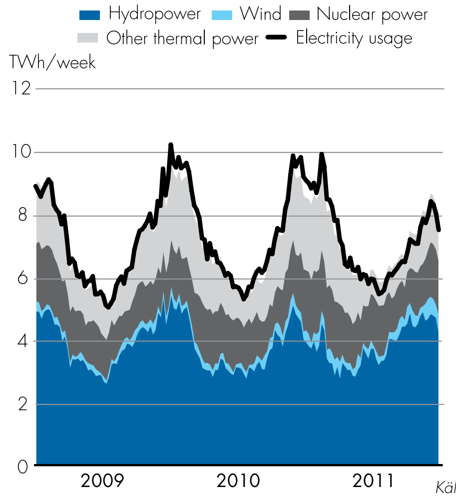
ELECTRICITY GENERATION AND USAGE IN SWEDEN 2009–2011, TWh PER WEEK



Source: Swedenergy

DIAGRAM 33

ELECTRICITY GENERATION AND USAGE IN NORDIC REGION 2009–2011, TWh PER WEEK



Källa: Nord Pool

Electricity usage on weekdays generally has two peaks, one at 8 a.m. and one at 5 p.m. Due to the use of electric heating, the temperature has a strong influence on electricity usage in Sweden. The amount of electricity used on a winter weekday is twice that used on a Saturday or Sunday during the summer.

The rise in electricity usage on a warm summer day due to increased use of fans and air conditioning, irrigation, etc., is still insignificant compared to the effects of a winter month in the form of higher electricity usage for heating.

ELECTRICITY EXCHANGE

Following deregulation of the Swedish electricity market in 1996, the country's exchange of electricity with neighbouring countries is accounted for in terms of physical (measured) values by country, with the sum of net exchanges specified by the hour and point of exchange. Svenska Kraftnät is responsible for this reporting.

Graph 1 shows the Swedish national grid's transmission capacity to the respective neighbouring countries defined in MW. As a result of constraints in the interconnecting grids, the capacity of cross-border connections can differ depending on the direction in which electricity is transmitted. The graph is a schematic representation; in reality Sweden has a number of separate links to each country.

In 2011 Sweden's inflow of electricity from neighbouring countries decreased to 14.8 TWh (17.6 in 2010). The outflow of electricity from Sweden increased to 22.0 TWh (15.6 in 2010), resulting in a net outflow of 7.2 TWh (net inflow of 2.1 in 2011), *see Table 18*. The electricity flow data for 2011 shows that Sweden had a varying in- and outflow during the year (*see also Diagram 35*).

Graph 2 shows the Swedish national grid placed within the Nordic transmission system. This expansion also increases the number of neighbouring countries to include interconnections with Russia, Estonia and in 2009 also the Netherlands. The link with Russia has been, and is currently, a one-way export to the Nordic region. Depending on developments in the Russian electricity market, however, it is conceivable that electric power could be transmitted in both directions in the future.

Electricity production in the Nordic region was down in all countries during 2011. The year began with relatively low hydropower production owing to strained water supplies. Order was restored in the second half of 2011 and the year as a whole was relatively normal. The exchange between the Nordic region and other countries resulted in a net import of approximately 5 TWh (*see Table 19*).

TABLE 18

ANNUAL VALUES FOR SWEDISH ELECTRICITY EXCHANGE WITH DIFFERENT COUNTRIES IN 2011

TWh	To Sweden		From Sweden	
Denmark	2.8	(5.0)	5.3	(2.8)
Finland	4.0	(5.7)	6.1	(3.0)
Norway	7.1	(4.2)	7.0	(8.0)
Poland	0.3	(0.5)	1.5	(0.8)
Germany	0.6	(2.3)	2.1	(1.0)
Total	**14.8**	**(17.7)**	**22.0**	**(15.6)**

(Data for 2010 in brackets).

Source: Svenska Kraftnät

TABLE 19

ANNUAL VALUES FOR NORDIC ELECTRICITY EXCHANGE WITH DIFFERENT COUNTRIES IN 2011

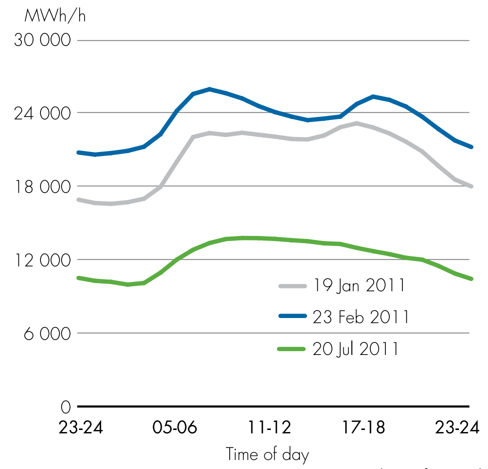
TWh	+ To/ – From Nordic region	
Estonia	1.2	(1.7)
Netherlands	-2.1	(0.6)
Poland	-1.2	(0.3)
Russia	10.8	(11.8)
Germany	-3.8	(5.0)
Total	**4.9**	**(19.4)**

(Data for 2010 in brackets).

Source: Nord Pool

DIAGRAM 34

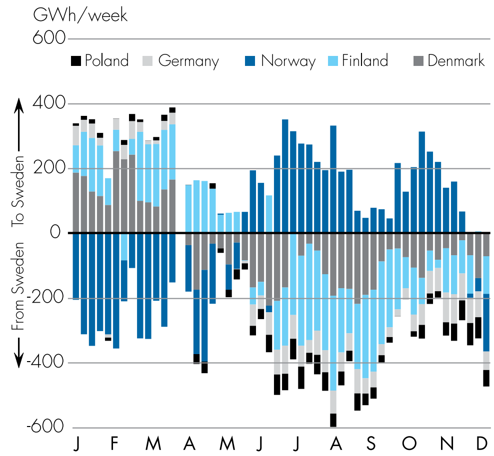
HOURLY LOAD PROFILE FOR ELECTRICITY USAGE WITH PEAK DEMAND IN 2011 AND TYPICAL 24-HOUR PERIOD IN WINTER AND SUMMER



Sources: Svenska Kraftnät and Swedenergy

DIAGRAM 35

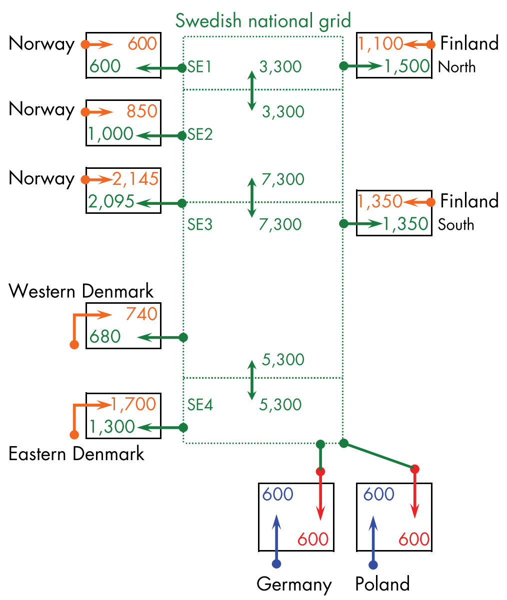
NET FLOW OF ELECTRICITY TO AND FROM SWEDEN PER COUNTRY IN 2011, GWh PER WEEK



Source: Svenska Kraftnät

GRAPH 1

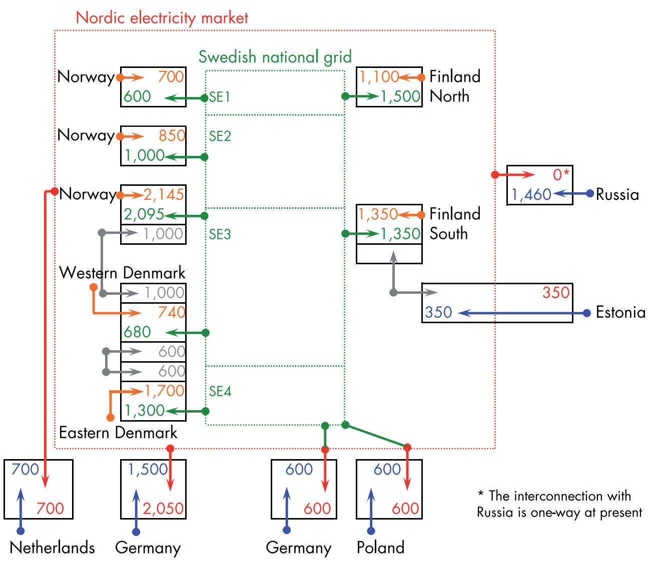
TRANSMISSION CAPACITY BETWEEN SWEDEN AND NEIGHBOURING COUNTRIES, MW



Source: Svenska Kraftnät

GRAPH 2

TRANSMISSION CAPACITY BETWEEN THE NORDIC REGION AND NEIGHBOURING COUNTRIES, MW



Source: Svenska Kraftnät

Environment – EU drawing up long-term plans

From an EU perspective, 2011 could be called the year of roadmaps. In March 2011 the European Commission (EC) presented its roadmap for a competitive low-carbon economy in the EU by 2050. The roadmap shows the potential to achieve an 80% reduction in emissions of greenhouse gases (GHGs) by 2050. By 2020 a reduction of 25% would be possible, compared to the EU's established target to cut emissions by 20%. The roadmap also highlights the central role of electricity in this context. In December 2011 the EC adopted the "Energy Roadmap 2050", in which renewable energy and energy efficiency are identified as the most critical measures in the energy sector to achieve a low carbon economy. The central role of electricity is also emphasized.

In the summer of 2011 the Swedish Environmental Protection Agency was tasked with drawing up a Swedish roadmap to meet the Government's goal an emissions-neutral Sweden by 2050. At the same time, the Minister for the Environment appointed a high level advisory group to assist in the roadmap process.

Swedenergy, and a number of other organizations, also contributed to the flora of roadmaps. Together with The Association of Swedish Engineering Industries (Teknikföretagen), Swedenergy published a report on policy and sustainable energy technology for a climate-neutral Sweden by 2050. The report contains proposed measures in the areas of electricity generation, distribution and usage in order for electricity and the power sector to contribute to a climate-neutral society.

At the global level, a climate breakthrough took place with the negotiation of a deal at the UN Climate Change Conference in Durban, South Africa. At the conference, a decision was made to establish a second commitment period under the Kyoto Protocol for 2013–2017 or by 2020. However, final determination of the parties' commitments was postponed until the next climate conference in 2012 in Qatar. First then can the changes in the protocol be ratified. At present, it appears that it is mainly the EU and a few developing nations that are interested in a second commitment period of the Kyoto Protocol. The parties also agreed to establish an ad hoc working group to draw up a roadmap to a legal binding treaty that will cover all parties to the UN Climate Convention (the Durban Platform). The decision states that this treaty can be a new protocol under the convention, or another legally binding instrument, or an outcome with legal force. The working group will define the terms of the treaty by 2015 at the latest so that a new agreement can take effect in 2020.

In November 2011 the IEA released its World Energy Outlook with pessimistic scenarios for climate change. The IEA's publication warned that global emissions are on the rise and that measures must be taken to break this trend by 2017 at the latest if there is to be any hope of limiting the rise in temperature to 2 °C.

The impact of hydropower on biodiversity was a hotly debated topic in 2011. The Standing Committee on Environment and Agriculture produced a report on the Government's initiatives for biodiversity in running water and held a hearing with the affected parties, including the power industry. The Committee stated that dams, hydropower plants and regulation reservoirs have a very negative impact on biodiversity in running water.

TABLE 20

AIRBORNE EMISSIONS FROM SWEDEN'S ELECTRICITY PRODUCTION IN 2010

Emissions	Total emissions from electricity production (tonnes)	Emissions per kWh of electricity produced	Share of total emissions in Sweden [%]
Nitrogen oxides (NOx)	5,711	0.03 g	3.5
Sulphur dioxide (SO_2)	3,189	0.02 g	9.3
Carbon dioxide (CO_2)*	4,080,907	25.53 g	7.7
Carbon monoxide (CO)	16,318	0.10 g	2.6
Volatile organic compounds (NMVOC)	1,313	0.01 g	0.7
Methane (CH_4)	1,700	0.01 g	0.03
Particulates (PM 10)	2,533	0.02 g	5.8
Nitrous oxide (N_2O)	535	3 mg	0.01
Ammonia (NH_3)	152	1.0 mg	0.3
Lead (Pb)	1.0	6 µg	0.01
Mercury (Hg)	0.03	0.2 µg	0.005

*fossil CO_2 emissions

Sources: Statistics Sweden, Swedish Environmental Protection Agency

The Committee felt there was a lack of adequate incentives for the power companies to pursue environmental issues and that is it vital that such incentives are created. The Committee also pointed out the risk that the Swedish Parliament's environmental quality objectives will not be realized. The industry is devoting considerable effort to preserving biodiversity, but there are conflicts between global and local environmental goals. Hydropower is a critical enabler in achieving a climate-smart society at the same time that the attainment of other environmental objectives must be taken into account.

Sweden's implementation of the Industrial Emissions Directive (IED) continued in 2011 with the appointment of a commission to present proposals for Swedish legislation. The directive may require more frequent reconsideration of permit conditions in pace with changes in the definition of best available technology (BAT). In 2011 an initiative was started to revise the reference document that identifies BAT for large combustion plants. This effort will be of major importance in setting future limit values for emissions of NOx, SO_2, particulates, etc., from combustion plants.

In 2011 it became clear that Sweden had failed to meet its reduction target for NOx emissions by 2010. As late as 2009 this goal appeared to be within reach, as annual emissions amounted to 149,000 tonnes and the target for 2010 was a maximum of 148,000 tonnes. However, emissions in 2010 reached 161,000 tonnes. The main contributor to the increase is higher emissions from transports and the energy supply sector, including electricity generation.

ENVIRONMENTAL ASPECTS OF ELECTRICITY

All extraction, conversion and usage of energy have some effect on the environment. Burning of fuels gives rise to emissions of substances such as sulphur dioxide and nitrogen oxides. However, even non combustion-based power generation, such as hydro and wind power, has an impact on the local environment. For example, construction of wind farms along the coast alters the visual landscape and hydropower plants lead to changed and irregular water flows, which affect biodiversity, the habitats of shoreline flora and the migratory paths of fish.

Environmental consideration has always been a natural part of the power industry's responsibilities but is now pursued in a more structured manner than before. Virtually all companies in the industry are certified according to the ISO 14001 environmental standard, which ensures that environmental issues are addressed systematically in order to continuously reduce negative environmental effects. Electricity production in Sweden has a generally low environmental impact in the form of emissions since it is based primarily on hydro and nuclear power, which generate no combustion-related emissions at all.

Table 20 shows the trend for a few combustion-related emissions from electricity generation. Emissions are calculated based on electricity generation data per fuel type, which is converted to total fuel usage for each power plant unit with the help of average efficiency rates for the plants. Emission factors are then applied to the fuel usage data to obtain total emissions.

ACIDIFICATION AND SULPHUR DIOXIDE

Acidification is counted among the more regional environmental problems, and sulphur fallout is the primary cause of acidification in Swedish soil and waterways. Since Scandinavian soils are particularly sensitive to acidification, this problem attracted attention at an early stage in Sweden. Sulphur dioxide (SO_2) is a transboundary airborne pollutant and approximately 90% of fallout in Sweden originates from Central Europe and the UK.

Sulphur dioxide emissions in Sweden have decreased sharply from a high of 925,000 tonnes in 1970 to around 35,000

tonnes in 2010, which is lower than the environmental target of 50,000 tonnes set for the year. Of total SO_2 emissions, around 70% is attributable to combustion of oil and coal. The few power and heat generation facilities that still use coal or oil have installed desulphurization plants or now use low-sulphur oil. Furthermore, these are used primarily for peak loads when the need for capacity is highest. Emissions of SO_2 from Sweden's electricity production in 2010 amounted to 3,189 tonnes, equal to around 9.3% of Sweden's total SO_2 emissions (*Table 20*).

EUTROPHICATION AND NITROGEN OXIDES

The primary effect of nitrogen fallout into the soil is to promote the growth of nitrogen-loving plants at the expense of indigenous flora such as blueberries and lingonberries. So far, NOx fallout in Sweden has caused only minor leaching into the country's waterways. Nitrogen oxides are transboundary airborne pollutants and only around 17% of fallout is of domestic origin.

NOx emissions also lead to the formation of ground-level ozone. In Sweden, this type of ozone causes both negative health effects and damage to trees and crops costing billions per year. Sweden's ozone levels are largely of foreign origin and are result of NOx fallout from Germany, the UK and Poland. International cooperation is therefore needed to deal with eutrophication problems, an area where the UN Convention on Long-range Transboundary Air Pollution and various EU directives, such as the recently adopted IED (Industrial Emissions Directive) and ongoing revision of the National Emission Ceiling Directive, are playing a central role.

NOx emissions in Sweden have declined in recent years but have proven more difficult to reduce than SO_2 emissions. In 2010 Sweden's total NOx emissions amounted to 161,000 tonnes, while the target was set at 148,000 tonnes. Of total emissions, the bulk is attributable to traffic, primarily passenger cars and trucks, but also machinery, equipment and seagoing vessels. The majority of power and heat generating facilities have installed denitrification scrubbers. Sweden's NOx emissions from electricity production in 2010 amounted to 5,711 tonnes, i.e. 3.5% of Sweden's total emissions (*Table 20*). *Diagram 36* shows the trend in emissions of NOx and SO_2 since 2000. The rise in NOx emissions in recent years is due to increased power generation from CHP plants. In 2010, production in combustion plants increased more than usual due to the cold winter and operating problems in the nuclear power plants. 2010 was also the first year when the natural gas-fired Öresundsverket was in operation for most of the year. The trend for electricity production in CHP plants is shown in *Diagram 37*.

CLIMATE CHANGE AND GREENHOUSE GASES

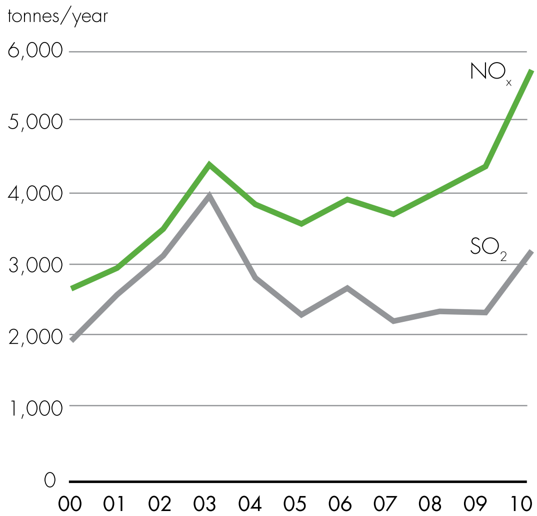
Certain gases in the Earth's atmosphere allow the sun's rays to pass through while at the same time absorbing the energy reflected back by the Earth's surface. This so-called "greenhouse effect" is a natural phenomenon that keeps the Earth's mean global temperature at +15 °C instead of the -18 °C which would otherwise be the case.

However, increased anthropogenic CO_2 emissions are altering the chemical composition of the atmosphere and affecting its radiation balance.

There are both natural and unnatural greenhouse gases (GHGs), all of which have varying degrees of climate impact. The greatest attention has been focused on carbon dioxide, since concentrations of CO_2 in the atmosphere have risen dramatically. Prior to industrialization the atmospheric concentration of CO_2 was approximately 280 ppm (parts per million), but has since then risen to around 390 ppm. Combustion of

DIAGRAM 36

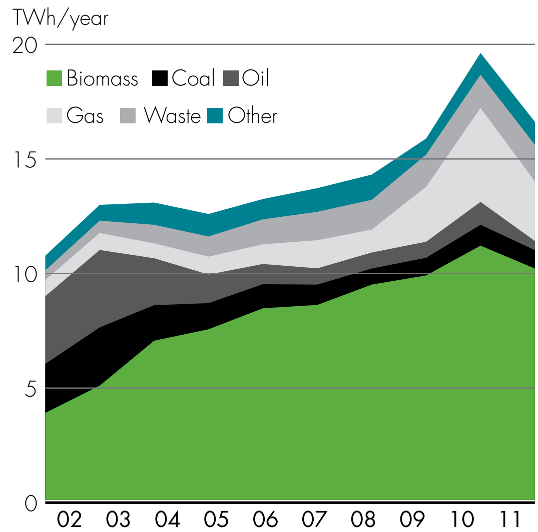
AIRBORNE EMISSIONS OF NOX AND SO_2 FROM ELECTRICITY PRODUCTION 2000–2010, TONNES PER YEAR



Soruces: Statistics Sweden, Swedish Environmental Protection Agency, Swedenergy

DIAGRAM 37

ELECTRICITY PRODUCTION IN CHP PLANTS, TWh



Source: Swedenergy

fossil fuels such as oil, gas and coal and deforestation are the main causes of increased CO_2 in the atmosphere.

Sweden has relatively low emissions of GHGs, in 2010 amounting to 66.2 Mtonnes (1 megatonne = 1 million tonnes) of CO_2 equivalents (climate-affecting gases converted into CO_2), while CO_2 emissions at the beginning of the 1970s exceeded 100 Mtonnes per year. The difference is mainly due to a drastic decrease in the use of oil in favour of electricity generated from nuclear power. At around 7 tonnes per year, Sweden's per capita emissions of CO_2 equivalents are low in comparison with other industrialized nations. The EU average is around 10 tonnes per capita and year.

Climate change is a global issue that must be addressed at the global level. Swedish emissions of CO_2 equivalents make up only 0.2% of annual global emissions. The United Nations Framework Convention on Climate Change was signed in 1992 and in 1997 led to the Kyoto Protocol, for which the commitment period runs from 2008–2012. Under the Protocol the industrialized nations must reduce their GHG emissions by at least 5% below 1990 levels. Since 1990, Sweden has reduced its emissions by 9%.

At the end of 2008 the EU agreed on new climate targets. Emissions of GHGs will be cut by 20% between 1990 and 2020. In the non-ETS sector, overall emissions in the EU will be reduced by 10% between 2005 and 2020 and the corresponding target for Sweden is 17%. In the ETS sector, emissions will be reduced by 21% between 2005 and 2020. If a new international climate treaty is signed, the EU's reduction target for 2020 will be raised to 30%.

In 2010, electricity production accounted for approximately 4 million tonnes, or around 7.7%, of total Swedish CO_2 emissions. Emissions vary dramatically in relation to the weather and runoff to the reservoirs. Sweden's CO_2 emissions rose in 2010 a result of increased electricity production based on oil, coal, peat, natural gas and blast furnace gas (BFG). This was largely attributable to the cold winter and operating difficulties in the nuclear power plants (*see Diagram 38*).

Electricity production also produces emissions of methane and nitrous oxide. In 2010 methane emissions from electricity production accounted for roughly 0.03% and emissions of nitrous oxide for around 0.01% of Sweden's total emissions.

Aside from the GHGs that are released in production of electricity, emissions of the greenhouse gas SF6 arise through leakage from power transmission facilities. In 2010 there were approximately 98,704 kg of SF6 in Swedish transmission and distribution facilities. Emissions from these in 2010 were estimated at 318 kg, or around 0.32% of the total usage, (*see Diagram 39*).

OTHER AIRBORNE EMISSIONS FROM ELECTRICITY PRODUCTION

Combustion of fossil fuels for electricity production gives rise to emissions of carbon monoxide (CO), volatile organic compounds (VOCs), particulates, ammonia, lead and mercury to varying degrees – depending on the fuel type.

CO and VOCs are produced in incomplete combustion and have negative effects on human health.

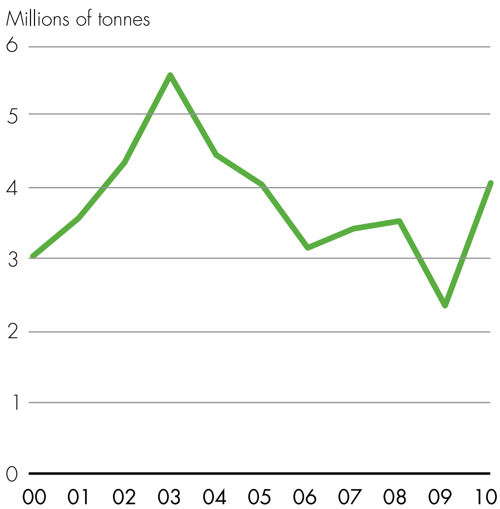
Particulate emissions depend on the ash content of the fuel as well as the combustion and cleaning technology in the facility. Particulates have significant health effects when inhaled.

Ammonia arises as a result of the addition of non-reacted ammonia in the use of certain cleaning technologies to eliminate other types of emissions from the process.

Heavy metals are emitted due to the varying heavy metal contents of the fuels, although emissions from electricity production are low (*see Table 20*).

DIAGRAM 38

AIRBORNE EMISSIONS OF CO_2 FROM ELECTRICITY PRODUCTION IN 2000–2010



Sources: Statistics Sweden, Swedish Environmental Protection Agency, Swedenergy

DIAGRAM 39

SF6 LEAKAGE (% OF TOTAL USAGE IN PRODUCTION AND NETWORK OPERATIONS)

Källa: Svensk Energi

ENVIRONMENTAL ASPECTS OF HYDROPOWER

From a historical standpoint, hydropower has been an important driver for development and prosperity in Sweden and today accounts for nearly half of the country's electricity generation in normal year conditions. Aside from its important function as a source of base and regulating power, hydropower is playing an increasingly vital role as an instantaneous peak load reserve and means for frequency control throughout the electrical system.

Hydropower spares the environment from harmful emissions such as acidifying substances and their consequences for soil and water. At the same time, the country's early hydroelectric development led to impacts on biotopes and species, both locally and regionally. In this context, public interest has been concentrated mainly on fish and related issues.

In 2000 a research program co-funded by hydropower producers and the Swedish Government was launched to provide a platform for environmental improvements in the currently exploited waterways. In 2010 the final results were presented from stage 3 of this research project – "HYDROPOWER – environmental impacts, remedial measures and costs in regulated waters". Within the program, a generalizable theory and methodology were developed for socioeconomic cost-benefit analysis of changes in regulated waterways. In addition, a dynamic population model was created to enable advance evaluation of whether the construction of fishways will lead to viable populations of migratory fish.

Environmental actions that lead to changed flow regimes can result in serious economic, legal, technical and other environmental problems for both the affected companies and society in general, and therefore involve careful weighing of pros and cons between different aspects. Such measures require in-depth analysis before proceeding and extensive follow-up after completion.

The national environmental objectives, the EU's Water Framework Directive and activities related to biodiversity have highlighted the importance of ongoing attention to environmental issues in existing and new hydropower facilities.

ENVIRONMENTAL ASPECTS OF NUCLEAR POWER

Unlike fossil fuels, nuclear generation of electricity produces virtually no emissions into the air. At the same time, the use of nuclear power entails responsibility for the highly radioactive spent fuel, which must be stored separately from the surrounding environment for a very long time. Nuclear power plants are subject to rigorous security and safety precautions, since malfunctions, transport accidents, etc. can have devastating consequences.

The environmental aspects of nuclear power can be divided into:

Fuel supply

Most extraction, conversion and enrichment of uranium for Swedish reactor fuel take place in other countries. Fuel elements are manufactured in a fuel factory. In Sweden there is a factory for production of fuel elements in Västerås.

Uranium for the Swedish reactors is purchased from mining companies on the global market, for example in Australia and Canada. Enrichment services for Swedish reactor fuel are also purchased on the global market, primarily from France, the Netherlands and the UK. Sweden uses approximately 2,000 tonnes of uranium annually. This naturally requires long-distance transports that produce climate-affecting emissions. Like other mining operations, uranium mines give rise to local environmental impact and occupational hazards. A uranium mine must have highly effective ventilation, since the maximum permitted radon level in the mines is equal to that in Swedish homes. All modern mines have invested in extensive protective systems for the natural and working environments in accordance with the norms established by the relevant authorities.

Operation

The radioactive emissions into the environment produced by reactor operation are very small and carefully monitored. According to the regulatory authorities, these should not exceed a maximum dosage of 0.1 mSv (millisieverts). The nuclear disaster in Fukushima, Japan, leading to increased radiation levels and very high emissions into the air and ocean, also had affects on the Swedish nuclear power plants in that all EU member states were ordered to carry out comprehensive risk and safety assessments of their nuclear power plants, so-called stress tests. The nuclear power plants in Sweden submitted their reports on 31 October. The Swedish Radiation Safety Authority (SSM) reviewed the nuclear power industry's analyses and presented a Swedish national report to the EU at year-end 2011.

In its report, the SSM found that the Swedish nuclear power plants are robust and resilient to most kinds of extreme events, but that improvements are necessary for a few events. The nuclear power plants are not fully dimensioned to withstand an accident scenario in which several reactors are put out of commission simultaneously, or for situations with an extended sequence of events. The EU's combined report on stress tests in the European nuclear power plants will be presented in June 2012.

CO_2 emissions from nuclear power are around 3 grams per kWh. The corresponding figure for coal-fired power is 800 grams of CO_2 per kWh. Hydro and wind power produce emissions of between 5 and 10 grams per kWh from a life cycle perspective.

Sweden's nuclear generation facilities are of the condensing power plant type, whose operation produces warm water emissions (waste heat) that affect areas a few square kilometers in size outside the point of emission. It is possible to utilize the waste heat among other things in district heating systems, which has been discussed in connection with the expansion of nuclear power in Finland and previously also in Sweden.

Waste

Our Swedish nuclear power plants produce electricity, but also radioactive waste. If the ten reactors still in operation are used for 50 to 60 years, Sweden's aggregate nuclear waste will have a volume equal to more than one third of the Globen arena in Stockholm. Spent nuclear fuel must be deposited in a final repository and isolated from the surrounding environment for up to 100,000 years. For the first 30 to 40 years the fuel is placed in interim storage while its radioactivity decreases to a

few percent of the level directly after operation. The interim storage facility has been located in Oskarshamn since 1985.

The Swedish Nuclear Fuel and Waste Management Company (SKB) has plans to build a deep repository that will isolate the fuel for a very long time – 100,000 years. The repository will be placed at a depth of around 450 meters in the Swedish crystalline basement rock, which is highly stable and has been in place for more than a billion years. The only thing that can transport radioactive substances from the repository is ground water, but this is prevented through the use of multiple protective barriers. The first is an impermeable copper canister in which the radioactive material is stored. The second is a layer of bentonite clay that protects the canister from corrosion and movement, and the third barrier is the Swedish crystalline bedrock that functions as a filter and keeps the spent fuel separate from humans and the environment.

The choice of location for the final repository for storage of spent nuclear fuel from the Swedish nuclear power plants was between Forsmark in the municipality of Östhammar and Laxemar in the municipality of Oskarshamn. For several years the SKB has carried out extensive site surveys, including drill hole sampling, analyses and 600 reports in each of the two locations. All known factors have been analyzed, evaluated and compared.

In June 2009 the board of the SKB made a unanimous decision to propose that a deep repository for spent nuclear fuel be sited in Uppland County, in the municipality of Östhammar, next to the Forsmark nuclear power plant. In March 2011, the SKB submitted an application for a permit to build the facility and expects to receive final permission from the Government after three years at the earliest. Construction of the repository is expected to begin around 2015 so that the first canisters can be deposited around 2025.

Although the repository is being built in Forsmark, a close collaboration with Oskarshamn will be developed, among other things with the planned encapsulation facility that is being built by the interim storage site. In addition, a collaboration agreement has been signed that includes investments in infrastructure and business development in both municipalities.

ENVIRONMENTAL ASPECTS OF WIND POWER

Wind power is a clean and environmentally friendly energy source that produces virtually no emissions during operation. It creates no environmentally hazardous waste and its operating sites are easily restored. The environmental impacts of wind power mainly consist of anticipated negative effects on the landscape, i.e. aesthetic values that are difficult to assess objectively. Other considerations include noise emissions and visual impact.

Among the potential ecological disadvantages, critics have mainly focused on damage and disruptions in the spawning and nursery areas of fish, the effects of infrasound on aquatic life and electromagnetic fields around cables. Other conceivable effects include the harmful consequences of noise and radiation on seals and collision risks if turbines are placed in the flight path of birds. Research is underway, but preliminary findings indicate that most of these risks are exaggerated.

ENVIRONMENTAL ASPECTS OF POWER DISTRIBUTION

Distribution of electricity also has an impact on the environment. Cables, power lines and switches are made of metals that are extracted from mines and give rise to environmental effects.

Transmission and distribution networks give off electromagnetic radiation, but the levels fall of rapidly with increasing distance from the power line. If needed, shields are set up and the lines are placed so as to limit exposure.

To protect them from rot and insect damage, wood utility poles are impregnated with various chemicals such as creosote and salt compounds containing chromium, copper and arsenic, which are highly toxic. The question of prohibiting the use of creosote has been under discussion for many years. In 2011 the EC gave the green light for continued use of creosote at least until the spring of 2018. But in order to use creosote in poles for use class 4 after 2013, creosote users must be able to show an acceptable level of leaching from the poles.

The greenhouse gas SF6 is used as an insulating gas in switchgears and circuit breakers. Although this greenhouse gas has a very high global warming factor, there is currently no alternative. Swedenergy is monitoring developments in the industry with regard to use of the gas and leakage during handling. Leakage has gradually decreased over the past ten years and recovery of gas from retired equipment is also taking place. Research is underway to find alternative gases that have the same performance but less environmental impact.

New power lines lead to changes in the natural environment that can have a negative impact on biodiversity. At the same time, existing power line areas have proven to be a haven for certain species and steps are being taken to species inventory and manage these.

Taxes, charges and renewable energy certificates (2012)

TOTAL BURDEN OF TAXES AND CHARGES ON ELECTRICITY SUPPLY

In many ways, the supply of electricity is subject to a heavier burden of taxation and charges than other areas of Swedish industry and commerce. For 2012 taxes and charges particular to electricity supply are estimated as follows (excluding VAT), *see Table 21*. Energy taxes and carbon dioxide tax are indexed annually, upwards or downwards, depending on inflation or deflation.

Including VAT, total taxes and charges on the electricity sector in 2012 are estimated at around SEK 40 billion.

Added to this are energy and climate policy steering instruments in the form of emissions allowances and RECs, which are also part of the electricity price.

PROPERTY TAX

All electricity generation facilities are subject to a general industrial property tax. In 2011 the property tax for hydropower was raised by 0.6% from 2.2% till 2.8% of the taxable value of the property (both land and buildings, Act on National Real Estate Tax [1984:1052]).

The temporary tax increase by 0.5% during the tax assessment years 2007–2011 was thus made permanent and raised further. The end result was thus an increase in the property tax by 0.6% rather than a reduction by 0.5%.

On 1 January 2007 the property tax on wind power plants was reduced from 0.5% to 0.2%. For other electricity generation facilities, the property tax is unchanged at 0.5% of the taxable property value.

NUCLEAR POWER

Electricity produced in nuclear power plants has been taxed since 1984, initially in the form of a production tax. In 2000 this taxation was restructured as an output tax based on the thermal output of the reactors, and is thus unrelated to the amount of electricity generated. As of 1 January 2008 the output tax amounts to SEK 12,648 per MW thermal and month, equal to an average of around SEK 0.055 per kWh. If a reactor has been out of operation for a contiguous period of more than 90 days, a deduction of SEK 415 per MW is permitted for the number of calendar days in excess of 90.

Electricity produced from nuclear power sources is also levied with a charge of SEK 0.003/kWh according to the so-called Studsvik Act, to cover the costs arising from Studsvik's previous operations.

TABLE 21

TAX BURDEN ON THE ELECTRIC POWER SECTOR IN 2012 (FORECAST)

	SEK million
Property tax on power generation facilities	3,800
Nuclear power tax and Studsvik charge	4,500
Fees for financing of government agencies, nuclear power producers	320
Electrical safety tax, network monitoring fee and electricity preparedness fee	300
Tax on fossil fuels	100
Energy tax on electricity	20,000
Total	**29,000**

Source: Swedenergy

TABLE 22

TAX ON FUELS IN 2012*

	Energy tax		Carbon dioxide tax	
Fuel oil **	SEK 0.082/kWh	SEK 819/m³	SEK 0.313/kWh	SEK 3,100/m³
Crude tall oil ***		SEK 3,919/m³		
Coal	SEK 0.082/kWh	SEK 622/tonne	SEK 0.400/kWh	SEK 2,697/tonne
Natural gas	SEK 0.082/kWh	SEK 914/1,000m³	SEK 0.215/kWh	SEK 2,321/1,000m³

** Exception for electricity production, see section on tax on electricity production with fossil fuels.*

*** Fuel oil to which a dye or chemical marker has been added or which produces less than 85 volume percent distillate at 350 °C.*

**** Crude tall oil (CTO) used for energy purposes is levied with a special energy tax equivalent to the combined energy and carbon dioxide on low-taxed fuel oil, i.e. SEK 819 + SEK 3,100 = SEK 3,919 per m³.*

Source: Swedenergy

In order to cover future costs for final storage of spent fuel, each nuclear power plant is charged an individual fee. For Forsmark these fees correspond to SEK 0.021 per kWh, for Oskarshamn to SEK 0.020 per kWh and for Ringhals to approximately SEK 0.024 per kWh. As a weighted average for Swedish nuclear power, this is equal to SEK 0.022 per kWh as of 1 January 2012. For Barsebäck, the fee amounts to SEK 842 million per year. Furthermore, the reactor owners are required to pledge collateral to the Government – each plant in an individual amount – for a total of around SEK 19.3 billion in 2012.

Nuclear power producers also pay fees for financing of the Swedish Radiation Safety Authority (SSM) in a total amount of approximately SEK 320 million per year.

TAX RATES ON USE OF FOSSIL FUELS

Uniform energy tax, etc.

On 1 January 2011 a uniform general energy tax of approximately SEK 0.08 per kWh was introduced on all fossil fuels. This implicated a vast increase in the taxation of natural gas. This level corresponds to the energy tax on oil of SEK 797 per m^3 for 2011. For industrial installations, CHP plants, etc., included in the EU Emissions Trading Scheme (ETS), the level is 30% of the general energy tax.

For crude tall oil, the level for industries participating in the EU ETS is 30% of the general level of the energy tax on oil, i.e. 30% of SEK 797 per m^3.

The carbon dioxide tax on fossil fuels was abolished on 1 January 2011 for industries in the EU ETS.

Tax on electricity production with fossil fuels

According to the Energy Taxation Act, no tax is levied (i.e. a deduction is allowed) on fuels used for the production of taxable electricity. However, for fossil fuel-fired condensing power production, a standard 5% of electricity production is classified as untaxed internal electricity usage, for which reason 5% of the supplied fuel is taxed. For fossil fuel-fired CHP, 1.5% of the fuel for electricity generation is classified as internal usage and is taxed.

The rates for energy and carbon dioxide tax have been adjusted for indexation (change in the consumer price index between June 2010 and June 2011) according to government bill 2011/12:1 and SFS 2011:1134. The increase is 2.74%. *Table 22* shows the tax rates applied for use of fossil fuels in 2012.

As of 1 January 2012 the full carbon dioxide tax amounts to approximately SEK 1.10 per kg CO_2. Biofuels and peat are not taxed.

Sulphur tax

Sulphur tax is levied at SEK 30 per kg of sulphur in SO_2 emissions from combustion of solid fossil fuels and peat. For liquid fuels, the tax is SEK 27 per cubic meter for each tenth of one weight percent of sulphur in fuel exceeding 0.05%. If the sulphur content is higher than 0.05% but lower than 0.2%, it is rounded up to 0.2%.

Nitrogen oxide tax

A nitrogen oxide tax is levied at SEK 50 per kg of nitrogen oxides (designated as NO_2) from use of boilers and gas turbines with a utilized energy amount of more than 25 GWh per year.

The bulk of the fees are repaid to the taxable entities in proportion to their share of the utilized energy.

CHP tax

With effect from 1 January 2011, the qualifying limit for tax abatement in CHP plants has been set at an electrical efficiency rate of at least 15% according to the bill "Certain selective tax issues in respect of the budget bill 2010" (govt. bill 2009/10:41). In cases where multiple fuels are used, the order of fuels for taxation may no longer be chosen freely but is instead subject to rules for proportioning.

As of 1 January 2011, fuel used for heat generation in CHP plants is exempt from 93% of the carbon dioxide tax. This is a further reduction of 8 percentage points compared to 2010. At the same time, however, the general uniform energy tax has been introduced. For industrial, CHP and other facilities included in the EU ETS, the level is equal to 30% of the general energy tax. For CHP, not included in the EU ETS, the carbon dioxide tax reduction is 70% of the general level from 1 January 2011, while the reduction for pure heat production plants is 6%.

SEPARATE TAXATION OF CHP PLANTS

Taxation abatement rules are not equal for CHP plants compared to manufacturing industry, including industrial back pressure plants. The industry does not pay carbon dioxide taxes from 1 january 2011.

Under the current tax legislation for installations covered by the EU ETS, CHP plants are taxed individually depending on the owner's industry affiliation. The regulation, in which certain owners of CHP plants are favoured (industrial back pressure) while others are disadvantaged through taxation, is currently being examined by the European Commission to determine whether the differentiated treatment distorts competition. Swedenergy and a few of the affected members have filed a complaint with the European Commission's Directorate General for Competition according to Article 87 of the Treaty.

In its spring fiscal policy bill for 2012 (govt. bill 2011/12:100), the Swedish Government proposed that the carbon dioxide tax also be abolished for CHP starting in 2013. An official memo was referred for consideration during April and May.

WASTE INCINERATION TAX

The Swedish Parliament passed a decision in accordance with government bill "Certain selective tax issues in respect of the budget bill 2010" (govt. bill 2009/10:41) to abolish this tax as of 1 October 2010. Consequently, no tax is now levied on waste incineration.

WIND POWER

Commercial suppliers of wind-generated electricity produced in Swedish offshore wind farms were previously allowed to deduct part of the energy tax on electricity. The deduction amounted to SEK 0.12 per kWh during 2009, but was abolished as of 1 January 2010.

Electricity is exempt from taxation if it is produced in Sweden in a wind farm by a non-commercial supplier (Energy Tax Act, Chapter 11, § 2).

ENERGY TAXES ON ELECTRICITY FOR USAGE

The energy tax on electricity in certain municipalities in northern Sweden was lowered by SEK 0.03 per kWh as of 2008 following approval by the European Commission.

For 2012, the tax on electricity has been adjusted for indexation with the consumer price index, based on the actual change in the index during the period from June 2009 to June 2011 applied to tax rates for 2010. The index has risen by 3.5%.

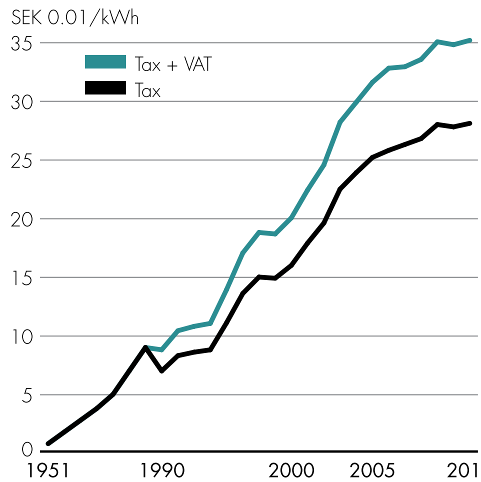
On 1 January 2012 Sweden introduced a reduced rate of electricity tax for electric power used in seagoing vessels with a gross tonnage of at least 400, when the vessel is lying at berth in a port and the voltage of the electric power transmitted to the vessel is at least 380 volts. By using shore-side electricity is it possible to avoid air pollution from burning of bunker fuel to generate electricity on board vessels in the port, thereby improving the local air quality in the port cities. Through use of electricity from the Nordic electricity market, this also leads to lower CO_2 emissions. The tax reduction was approved (2011/384/EU) by the Council of the European Union on 20 June 2011 in accordance with Article 19 of Directive 2003/96/EC. The decision is valid for a limited period and applies until 25 June 2014.

After indexation (SFS 2011:1134), energy tax on usage of electricity is levied according to the following as of 1 January 2012:

1. SEK 0.005 per kWh for electricity used in industrial operations, in the manufacturing process or for professional greenhouse cultivation.
2. SEK 0.005 per kWh for shoreside electricity used in seagoing vessels with a gross tonnage of at least 400 and a voltage of at least 380 volts.
3. SEK 0.192 per kWh for electricity other than that referred to under 1) and which is used in certain municipalities in northern Sweden.
4. SEK 0.290 per kWh for electricity used for other purposes.

DIAGRAM 40

DEVELOPMENT OF ELECTRICITY TAX* (ENERGY TAX ON ELECTRICITY) SINCE 1951



*The energy tax is lower for certain municipalities in northern Sweden

Soruces: Statistics Sweden, Swedish Energy Agency

The energy tax trend is illustrated in *Diagram 40*. The previous reduction for electricity used in the supply of electricity, gas, heat or water was abolished as of 1 January 2006.

Taxation of the electricity suppliers' own usage of electricity was introduced and the increased energy tax on electricity used in large electric boilers during the winter months was abolished. The reason for these changes is that the EU Energy Tax Directive no longer permits special rules in these cases. Agricultural, forestry and aquacultural operations are allowed an electricity tax refund for the difference between amount of tax paid and an amount computed according to a tax rate of SEK 0.005 per kWh. A refund is permitted for that part of the difference exceeding SEK 500 on an annual basis. If the sum exceeds SEK 500 for a calendar year, a refund is permitted for the full amount.

Under the Energy Efficiency Act (PFE) that went into effect on 1 January 2005, energy-intensive companies that use electricity in the manufacturing process can qualify for tax-exemption by participating in a five-year energy efficiency program. A continuation of the program is currently under consideration by the European Commission.

Electricity customers also pay fees for financing of certain government agencies. All in all, high voltage customers will pay SEK 3,577 and low voltage customers SEK 54 in electrical safety, network monitoring and electricity preparedness fees in 2012. Low voltage customers will pay SEK 6 to finance the National Electrical Safety Board, SEK 3 to the Energy Markets Inspectorate and SEK 45 to cover costs for measures and activities under the Electricity Contingency Act (1977:288). For high voltage customers, the corresponding amounts are SEK 500, SEK 600 and SEK 2,477.

RENEWABLE ENERGY CERTIFICATES

Renewable Energy Certificates (RECs) were introduced in 2003 as a new support system for promoting the use of electricity from renewable sources. The system replaced earlier subsidies on renewable electricity production.

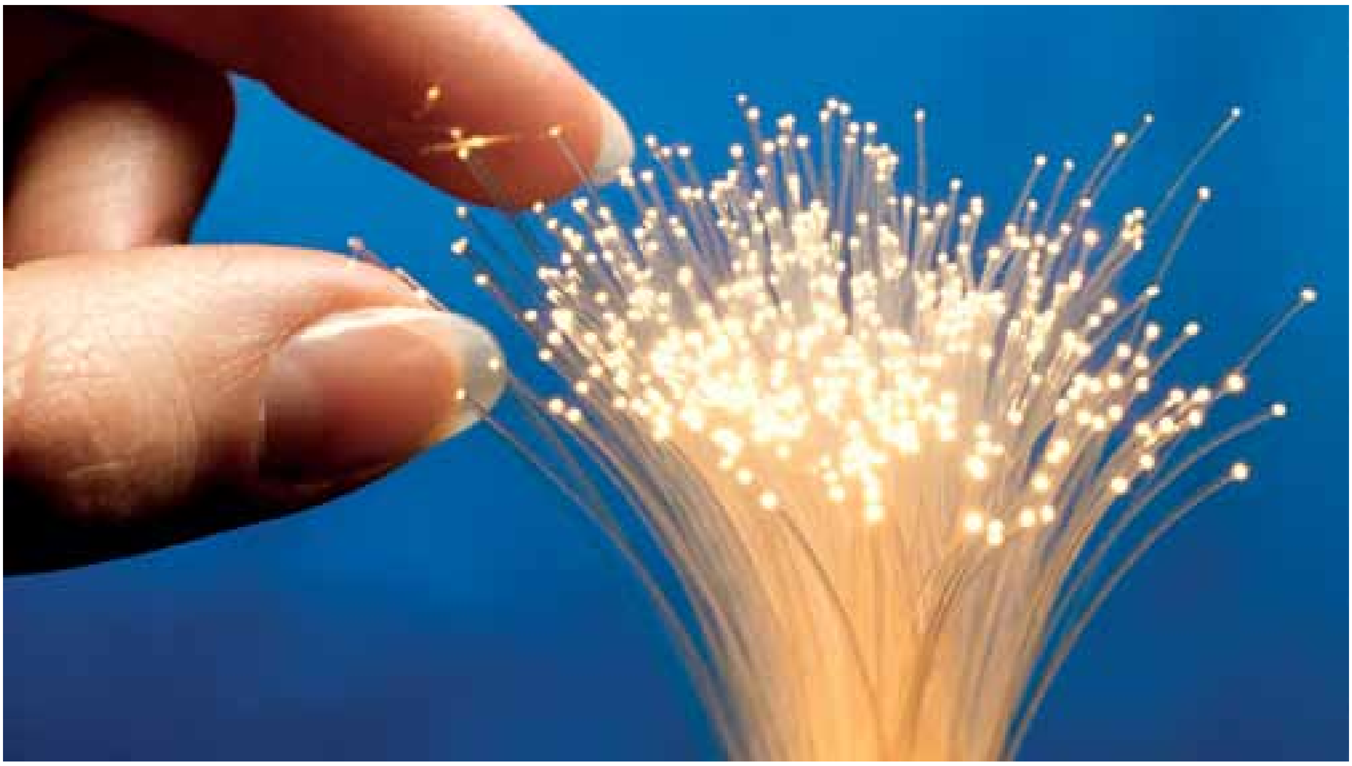
The initial aim of the REC system was to bring about a 17 TWh increase in annual electricity generation from renewable energy sources by 2016 compared to the 2002 level.

The basic principle behind the system is that producers are issued an REC by the Government for every MWh of renewable electricity generated. At the same time, electricity suppliers are obligated to purchase RECs for a certain quota/percentage of their total electricity sales and usage, a so-called quota obligation. The sale of RECs gives electricity producers an extra source of revenue aside from electricity sales, thereby improving the ability of renewable energy to compete with non-renewable sources. The energy sources entitled to allocation of RECs are wind power, certain hydropower, certain types of biofuel, solar energy, geothermal energy, wave energy and peat in CHP plants.

For 2011 the quota obligation was 0.179, or 17.9%. In 2010 the average REC cost for electricity consumers was SEK 0.063 per kWh.

EXEMPTIONS

Free power (agreement between a property owner and an electricity producer in which the former grants the use of its riparian rights in exchange for electric power from the electricity producer) and electricity used as auxiliary power in electric power generation are exempted from the quota obligation, as are the transmission losses that are required to maintain transmission network function.



Electricity-intensive industries are exempted from the quota obligation for electricity used in manufacturing processes, but not for their other electricity usage.

With effect from 1 January 2009, a company is defined as electricity-intensive if it conducts and has during the past three years conducted industrial manufacturing in a process that uses an average of at least 190 MWh of electricity for every SEK 1 million of the total sales value of the electricity-intensive industry's production, or conducts new operations with industrial manufacturing in a process that uses an average of at least 190 MWh of electricity for every SEK 1 million of the total sales value of the electricity-intensive industry's production, or conducts operations for which a deduction is permitted for tax on electric power in accordance with Chapter 11, 9 §, 2, 3 or 5 of the Act on Excise Duties on Energy (1994:1776).

EXTENSION OF THE REC SYSTEM AND NEW TARGET

On 10 March 2010 the Swedish Government presented a bill calling for further development of the renewable energy certificate system. The REC system has been extended until the end of 2035 and the new target for production of renewable electricity has been raised by 25 TWh by 2020 compared to the level in 2002. The quota obligation will be calculated according to new quotas that apply as of 2013. The amendments are effective as of 1 July 2010. So far the system is estimated to have resulted in the addition of around 13 TWh in renewable electricity production.

JOINT REC MARKET WITH NORWAY

On 7 September 2009 Swedish Minister for Enterprise and Energy, Maud Olofsson met with her Norwegian colleague Terje Riis-Johansen and agreed to aim for the establishment of a common REC market as of 1 January 2012, a market that should be technology-neutral. Norway intends to adopt an equally ambitious commitment as Sweden. The transmission connections that have already been agreed on between the Nordic TSOs will be implemented as quickly as is feasible.

On 8 December 2010 the establishment of a common REC market was secured through the signing of a joint protocol by the two ministers. The level of ambition in the common system is to build 26.4 TWh of new renewable electricity production between 1 January 2012 and 2020. On 29 June 2011, Maud Olofsson and the Norwegian Minister of Petroleum and Energy Ola Borten Moe signed a binding agreement for a joint Swedish-Norwegian REC market.

The Norwegian-Swedish REC system was introduced on 1 January 2012. This is the EU's first example of use of the cooperation mechanisms provided for in the Renewable Energy Directive.

The Swedish Energy Agency has analyzed the consequences of a joint REC market with Norway and has come to the conclusion that the REC price will not be significantly affected in the long term. All in all, the addition of new generating capacity will be somewhat greater in Norway and will consist mainly of hydroelectric and wind power. Sweden's expansion of wind power is expected to be somewhat lower in the common system than under a solely Swedish system. New biomass power is expected to be added primarily in Sweden.

HYDROPOWER

In 2010 the Swedish Energy Agency proposed certain changes for REC qualification of hydropower plants. According to the proposal, only additional hydroelectric power production in a location where hydropower operations have been previously conducted are eligible for RECs.

EMISSIONS TRADING

The EU Emissions Trading Scheme (EU ETS) was launched on 1 January 2005. The goal of this trading is to enable countries and companies to choose between carrying out their own emission- reducing measures or buying emission allowances which then generate emission reductions somewhere else. The idea is for the least expensive measures to be taken first, thus keeping the total cost of meeting Kyoto targets as low as possible.

The scheme started with a trial phase, Phase I, between 2005 and 2007. The second trading period, Phase II, runs between 2008 and 2012 and is concurrent with the Kyoto Protocol's commitment period.

At present the system covers electricity and heating generation and energy-intensive industries. As of 2012, the aviation industry is also included in the EU ETS.

In December 2008 the EU Parliament and the Council of Ministers agreed on a revised EU ETS Directive to apply for the 2013–2020 budget period. A total emissions cap equal to a 10% decrease in emissions has been set for the period between 2005 and 2020. Furthermore, emission allowances in the power sector will be awarded through auctioning, with certain exceptions, in contrast to the current free-of-charge allocation. In the industrial sector, emission allowances will be initially allocated free of charge but with a successive transition to auctioning.

In 2010 the European Commission approved a draft regulation on auctioning of emission allowances and started a procurement for an EU-wide auctioning platform. The EC has also adopted rules for free-of-charge allocation of emission allowances, which are based on a number of product targets. In addition, the EC has decided to ban the use of offsetting credits from specific CDM (Clean Development Mechanism) projects for the destruction of industrial gases HFC-23 and N_2O (nitrous oxide) in production of adipic acid within the EU ETS.

The process surrounding procurement of an auctioning platform continued in 2011. In addition, it was debated whether or not emissions allowances should be treated as financial instruments. This issue has not yet been resolved. Preparations for allocation of free allowances are moving forward and Sweden and several other member states have submitted their applications for the number of emissions allowances the Swedish installations should receive in accordance with the established rules. In 2011 the price of European allowances fell by around 45% compared to 2010. In January the price was just over EUR 14 per tonne but dropped to a record low of EUR 7 per tonne in mid-December. The recession was a key factor behind the low prices, which have sparked concerns that something must be done to keep up the price of emission allowances. As a result, discussions are underway on the potential to adjust the cap in the emissions trading system and to set aside a share of the allowances planned for auction on the market starting in 2013.

Electricity networks

The Swedish power system can be divided into three levels – local networks, regional networks and the national grid.

Most electricity users are connected to a local network, which in turn is connected to a regional network. The regional networks are then connected to the national grid. There are around 170 local distribution system operators (DSOs) in Sweden.

The networks owned by these DSOs vary considerably in size. The smallest has a line length of around 3 km, and the largest over 115,000 km.

The local networks are normally divided into low voltage (400/230 V) and high voltage networks (typically 10–20 kV). The total line length of Sweden's low voltage networks is over 306,000 km, of which 74,500 km consist of overhead lines and 231,500 km of underground cable. The local high voltage networks, also referred to as medium voltage networks, are made up of 93,000 km of overhead lines and 98,000 km of underground cable. Some 5.2 million electricity users are connected to the low voltage networks and 6,500 to the high voltage networks.

The regional grids are owned mainly by three DSOs and have a combined line length of around 33,000 km. The Swedish national grid is owned and operated by the public utility Svenska Kraftnät, and is made up primarily of 400 kV and 220 kV lines with a total length of around 15,000 km. In total, the Swedish electricity grid contains 545,000 km of power lines, including 329,500 km of underground cable. If the Swedish grid were stretched out in one long line, it would extend more than thirteen times around the earth.

Delivery reliability in the Swedish grid is 99.98% (see also under the next heading).

OPERATING EVENTS STATISTICS (DARWIN)

The statistics include the 114 DSOs that have provided complete material covering all of 2010 (the figures for 2011 are not yet available, *see Table 23*). These DSOs represent 93% of Sweden's 5.2 million electricity customers and are relatively evenly spread between urban and rural networks.

Total delivery reliability in 2010 was down slightly compared to 2009 and fell back to 99.98% (called "three nines" when comparing system reliability), which is good but not on par with the transmission and distribution industry's ambitions. However, it is still apparent that the major investments in weatherproofing of the grid have been effective, since the storms in 2011 caused fewer disruptions than they did ten years ago.

FIRST YEAR WITH FUNCTIONAL REQUIREMENT

1 January 2011 marked the effective date of the functional requirement for power distribution that was introduced into the Swedish Electricity Act in 2006 and states that no power outage may last for longer than 24 hours. The Energy Markets Inspectorate (EI) has also published regulations clarifying this requirement. Sweden's DSOs were ready to meet these stricter requirements after having launched a large-scale effort at the end of the 1990s to weatherproof power distribution – mainly by replacing the majority of sensitive power lines in forest terrain with underground cable. Of the approximately 57,000 km of power line that were regarded as the problem, an estimated 5,000 km now remain to be converted (*Diagram 41*). This has cost around SEK 40 billion. Both the functional requirement and the regulations correspond to the visions and planning targets that the DSOs were already working according to, so the requirements were not new to the industry. The first year of the functional requirement turned out to be a trial by fire for the distribution networks, since the country was hit by several severe storms that also affected areas not statistically shown to be vulnerable. As a result, these areas had been given lower priority and the weatherproofing measures had not yet been completed, with unfortunate consequences for the customers.

REGULATION OF TARIFFS FOR 2010

The Energy Markets Inspectorate (EI) has chosen 48 local DSOs for further regulation of revenues for 2010. In addition, the revenue levels of all regional DSOs will be subject to continued regulation. In 2012 the EI will review revenue levels for 2011. Once the EI's reasonability assessment of tariffs for 2011 has been completed, the EI will carry out an overall evaluation of the results for the years from 2008 to 2011 for the DSOs that have been given notice of further regulation. The EI will then assess the need for adjustment of network tariffs.

PROACTIVE FORUM

Swedenergy has organized a forum in which experiences from the meter reform have been discussed and used as a platform for creating a forward-looking vision. Information materials describing the electricity meters of the future have been produced based on questions such as the requirements for smart electricity meters, which data flows are logical, how to achieve a cost-effective system and what exactly constitutes customer benefit. The so-called Proactive Forum for Electricity Meters, consisting of representatives from both the energy industry and manufacturers, has presented a first draft of its vision within Nordenergi and a position paper is in the works.

TABLE 23

KEY STATISTICS FOR OPERATING INTERRUPTIONS IN LOCAL NETWORKS WITH A DURATION OF MORE THAN 3 MINUTES IN 2010

2010 Own networks	INDEX: SAIFI System Average Interruption Frequency Index no./year	SAIDI System Average Interruption Duration Index min./year	CAIDI Customer Average Interruption Duration Index min./year	ASAI Average Service Availability Index %	Total no. of interruptions	Total no. of customers affected
24 kV	0.35	20.19	58.04	99.99	4,873	1,671,580
12 kV	0.70	49.38	70.40	99.99	14,687	3,370,446
<10 kV	0.01	0.20	28.04	1.00	55	34,568
0.4 kV	0.05	6.70	147.86	99.99	34,604	227,342
Total	**1.10**	**76.78**	**69.55**	**99.98**	**54,219**	**5,303,936**
All networks	**1.42**	**86.81**	**61.35**	**99.98**	**58,455**	**6,798,848**

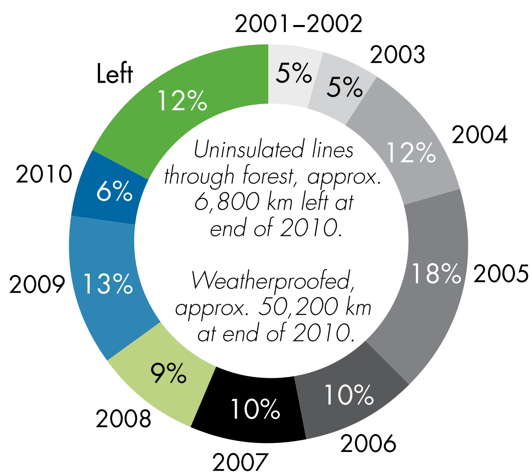
Source: Swedenergy

RANDOM INSPECTIONS

With the introduction of the regulations and general guidelines in STAFS 2010:14, SWEDAC (The Swedish Board for Accreditation and Conformity Assessment) is for the first time collecting fees to regulate conformity assessment of electricity meters in category 1. During the year, Swedenergy intensified its communication with the DSOs about the national random inspections and the response has been very positive. In 2012, as a first step, SWEDAC intends to conduct a survey to see how the industry is handling its quality control and, as a second step, the agency plans to make on-site visits.

DIAGRAM 41

RATE OF WEATHERPROOFING IN THE SWEDISH DISTRIBUTION GRID, 2001–2010



Source: Swedenergy

OPERATIONS

2011

SVENSK energi

Despite a few storm clouds – Sweden is recharging!

Storm clouds for the industry have gathered over Brussels and Strassbourg with the arrival of the Energy Efficiency Directive at the European level, where we won't know the outcome until this summer – at the earliest.

THE EUROPEAN PARLIAMENT'S ITRE Committee, which deals with issues related to industry, research and energy, has by a wide majority approved a proposal that includes national ceilings for primary energy usage. In a worst case, this would mean a reduction of 167 TWh by the year 2020 for Sweden (page 10 of 2011/0172 COD).

This is complete absurdity that would have devastating effects on the industry and hinder economic growth. The Committee has not carried out any impact assessment – neither for Europe as a whole nor for the individual countries. In the spring and early summer, attempts have been made to reach agreement between the European Commission, the European Parliament and the Council of Ministers – where the decision will ultimately be made.

A UNITED VOICE INCREASINGLY IMPORTANT

This clearly illustrates the forces in society that we must be able to cope with as an industry. Sometimes the issues are significantly closer to home – and have foreseeable consequences. But it underlines the importance of maintaining solidarity in the industry. A strong and united voice is what the industry needs, and what government authorities and politicians want to hear. If our message is too diffuse and individual players pursue their interests separately, we lose focus. And the policymakers do exactly what they had planned to do from the start.

During the spring's regional meetings I have presented all of the activities that are underway. This includes some 30 different issues, all of which are vital. I have also had the pleasure of initiating a close dialogue in which we have met with the members on their own home turf. It has been an effective way to measure the temperature of the industry. The emphasis has varied depending on whether it has been a small, mid-sized or large organization. For me, it has confirmed that the majority are fully focused on their day-to-day activities and don't have time to concentrate on the ten or so issues that are currently being discussed at the European level or among the Swedish authorities and Government. Once again; this underlines the importance of having an association to take this responsibility.

As usual, we experienced a fair share of drama in 2011 when we went from extremely dry conditions at the beginning of 2011 to an extremely wet year. In addition, renewed availability problems in the nuclear power plants further undermined confidence in the industry. Despite this, we have reason for optimism ahead of the coming winters. The current reservoir levels are high and the nuclear power problems are most likely behind us.

BIDDING AREAS AND EX ANTE REGULATION

Swedenergy's work during the year was marked by two major issues:

- The introduction of electricity bidding areas on 1 November 2011. Experiences from the bidding areas clearly show – and confirm Swedenergy's longstanding message – that new electricity production must be built in area 4, in the far south of the country, to eliminate the impact of bidding areas on electricity customers. It is equally important that the transmission networks are reinforced. In both cases, it is crucial to speed up the permitting process.
- Preparations for a new regulatory model in the distribution area. The new ex ante regulation went into force on 1 January 2012. The Energy Markets Inspectorate (EI) has set revenue caps for all DSOs for a four-year period; of which the first period runs from 2012 to 2015. As the last country in the EU, Sweden took the step from reviewing the reasonability of transmission tariffs retroactively to assessing price levels in advance.

The EI's decision on revenue caps for the DSOs for the period 2012–2015 was an unpleasant surprise. At a late stage, the EI changed its basis for calculation with a risk for catastrophic consequences for many of the member companies. In a situation where the focus is on realizing smart grids, developing smart electricity meters, etc., the revenue caps do not provide scope for this. Instead, we have seen powerful concern among the members about the effects of these investments. And 86 member companies have filed appeals. We are in for a new spate of legal disputes – and most likely continued badwill for the industry, which is regrettable.

TEENAGERS: "ENERGY IS AN INDUSTRY OF THE FUTURE"

On the bright side, we have noted that teenagers see us as an exciting industry for the future. In the Youth Barometer survey of 11,000 young adults, the energy industry was ranked in a shared third place with some 40 others industries. This is an excellent starting point, although it doesn't mean that all of the respondents want to pursue a career with us. In the next five years we will need 8,000 engineers and technicians with energy or electric power expertise – a major challenge!

To improve public attitudes to electricity, last autumn we started a multi-year project called "Recharge Sweden". We have broad-based agreement on the need to join forces in different ways to create change. The project has identified two journeys that must be made when it comes to electricity's image as a product. We will go from "expensive" to "fairly priced" and from "threat" till "hero". Electricity should be seen as fairly priced hero that contributes to meeting customer needs.

We have no problem rolling up our sleeves and tackling the important tasks that face us. We are ready to gather our forces and "Recharge Sweden!"

KJELL JANSSON,
MANAGING DIRECTOR, SWEDENERGY

Swedish-Norwegian market for energy certificates finally launched: "A role model for Europe"

The joint Swedish-Norwegian market for renewable energy certificates (RECs) was launched on 1 January 2012 following at least three years of negotiations and preparations. For Swedenergy, this has been an urgent goal to realize. "A larger market is more efficient," says Cecilia Kellberg, who is responsible for REC issues at Swedenergy.

IT IS STILL TOO EARLY to see the full effects of this outcome, but a crucial step was taken at year-end 2011. Cecilia Kellberg stresses the importance of RECs in stimulating cost-effective growth in renewable electricity production:

"Earlier, there was support for renewable electricity production directly from the state budget. When the system was handed over to the market players, this led to the creation of stable ground rules. It also resulted in direct competition between different renewable energy sources, which over the years has mainly involved wind energy and bioenergy. Looking back, we can see that the Swedish system has so far contributed to 11 TWh of new electricity production. And the RECs have naturally been a vital enabler for the rapid expansion of wind power."

One key aspect of the RECs is that they are technology-neutral, which means that they always promote investment in the least expensive production source.

Sweden has had a longstanding ambition to export the system to additional countries other than Norway. Cecilia adds:

"Experience from the various support systems throughout Europe shows disadvantages of tying these supports to the respective national budgets. In times of crisis, there has been a tendency to reduce or simply abolish the support. This is a compelling argument for promoting a system that is market-linked."

On behalf of Swedenergy, Cecilia Kellberg has served as the contact in discussions with Energy Norway. She is satisfied with the spirit of unity around the goal of realizing a joint market. This new market has come about through a political agreement between the energy ministers in Sweden and Norway. She says that is will be exciting to see what happens when the energy certificates "go live".

The agreement between the two governments sets the target for ongoing expansion of renewable electricity production at 26.4 TWh during the period from 2012 to 2020. In a study, the Swedish Energy Agency has determined that Norway will most likely account for a somewhat higher share of the new generating capacity, which will consist mainly of Norwegian hydropower but also wind power. In Sweden, the new capacity will consist of wind power and bio-based power. On this topic Cecilia says:

"Swedenergy has not made its own assessment of the details. The market players themselves determine where the investments end up and in which power type. The Norwegian-Swedish model contains no mechanisms to control which country the investments are made in, and virtually no steering of which power type is built. That's the whole point."

This will lead to a significant addition of electricity by the year 2020 as Sweden and Norway increase their power production capacity by around 10%. Where will this new power go? Cecilia Kellberg sums it up:

"It is vital that the transmission system is expanded over the next few years so that by 2020 we have such a free flow that the new electricity production can be supplied to customers both in the Nordic region and on the continent."

Bidding areas and Swedenergy: "Handling the communication was natural for us"

On 1 November 2011, Svenska Kraftnät (the Swedish transmission system operator) divided Sweden into four electricity bidding areas, making it possible to have different area prices in Sweden for the first time.

MAGNUS THORSTENSSON, who has worked in this area at Swedenergy, provides a fast rundown on the division of roles in this process:

"The Swedish Government commissioned the national grid owner Svenska Kraftnät to introduce electricity bidding areas. Svenska Kraftnät decided to divide the country into four areas. The effective date for the changeover was determined by the European Commission."

What was Swedenergy's role in this process, Magnus?

"When Svenska Kraftnät made its decision to introduce bidding areas, Swedenergy played an active role in communicating with the public and the media. There was no reason to resist, it was better to ensure smooth and efficient implementation of the change."

During the year, Swedenergy's position on bidding areas was questioned. Newspapers in southern Sweden described Swedenergy as "wholly positive" to the division, which means that electricity prices are periodically higher in the south of the country. Magnus Thorstensson comments:

"Swedenergy has had the same position since the reactors in Barsebäck were shut down in 1999 and 2005. We have continuously underlined the importance of reinforcing transmission capacity, which would eliminate the need for bidding areas. And if the bidding areas were to be realized, advance planning would be needed in order to respect contracts already in force in the electricity market. At the same time, we also pointed out the wisdom of awaiting completion of the Southern Link between Hallsberg and Hörby that was decided already in 2004."

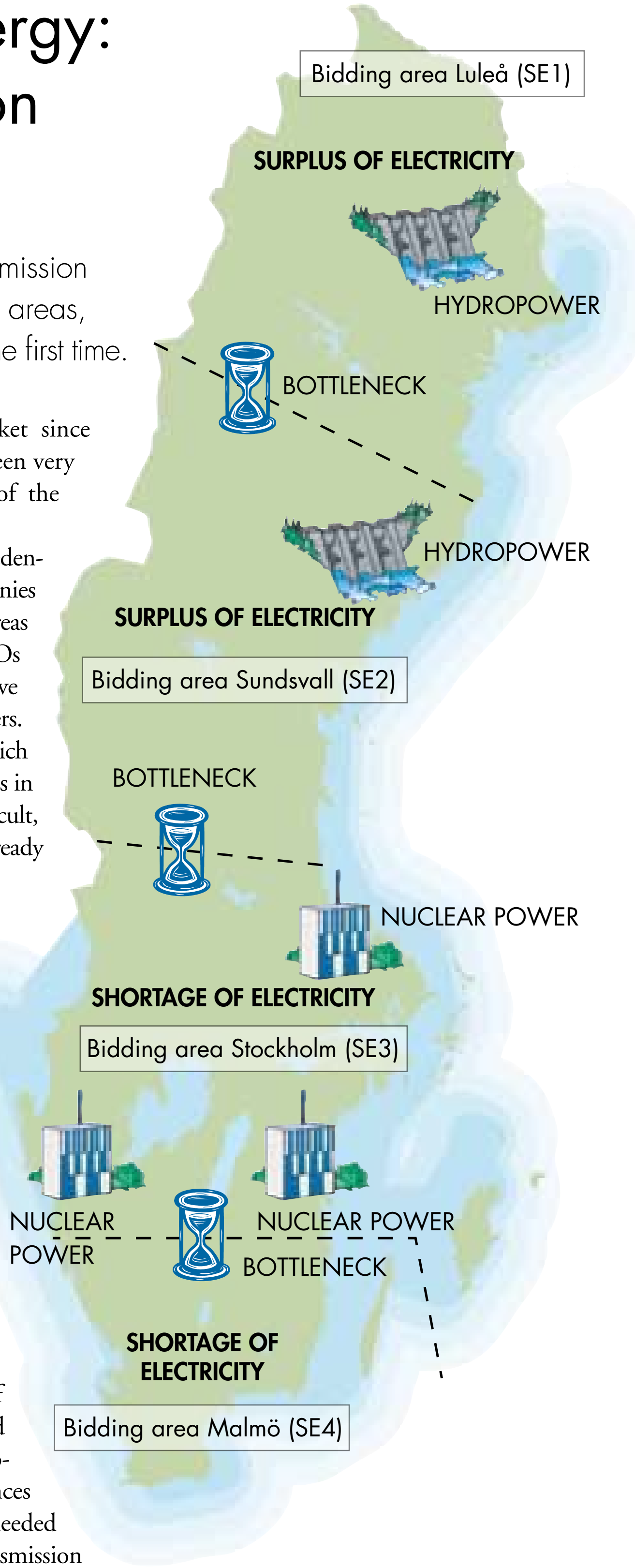
Magnus Thorstensson sees the introduction of bidding areas as the biggest change in the electricity market since deregulation. He himself has been very active in explaining the role of the bidding areas.

It has been natural for Swedenergy to assist the members companies in communicating the bidding areas to consumers, since it is the DSOs and electricity suppliers that have contact with electricity customers. Explaining bidding areas, which result in different electricity prices in different parts of Sweden, is difficult, particularly in a market that is already hard to understand.

"But remember that Swedenergy has always prioritized expansion of the grid over other methods, since this addresses the problem by making it physically possible to transmit electricity to southern Sweden."

Since the closure of Barsebäck, the existence of transmission bottlenecks has been known to industry insiders, but not to customers or decision-makers. The introduction of bidding areas has also alerted these target groups to the problem through the price differences that arise where measures are needed in the form of increased transmission capacity and investments in power production. However, the common denominator for both is the need to obtain permits to build within a reasonable timeframe.

This prompts Magnus Thorstensson to remind us of the industry's main message on this topic:



"It must be a top priority for Svenska Kraftnät to strengthen transmission capacity to southern Sweden. The permitting process must also be accelerated so that new power plants can be built in our southernmost bidding area 4, where there is a shortage of electricity."

Hourly metering to be required as of October 2012: "Customer benefit so much more than hourly values on their electricity bill"

In 2011, hourly metering for active electricity customers was a hot topic on the political agenda and therefore also for the entire power industry. Swedenergy feels that the underlying idea is positive – namely, to give customers clearer and more detailed information about their electricity usage in order to make more active choices.

HOWEVER, Swedenergy sees a danger that policy-makers are underrating the extent of changes needed in the electricity meters' peripheral systems. The costs for the changes among Sweden's DSOs have also been dramatically underestimated.

The latest meter reform was completed as recently as 2009, when all electricity meters in Swedish households were replaced at a total cost of up to SEK 15 billion for the DSOs. The change was made to ensure that all meters are capable of daily meter reading so that customers can be billed for their actual monthly usage, rather than an estimated usage that was adjusted on a yearly basis.

A mere two years after the last meter reform, it's time for the next step. Peter Silverhjärta, who is responsible for metering issues at Swedenergy, comments:

"The hourly metering proposal means that all installed meters must now record usage by the hour. The proposal presented by the Government at the end of the year claims that 90% of the existing meters are equipped for this – but that is simply not true. Many meters can't handle hourly metering at all, but the greatest concern is the need for modification of the peripheral systems that handle the reported data. And as far as I know, no one has analyzed the cost of this for DSOs."

Swedenergy is opposed to a rapid changeover since the introduction requires far more extensive and costly changes than anticipated by policy-makers. Already by 1 October 2012, the intention is for all interested customers to have access to hourly metering free of charge.

Swedenergy is in favour of the basic premise: that customers should have access to clearer information about their electricity usage as a basis for making more active choices. But the question is whether the solution now being legislated is sufficient for customers to see any actual benefits in the form of saved money.

"From the industry's perspective, the customer benefits are not on par with the necessary investments," says Peter Silverhjärta. "To bring about a tangible change in behaviour and create real customer benefits, we believe that much more is required than hourly meter values on the monthly electricity bill."

Swedenergy is working alongside the electrical material suppliers to promote this development through the "Proactive Forum". It should be possible to access usage data from the meter and visualize it in real time on the customer's computer or smart phone via apps. It is hoped that this will open up a new market for service suppliers where customers "own" their meter data and choose a supplier based on their individual needs.

According to Peter Silverhjärta, the real value of being able to monitor and control electricity usage will not become obvious until major changes take place. These changes can include a higher share of wind power, microgeneration of electricity via solar panels on single-family homes and perhaps, above all, charging of electric vehicles.

"At present, the difference in cost between doing a load of laundry at night instead of in the daytime is marginal and it is doubtful whether consumers will change their behaviour at the expense of convenience. But if they are going to charge their electric vehicle once a day, this will increase the total amount of electricity used and therefore also the potential savings."

In conclusion, Peter Silverhjärta points out the need to immediately start drafting the provisions resulting from the government bill, in order to further concretize the requirements and eliminate any remaining confusion.

"It is also crucial to take far-reaching consideration to the introduction of a Nordic end-user market. At this point it is still unclear which requirements will be placed on electricity metering from a joint Nordic perspective, and it would be a shame if Sweden's DSOs were forced to contend with a third meter reform in a short span of time."

Ambitious DSO initiative now completed: "But there is still much to be done"

Since the millennium shift, the Swedish DSOs have carried out a massive program to weatherproof the distribution system. Some 50,000 km of power lines have been converted and the former uninsulated lines are now a thing of the past. Most of the grid now consists of underground cable and the rest is insulated. All at a cost of around SEK 40 billion.

A SERIES OF WINTER STORMS in the 1990s led to higher demands on the industry to address these problems. The triggering factor was Hurricane Carola in the autumn of 1999, which led to a close dialogue between the Government and the industry. The industry's voluntary commitment to eliminating shortcomings in the grid has been called NÄTKIC (short for "Network Customers in Focus").

Matz Tapper, coordinator of Swedenergy's network unit, sums up an exciting course of events over the past decades. When asked how the industry could end up in this situation, he replies:

"In the 1960s, the modern Swedish distribution system was still under development and construction. In those days, it was standard practice to use uninsulated lines at all voltage levels. The autumn storms of 1969 had devastating consequences and were a first wake-up call that sparked a trend toward insulation of the low voltage network. Then we saw the emergence of the plastic-coated line known as ALUS. But it was still overhead line. No other option was even being discussed at that time.

"Eventually, this was followed by a corresponding insulation of the medium voltage network."

After this came coated lines (BL) of the BLX och BLL types. Much of the industry's development activities were focused on EBR (Rationalization of Electrical Construction). BLX and BLL were the most common weatherproofing methods until Hurricane Gudrun in 2005, when the technology was found to have certain weaknesses in connection with extensive storm felling of forest. After Gudrun, underground cable became the main alternative in intensified efforts to weatherproof sensitive power lines. This has contributed to higher delivery reliability – the foremost quality criterion that customers and the public associate with the industry. In recent years, delivery reliability in the Swedish grid has varied between 99.98% and 99.99%, where the differences are due to major disturbances from year to year.

Customer quality requirements have risen over the past 20–30 years. They used to accept the occasional outage, but not anymore.

Without a doubt, the NÄTKIC initiative has been successful in improving the industry's image. As part of NÄTKIC, the industry started its own voluntary organization for collaboration during outages – which has been active during hurricanes like Gudrun, Per and Dagmar. A collaboration was forged with Swedish Radio and today it is standard practice for local radio stations nationwide to provide continuous information about outages. Voluntary outage compensation – which was later made statutory – and an in-depth cooperation with the Federation of Swedish Farmers (LRF) and local associations were other central pillars of the initiative.

Hurricane Gudrun in January 2005 was the starting shot for a whole new and stricter regulatory framework covering all aspects of power distribution operations. Matz Tapper comments:

"Now there is a complete set of rules. A few examples of this are annual risk and sensitivity analyses with related action plans, the Swedish Electricity Act's functional requirement for a maximum outage time of 24 hours which has been supplemented with special provisions, outage reporting down to the customer level, and much more.

"Despite everything, the events of 2011 show that there is still more to be done. The DSOs are still striving to realize their vision of 100% delivery reliability and ambition to reduce the risk for outages. However, there is an obvious risk that the recently launched regulation model for revenue will throw a spanner in the works by initially limiting return on new facilities to under 2%."

Hydropower an important success story: "But don't take it all for granted"

We need increased knowledge about hydropower as such, and thereby greater acceptance for the function and roles of hydropower. Solar, wind and hydroelectric power are often favoured by the public. But the role of hydropower is far from self-evident today, according to Gun Åhrling-Rundström, who is responsible for hydropower at Swedenergy.

FOR GUN ÅHRLING-RUNDSTRÖM, it is imperative to find an opening into the political sphere so that hydropower is fully valued and appreciated for its many advantages. She says:

"The average person today typically has a positive attitude towards hydropower. There is an insight and awareness that much of our prosperity as a society is intimately linked to the emergence of hydropower. And hydropower has many ambassadors. Even so, hydropower – for those who follow the debate pages and blogs – is often portrayed as an environmental threat by special interest groups. This kind of thinking is also seen among certain politicians."

Gun Åhrling-Rundström has been devoted to hydropower issues for the past 25 years and sees it as one of the most exciting areas of the industry. From her perspective, hydropower power is a success story that should be further highlighted in these times of growing concern about the consequences of climate change. Gun adds:

"Hydropower is taken for granted by many people outside the industry. We – and by that I mean all of us – need to be better at advancing the position of hydropower and more clearly communicating what is actually being done."

Hydropower makes up the base of the Swedish and Nordic power system. Hydropower can be quickly and easily regulated – which is an increasingly important consideration – since one major challenge for the years ahead is to ensure adequate regulation capacity to offset fluctuations in intermittent power sources such as wind energy. It is also vital to respond to rapid changes in electricity usage. All in all, this places hydropower in a class of its own.

In addition, Gun Åhrling-Rundström points out Swedish and Nordic hydropower capacity as a resource for Europe:

"In pace with a more cohesive Europe, people are increasingly looking at the opportunities to evaluate our combined resources. Here, the Nordic hydropower has a growing strategic role."

The major era of expansion for Swedish hydropower took place during the 1940–1970s. Since then, certain upgrades have been and are still being carried out. Looking ahead, Gun feels that there is still much to be done in developing the existing facilities. In this context, she says:

"The hydropower companies have taken, and are taking, major initiatives in the environmental area. The debate is largely focused on a contention that nothing is being done. And this is far from true. In the future, I would like to see all of the power plant owners making an effort to actively inform the media and local residents about the significant environmental efforts that are being made. In this respect, there may be room for some self-critique."

In Gun's words, the greatest environmental benefits of hydropower are that it is virtually emission-free and creates no additional climate impact – despite the fact that it supplies half of our electricity requirement:

"With a growing focus on climate change, the role of hydropower must be underlined from a holistic perspective and its potential must be emphasized. This is best achieved in a constructive dialogue with other stakeholders in society."

Convoluted path towards a common Nordic end-user market: "The electricity supplier will be the customer's main point of contact"

The electricity supplier will be the electricity customers' main point of contact when acting in the electricity market, for example when switching suppliers or moving. At the same time, the DSO will take care of aspects related to the customer's physical connection to the network, including metering, delivery quality and outages. This is the main implication of the ongoing efforts to realize a common Nordic end-user market according to the ambitions of the Nordic energy ministers.

NORDREG, consisting of the Energy Markets Inspectorate and its Nordic counterparts, has conducted an inquiry on behalf of the respective governments. Already at an early stage, it was clear that things were headed in this direction. The model, which has been strongly supported by the past two Swedish energy ministers, is known in the industry as a "Supplier Centric Model".

Gunilla Stawström, who is responsible for this area at Swedenergy, says:

"The question of a future Nordic end-user market is a political goal that is based on the EU vision for free movement of goods and services. The underlying initiative has thus come from outside the power industry itself."

Another important task for NordREG is the choice of billing regime. At the end of the year a decision was made to move forward with mandatory combined billing for both electricity supply and network services, and that the bill will be sent by the electricity supplier. Stawström explains:

"This probably means that customer service will be handled by the electricity supplier as far as possible – to a significantly greater extent than if voluntary combined billing had been chosen."

The past year's efforts in this area have not been easy for Swedenergy. The member companies have been and remain divisive on this issue, and it has been difficult to reach consensus. However, in the autumn the board of Swedenergy chose to accept a transition to NordREG's proposed market model. Gunilla says:

"NordREG has won strong support for its position from the Nordic departments of energy. On several occasions, our Swedish energy minister Anna-Karin Hatt has been explicit in advocating NordREG's proposal. During the autumn it has been clear that NordREG has given no consideration whatsoever to thoughts and ideas which it has not regarded as constructive and in line with its mission."

"Against this background, stakeholders have found the only viable option to accept the proposed market model in order to take part in influencing future developments and thereby make the best of the situation."

The trend in the rest of the EU is also moving toward a model where the electricity supplier is the main point of contact for electricity customers and the party responsible for billing.

Distribution regulation leads to new legal carousel: "It's creating an undesired negative spiral!"

As the last country in Europe, Sweden made the transition to ex ante regulation of DSO tariffs as of 2012. After four years of preparations in close dialogue between the Energy Markets Inspectorate (EI) and the power industry, the changeover gave rise to new discord at a late stage. When the EI announced its decision on revenue caps for the period 2012–2015, it also introduced an unanticipated transitional rule preventing the DSOs from fully utilizing the requested revenue caps until 2024.

ANDERS PETTERSSON, responsible for regulation issues in Swedenergy's transmission unit, says:

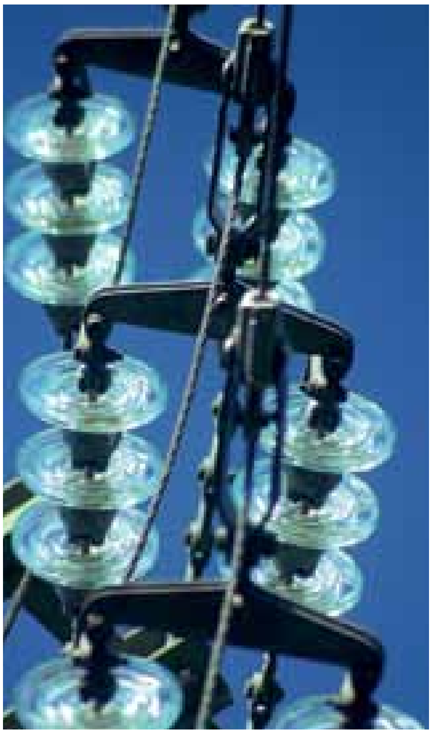
"It's regrettable that this will set off a new legal carousel that could continue for many years. This was a serious shortcoming in the earlier system and all of the involved parties were eager to find a good and functioning regulation model that would not have to be settled in court. Everyone agreed on that.

"We now find ourselves in a situation where 86 of the DSOs have chosen to take their cases to court as a logical consequence of the EI's late changes to the model. With the current model and its application, the DSOs will not even reach the return level of 5.2% that has been determined reasonable by the EI, which the DSO's already considered too low. And this will have a serious impact on investment spending."

Much of the debate on transmission issues in recent years has been marked by the emergence of smart grids, which will make it possible for customers to become more active. Among other things, this will require the development of smart meters. Expansion of the network system is also critical in order to handle all of the new renewable power production, and not least to ensure the quality of electric power deliveries.

Anders Pettersson sees a risk that this will more or less put a brake on the desired progress:

"Power distribution is an industry that relies on viable ground rules. With an annual turnover of SEK 40 billion, the players in the industry must be given a reasonable planning horizon. Power distribution operations obviously require regulation, since they are a natural monopoly, and this regulation must take into account the interests of both the companies and their customers. However, we have already seen examples of negative effects such as announced staff reductions and reassessment of planned investments, which shows that the EI's decision hasn't given sufficient consideration to the DSOs' need to invest in and develop the grids. At the moment, there are probably several boards of directors that are thinking about the future and wondering whether there is any point in owning distribution networks at all.



"There is risk that we will see a negative spiral of falling investments that leads to more outages, lower stability in the network system and a generally negative trend that no one wants."

Anders Pettersson feels that the following equation clearly demonstrates the dilemma caused by the effects of the new distribution regulation:

"The political forces seem to be in favour of hourly metering for all electricity customers. Most likely, all electricity customers who want hourly metering will have access to this service free of charge already during 2012. But this calls for immediate and large investments in new electricity meters and systems for collection of meter data, as well as systems to handle the increased flow of meter data. Under the EI's regulation model, this will be a losing venture for the affected DSOs.

"For the first three regulation periods (2012–2023), the EI's regulation model is based on the configuration of the distribution grid between 2006 and 2009. But the regulation should be steered entirely on the basis of the current and future transmission system, and not, as in the EI's model, only to a certain extent. This discourages investments, which is easily illustrated by the fact than an investment of SEK 100,000 in electricity meters in 2012 will generate a return of only SEK 67,000. Simple math is enough to show the absurdity of this!"

In the past year, intensive efforts have been made to prepare for the new regulation model. All DSOs submitted their requests for the period 2012–2015 to the EI in March. The EI's decisions were announced at the end of October and were greeted with justifiable dismay.

New steps taken in educational and publishing activities: "Our ambition is to make things easier for our users"

The development of digital services and technical upgrading of publishing activities have been in focus for several years at Swedenergy. In 2011 we took a big step forward in making things easier for our member companies.

TOTAL FACELIFT FOR THE MEDIA MONITORING SERVICE "ENERGI I MEDIA" AND EBR-E. The new webshop offering Swedenergy's entire range of published materials went online directly after the summer. It is now easier to find EBR, the DSOs' and service companies' most important tool for cost savings and efficiency optimization.

EBR-e (EBR's total online publications) have been upgraded and given a new structure, a more modern layout and improved searchability. At the same time, the service has been incorporated into Swedenergy's web structure so that users can now log into the service when logging in to the rest of the website.

"Our ambition is to provide greater ease of use. One such step is that the visitors only need to log in once to access all of the services on Swedenergy's site. This is a goal we met during 2011," says Marie Wiklund, head of publishing activities at Swedenergy, and continues:

"At the same time, we have significantly increased the number of licensees for EBR-e. There are even companies that have given all of their electrical technicians and linemen access to EBR-e. This trend is extremely encouraging and we hope that more companies will follow their example."

INDUSTRY MAGAZINES

ERA magazine was published in ten issues during 2011. In the past year, a collaboration was started with Swedish Wind Energy through four issues with special coverage of wind power in a supplement called Wind. The verified circulation for ERA in 2011 was 12,400 copies.

Tidningen EL, which reaches the end-users, was published in three issues and reached an annual circulation of nearly one million copies.

WIDE OFFERING OF COURSES AND CONFERENCES

In 2011 Swedenergy held 241 courses and conferences with close to 5,000 participants. This translates into 7,658 training days divided among the industry's approximately 20,000 employees.

Close to half of the courses were held locally and regionally, while the rest were carried out in Stockholm. 112 courses were held internally within specific companies and 129 were offered as open events.

Two examples of courses that attracted many participants were the basic course for building environment coordinators that was carried out on 17 occasions for 250 participants, and ESA in Practical Application, which was held on 17 occasions and attended by 220 participants.

In November Swedenergy hosted EBR Pole Days, a new conference that attracted over 80 participants. For two days, the participants gathered with 18 exhibitors in Åsbro to explore the pros and cons of both current and future utility poles. The possible future ban on creosote, problems with damage on new wood poles and selection of alternatives to wood poles have placed pole-related issues high on the agenda of both the electric power and telecom industries.

"This is a type of event that we intend to continue working with," says Annika Liljedahl, who is responsible for education and training activities at Swedenergy. "When we become aware of technological and product innovations that can benefit our members, we gather new findings to put together a program and sometimes also an exhibition."

Annika Liljedahl ends on a happy note: "The professional arenas that were arranged in the past year aroused powerful interest and in many cases, attracted a higher number of participants than before. This is naturally very satisfying for us!"

Up to 8,000 new engineers and technicians by 2016: "Now we know where to set the bar"

Securing the industry's future recruitment needs is a massive challenge that demands both commitment and cooperation. At least 7,000 – and most likely up to 8,000 – engineers and technicians with energy and electric power competence over the next five years is a need that the current educational system is not capable of meeting.

ACCORDING TO Sofia Sekund, who is responsible for industry recruitment issues at Swedenergy, this makes the challenge even greater. She says:

"These were the findings of our labour market analysis from the autumn of 2011. The survey also includes companies other than our own members, such as subcontractors, major engineering companies and large consulting companies, all of which are competing for the same expertise. That's what makes this knowledge so valuable. Now we know where to set the bar.

"The Swedish Association of Graduate Engineers estimates the industry's need of each year's degree earners at 10% of all MScs in engineering, 30% of all BScs in engineering and 15% of other graduates. And we know that not all future engineers are studying energy or electric power."

Commitment and cooperation are two key aspects of Sofia Sekund's challenge for the year ahead. The ongoing buildup of regional networks in the industry is a critical strategic step. It is a difficult equation to solve and will require the help of everyone involved.

She sees Swedenergy's role as the central engine in a larger machine. Swedenergy has an excellent and extensive platform of basic facts – both new films and effective information materials – available for use by the member companies.

Despite everything, Sofia Sekund feels that the industry has good prospects for success:

"Public opinion is shifting in favour of the industry, at least among young people. In the annual Youth Barometer survey, we came in fourth place when 11,000 young people ranked industries of the future. As earlier, the focus is on the environmental aspects and it seems that young people see us as a key player in solving environmental problems.

"Our challenge is to convert this interest in the industry as a force for social change into an interest in working for the industry. We have a little way left to go in this respect, since the connection is not obvious as things stand today. It is time for us to deliver and talk seriously about why we should be the industry of choice for young people.

"In the future," says Sofia Sekund, "we will focus on matching between the supply of and demand for labour. The goal is for the educational system to deliver the right number of people with the right competence at the right time."

One central part of this process is the start of a new BSc program in electric power engineering in northern Sweden. The program is the result of a collaboration between 13 member companies with special interests in the north and Sweden's three northernmost universities as well as Swedenergy. The high number of applicants to the program indicates that the tide has turned when it comes to interest in pursuing a technical education.

An active approach to EU issues increasingly important: "Clearer priorities lead to better results for our members"

The decisions made by the EU are of major significance not only for Swedenergy's members, but for the entire energy market and society in general. Swedenergy is working actively to analyze the consequences of current issues and decisions at the EU level on the power industry, the member companies and their customers, but also for society and the environment.

"2011 WAS A YEAR OF CHANGES IN THE EU," comments Helena Wänlund, Swedenergy's EU coordinator. Several major economies were hard hit by financial crises and the catastrophe in Fukushima, leading to Germany's decision to close all its nuclear reactors, has increased the focus on a secure supply of energy.

At the end of 2010 the European Commission adopted its "strategy for competitive, sustainable and secure energy", and the subsequent activities have shaped energy issues in 2011. The strategy is concentrated among other things on achieving a more energy-efficient Europe and empowering consumers. Another priority is to build an integrated pan-European energy market.

"A more integrated energy market is vital not least in meeting to goal to dramatically expand renewable electricity production. If electricity can be more easily transmitted between the member states, this will also increase the potential to regulate and balance weather-dependent electricity production. This is one of the areas covered by the EU's network codes," says Helena Wänlund.

The process of drafting network codes was started in 2011. In Swedenergy's opinion, it is urgent that the Swedish power industry involves itself in this effort. It is crucial that the codes are no more exhaustive and detailed than necessary to address cross-border network issues.

Another top issue in 2011 was the proposal for a new Energy Efficiency Directive, as part of the well known 2020 target. Swedenergy has continued to play an active role in proposing changes in the directive and analyzing the possible consequences.

"The new Energy Efficiency Directive will be a prominent issue in 2012. From Swedenergy's standpoint, the most important thing is to avoid decisions that look good on the surface but in reality defeat their own purpose. One such example is a demand to save electricity when electricity is in fact an efficient energy-bearer that can be utilized more, for example as vehicle fuel. Ensuring that our proposed changes to the directive enter the decision-making processes at the right stage relies on regular contact, above all with the Swedish negotiators."

Electricity and energy issues are standing items on the political and media agenda, and as electricity users the public is affected by these decisions. The Swedish and Norwegian power industries are influential voices in calling attention to the local perspective at the EU level. In this context, Swedenergy's cooperation with its Nordic counterparts is crucial, as is that with Eurelectric (the pan-European electricity industry association) and Geode (association of European independent electricity and gas distributors). For the past few years Swedenergy also has an office in Brussels.

"Our presence in Brussels is essential so that we can monitor issues and network with other stakeholders on site. But a great deal can also be accomplished from the secretariat in Stockholm. Among other things, we now have a greater emphasis on coordinating all of the issues we handle, since we believe that we can achieve better results for our members by more clearly prioritizing which areas to work actively with," adds Helena Wänlund.

In 2012 EU energy policy will continue working towards the inner market for electricity, which will be achieved by 2014. There will also be a sustained focus on the 2020 targets and the climate roadmap to 2050. Another central issue is to achieve more harmonized rules in line with the steps being taken in the Nordic end-user market.

"Swedenergy is continuing its intensive efforts to analyze the consequences of proposals and identify both opportunities and risks arising from future decisions. In addition, we serve as the united voice of the Swedish power industry in Europe," concludes Helena Wänlund.

Board of Directors

Secretariat Management

(at 31 December 2011)

Board of Directors

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Jämtkraft

Anders Olsson,
First Vice Chariman,
E.ON

Anna Karlsson,
Second Vice Chariman,
Kalmar Energi

Pia Brühl Hjort,
Göteborg Energi Nät

Joacim Cederwall,
Gislaved Energi

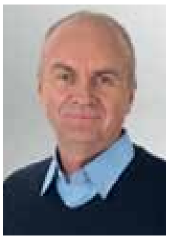
Roger Johansson,
Uddevalla Energi

Anders Jonsson,
Tekniska Verken i
Linköping

Alfons Kubulenso,
Sandviken Energi

Per Langer,
Fortum

Jan Samuelsson,
Lunds Energikoncernen



Göran Sörell,
Sundsvall Elnät

Inger Wadström,
Närkes Kils Elektriska
förening

Torbjörn Wahlborg,
Vattenfall

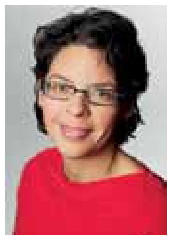
Inger Abrahamson,
SACO (The Swedish Confederation of Professional Associations)/ Sveriges Ingenjörer (The Swedish Association of Graduate Engineers), employee representative

Folke Sjöbohm,
Unionen (Union for White-Collar Workers in the Private Sector), employee representative (replacement for Inger Abrahamson

Secretariat Management

Kjell Jansson,
Managing Director

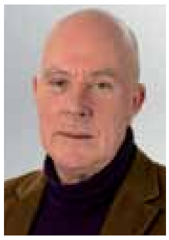
Bosse Andersson,
Production



Karima Björk,
(on leave of absence),
Trading & Sales

Eva Elfgren,
Competence &
Publishing

Catharina Götbrant,
Administration



Kalle Karlsson,
Communication

Christer Larsson,
Accounting & Finance

Anders Richert,
Distribution, Trading
& Sales

Maria Wärnberg,
Central Staff,
passed away
at beginning of 2012

Regional Managers

Mats Andersson,
Region North

Annica Lindahl,
Region Central

Johan Lundqvist,
Region West

Paul Andersson,
Region South

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