

ENVIRONMENTAL PERFORMANCE

Management approach

Vattenfall manages many different energy sources and technologies, all with different environmental characteristics and challenges. Most of Vattenfall's operations are strictly regulated by laws, regulations, and permits – on global, EU, national, regional and local levels. In addition to complying with regulations, Vattenfall considers environmental performance to be a foundation for sound business development, which improves the company's competitive position and protects the value of current and future assets.

Vattenfall's Environmental Policy

Vattenfall's Environmental Policy, which is valid throughout the Group, states that (extract):

Vattenfall's ambition is to be Number One for the Environment and to be recognised for this. This means that:

- We manage our operations with openness, effectiveness and accountability and, for each energy source and type of technology, we strive to be best in class.
- We do our utmost to choose modern, efficient and environmentally effective technologies while making a sound assessment, balancing environment and economy when making investments.
- We strive to increase our use of energy sources and technologies that have low emissions of carbon dioxide and other emissions.
- We invest in Research and Development to improve energy efficiency in our operations, in renewable and low emission energy sources and to reduce carbon dioxide emissions from power plants based on fossil fuels.
- We have a structured and systematic approach to taking environmental aspects into account, including setting requirements and targets as well as performing follow-ups. We handle this as an integral part of our business management. We assess environmental, social and ethical performance when selecting suppliers, contractors and business partners.

Vattenfall's key environmental aspects

Vattenfall's key environmental aspects include energy and resource efficiency, emission reduction, management of waste and production residues, responsible land use and biodiversity protection. This is further described under the respective headings below, and in the Environmental Indicators.

In addition, as an energy utility with large market presence and purchasing power, Vattenfall strives to ensure that its activities to improve environmental performance also target suppliers, customers and policy makers:

- Supplier criteria are developed to ensure that UN Global Compact standards are met in procurement. These are described in Vattenfall's code of conduct for suppliers. Supplier audits are performed and Vattenfall may provide support to improve a supplier's environmental work (see also Human rights management approach).
- Vattenfall provides retail and industrial customers with support and expertise regarding energy efficiency measures (see EN5–7 and PR3).
- Information on the environmental impact of Vattenfall's energy generation is also provided, and in many markets, Environmental Product Declarations (EPD) are available (see EN5–7 and PR5).
- In relation to policy makers, Vattenfall is actively taking initiatives and entering into dialogue to stimulate the development of frameworks needed to reduce environmental impact from energy generation while at the same time meeting society's need for secure energy supply. Vattenfall has launched a Climate Map, stretching across industries, in an effort to quantify the global potential for reducing greenhouse gas emissions by 2030.

Energy efficiency

Energy efficiency is one of the most important environmental aspects for Vattenfall. Improved efficiency in power plants means that society's need for energy will be met while using less resources and causing less environmental impact per generated unit of energy. Many development and investment programmes aim to increase energy efficiency.

Emissions

The most significant environmental impact from Vattenfall's operations that remains to be handled is from CO₂ emissions from fossil fuel combustion in energy generation, both in terms of quantity and effect on global warming. Vattenfall believes that curbing CO₂ emissions will be the overriding challenge of our time and a defining issue for the power industry. Therefore, Vattenfall has laid out the strategic direction of dramatically reducing emissions from energy generation by developing low CO₂-emitting technologies and reshaping Vattenfall's energy generation portfolio during the coming 20 years.

Vattenfall has set the target to reduce emissions of CO₂ per kWh in the generation portfolio. The long-term target is a 50% reduction by 2030 compared with 1990. Vattenfall's climate vision is to be climate-neutral by 2050 (2030 in the Nordic countries). As a result, significant investments are currently being made in viable renewable energy sources, such as wind and ocean energy, in the development of coal-fired power generation using Carbon Capture and Storage (CCS) technology, and in increased capacity of nuclear power generation. Improved energy efficiency is also essential for ensuring that customers' and society's needs for energy are met while at the same time reducing emissions per kWh.

Vattenfall believes that a global framework for reducing greenhouse gas emissions will be essential to solving the problem and has taken the initiative to propose such a programme for curbing climate change.

Other significant emissions from Vattenfall's operations, which are reduced by flue gas cleaning, are sulphur dioxide (SO₂), nitrogen oxides (NO_x) and particles. Small amounts of other greenhouse gases, such as nitrous oxide (N₂O) and methane (CH₄), are produced in boilers when any fuel is combusted. Sulphur hexafluoride (SF₆) is still used in some electrical equipment. Vattenfall strives to reduce emissions as far as possible applying advanced technologies to emit below national and regional requirements.

Materials use

The largest quantities of materials used by Vattenfall are fuels for electricity generation and heat production. The main fuels are lignite, hard coal, natural gas, biomass, peat, waste and oil. In nuclear power plants, the fuel is uranium. Lignite is mainly excavated in Vattenfall's own mines. Other fuels are purchased. Fuel efficiency is part of energy efficiency improvement measures.

Other large quantities of materials include auxiliary chemicals used mainly for flue gas cleaning, for example, limestone, ammonia and urea. Improved flue gas cleaning normally leads to increased use of these chemicals. See also "Emissions" and "Waste and mineral by-products".

In construction and maintenance of power plants, distribution networks etc., the materials used are concrete, steel, wiring, cables, etc. This is an important part of life cycle impact from energy sources that have no fuel input, such as hydro power, wind power and ocean energy. (See further information on life cycle analysis on page 48 and PR3 on page 59.)

Hazardous substances such as PCB, mercury and asbestos occur in smaller amounts in Vattenfall's operations. A long-term strategy has been applied for managing and phasing out undesirable substances.

Water use

Water is used in many operations in Vattenfall. In mining, ground water is removed, cleaned and returned to water bodies. In hydro power plants, the energy source is running water in rivers. In combustion power plants, as well as in nuclear power plants, water is used for cooling. Vattenfall takes a water balance perspective on the management

of water use, considering impacts from water withdrawal as well as discharge. Impacts from water use include, for example, temperature changes and the impact on biodiversity in surrounding water bodies. Risks for emissions and leakages, for example of oils, into water bodies are carefully monitored and preventive measures are taken.

Land use and biodiversity

The nature of Vattenfall's operations, with large power plants, dams, open-cast lignite mines, wind farms and electricity networks, has a physical and visual impact on the landscape. The affected areas have differing biodiversity value, and the conservation processes and actions differ accordingly.

Before starting new construction or major rebuilding work, environmental impact assessments are carried out, including impacts on biodiversity. Vattenfall strives to harmonise operational facilities with the landscape and the environment, and is committed to the protection of flora and fauna in the surrounding area. This is often a requirement of the operation permits granted by the regulatory authorities for the operation of power plants, and processes to obtain permits and protect biodiversity are well established within Vattenfall. This work is done in co-operation with national and regional authorities.

Waste, residues and by-products

Vattenfall's operations generate different types of waste and residues. Nuclear power plants generate radioactive waste. Combustion of solid fuels such as coal, biomass and waste generate ashes that can be reused and mineral by-products, such as gypsum.

Radioactive waste

Vattenfall operates nuclear power plants in Sweden and Germany. It is Vattenfall's responsibility to have reliable and acceptable solutions for the management of nuclear waste. High-level radioactive waste, which consists primarily of spent nuclear fuel, must be carefully shielded during the handling and transportation phases. It takes one hundred thousand years for the radioactivity to decline to the level that occurs in the quantity of uranium ore from which the fuel was originally fabricated. Vattenfall supports research and development for permanent storage solutions for radioactive waste, a process that is conducted according to different time plans in Sweden and Germany.

In Sweden, SKB, the Swedish Nuclear Fuel and Waste Management Company, has developed a solution for permanent storage, and the process is now in the final phases of selecting the location, which is expected to be announced in 2009. The choice is between Oskarshamn and Östhammar municipalities, which have both volunteered to host the repository. Evaluations consider several factors, such as extensive requirements on the bedrock characteristics and long-term safety, environmental impact, supporting infrastructure and local acceptance. The first Swedish nuclear waste may be deposited in the final repository by 2020 at the earliest. Until then the spent nuclear fuel – high level radioactive waste – is being stored at a central interim storage facility in Oskarshamn. The Swedish radioactive operational waste is stored in the final repository, SFR. This is a central facility for disposal of short-lived low- and intermediate-level waste from both nuclear power plants and hospitals. SFR is located near the Forsmark nuclear power plant in the municipality of Östhammar, 50 metres beneath the bottom of the Baltic Sea.

In Germany, studies and underground exploration have been conducted on the possibility of using the salt mine in Gorleben as a final repository for highly radioactive waste, however, no further exploration has been done since 2000. The German ministry for the environment intends to look into alternatives to Gorleben. Its goal to set up new safety requirements for final storage in 2008 was not realised. In Germany, interim storage facilities are situated at the nuclear power plants and operated by the nuclear power companies. A repository for wastes with negligible heat generating (low and intermediate level wastes) is under construction at the Konrad mine. Start of operation is planned for 2013.

Costs associated with the final disposal of nuclear waste from today's electricity generation are borne today. It has been taken into consideration that a significant part of costs for the deep disposal of high-level radioactive waste occurs many years after production has been closed down. In Sweden, the nuclear power companies continuously pay fees

to a state-controlled fund (the Swedish Nuclear Waste Fund), which is intended to cover all costs associated with waste storage and the decommissioning of nuclear reactors. In Germany, costs associated with the final disposal of nuclear waste shall be borne by those who produce the radioactive waste. The provisions built up for nuclear waste and decommissioning, however, remain within the nuclear industry, that is, the utility companies, energy companies and research centres. These provisions are reported in their respective financial statements. See also EU8.

Re-use of residues, ash and mineral by-products

The burning of solid fuels and cleaning of flue gases result in large amounts of useful ash and gypsum, which are considered as by-products. When ashes and by-products substitute other materials, it leads to less consumption of new resources. It also significantly reduces the amount of ash that has to be deposited, which leads to shorter transports and less emissions.

Most ash and mineral by-products from Vattenfall plants are re-used, and increased use is encouraged. Studies show that the risks associated with using ash as construction material are very small. Vattenfall undertakes research efforts together with the construction industry to improve the use of ash.

Waste management

Depending on different national legislation, some of the ash generated in Vattenfall's power plants also falls under waste legislation. Vattenfall strives to enable re-use of ash by applying quality and environmental standards. Hazardous waste is treated according to permits and regulations.

Waste from construction and the decommissioning of power plants, distribution grids, etc. is handled according to the respective national legislation. Vattenfall strives to stimulate re-use and recycling of construction waste. For example, discharged distribution poles are used for energy recovery, see EN22.

Most waste from Vattenfall's administrative offices, such as paper, etc. is recycled, and many offices minimise the use of paper cups, etc. in order to reduce the amount of waste. Waste from IT is handled locally by the vendor of the equipment, or by assigned specialised companies.

Environmental impact of products and services

The direct environmental impact of Vattenfall's main products, electricity and heat, is very small. Most impact refers to the generation and distribution of energy, such as emissions, resource use, etc., where a life cycle perspective is taken. Additional environmental impact is described below.

Operational safety

Safety is a fundamental aspect and basic requirement for all of Vattenfall's operations. Negative impact on human health and safety is minimised through comprehensive safety work and well-established risk management systems. Within the nuclear operations area, the Vattenfall Group co-ordinates all safety work through the Chief Nuclear Officer, who reports directly to the CEO (see also EU20).

Dam safety is an important aspect of hydro power, since a dam failure could have serious consequences, causing substantial property damage and a threat to human life. The risk of a dam failure is extremely small, and current requirements are calculated for water flows that statistically occur every 10,000 years. Vattenfall has invested actively in improved dam safety and is active in the industry's dam safety work. International audits indicate that Vattenfall's dam safety has a very high standard.

Risks for incidents, contamination and significant spills are carefully monitored, managed and mitigated locally (at the plant and regional level). Examples of risks include oil leaks from transformer stations and oil filled cables in the distribution grid, accidental discharges to water from power plants (for example, hydro power plants), etc. Training in co-operation with local authorities to prepare for possible incident scenarios is regularly carried out in parts of the organisation.

In addition, incidents, including such where there is a risk for environmental impact, are handled according to Vattenfall's Incident and Crisis Management (ICM) framework, which is applied to enhance preparedness and provide effective and proactive ways of handling events that could lead to an incident or crisis (see EU20).

Continued on page 48

Life Cycle Assessments

Vattenfall uses Life Cycle Assessments (LCAs) as one method to analyse and estimate the environmental impact of its operations “from the cradle to the grave”. For additional information, see PR3.

Electromagnetic fields (EMF)

Vattenfall complies with recommended and legal guidelines regarding electromagnetic fields (EMF), see PR1.

Noise levels around power plants

In addition to other environmental aspects, some power plants also generate noise. Most permits include requirements on noise levels, which are carefully monitored during the construction and operation of power plants.

Benefits from heat and electricity use

Electricity and district heating are efficient carriers of energy. Therefore, centralised energy generation often leads to improved efficiency, with less impact per kWh compared with other energy use. For example, replacing an oil-fired furnace for household heating with a heat pump will radically decrease the total CO₂ emissions for the household, while the use of electricity would increase. Another example is a plug-in hybrid car, which produces less emissions than a car that uses fossil fuel. Vattenfall is contributing to research and development on future use of electricity and heat in order to generate sustainability advantages in society (see EU7).

Environmental management

Vattenfall governs environmental issues at all organisational levels. Environmental performance is a business responsibility and is described in the Vattenfall Management System, which applies for the entire Vattenfall Group.

Environmental goals and performance

At the Group level, Vattenfall sets long- and short-term business planning targets for reducing CO₂ emissions (see EN16–18). The long-term development of Vattenfall's generation portfolio requires significant investments, which are co-ordinated at the Group level. At the Business Group and business unit levels, additional environmentally related targets may apply.

Environmental management system

At the Vattenfall Group level, environmental data from operations is reported and consolidated annually in a dedicated reporting process. In addition, reporting on qualitative issues, such as risks and incidents, is done quarterly to the Executive Group Management.

Vattenfall's Group Environmental Management System includes annual Environmental Management Reviews where corrective actions can be initiated. Most parts of Vattenfall have their own environmental management sub-systems aligned with recognised standards, many of which are certified. Thirty-five units are covered by ISO14001, eight power plants are covered by EMAS, and eight by other recognised environmental management systems. The certificates cover approximately 50% of installed capacity or approximately 30% of revenues.

Organisational responsibility for environmental performance

Regarding environmental issues, the Vattenfall Group Management focuses on strategic development, long-term development and financing, managerial principles and deviation analyses. Based on targets set by the Executive Group Management, each Business Group and business unit has full responsibility for planning, carrying out, following up on and developing its business. This includes taking responsibility for environmental concerns.

Business Groups (BG) and business units

All organisational units are required to have access to relevant competence to manage environmental aspects. All units are responsible for their environmental performance, for identifying, prioritising and implementing initiatives and activities to improve environmental standards and fulfil the strategic ambition to be Number One for the Environment. In addition, each unit shall monitor and manage environmental risks.

Group Environment function

Vattenfall's Group Environment function manages and follows-up environmental issues within the Group and ensures that an efficient and competent environmental organisation is in place at the Group level to support the organisation. The Group Environment function also monitors and evaluates environmental opportunities and risks of importance for the Vattenfall Group and the Vattenfall brand. The Group Environment function creates and supports platforms for sharing best practice within the Vattenfall Group. The Head of Group Environment executes the functional responsibility for environmental issues as described in the Vattenfall Management System and is the Environment Management Representative for the Group.

Environmental Committee

The Group Environmental Committee is an advisory function to help set strategies and support the Group Environment function. It is also a meeting place for sharing best practice and identifying cross-border benefits from extended co-operation within Vattenfall. The Committee is chaired by the Head of Group Environment. It has members representing all Business Groups.

Centres of Excellence

As a major player in the European electricity market, Vattenfall has considerable experience and knowledge in the environmental field and is a key dialogue partner for European and national policy makers. Under the Vattenfall Group Environmental Committee, the following five Centres of Excellence have been established: Air quality, Soil protection, Water protection, Waste and by-products, and Chemicals management.

The Centres of Excellence monitor and analyse policy developments and serve as a forum for information exchange and knowledge transfer, within Vattenfall but also externally.

Environmental experts

Vattenfall has significant environmental competence across the organisation. Vattenfall consultants provide expertise in energy efficiency, environmental and sustainable strategies, etc., and participate in projects and initiatives not only throughout the Vattenfall Group, but also in other industries, thereby stimulating knowledge transfer.

Environmental risk management

Environmental risks are monitored, managed and mitigated locally in Vattenfall. The Group Environmental Risk Management approach includes six different components:

- Environmental Debt – Established debt, in relation to existing regulatory conditions
- Legal & Regulatory Risk – Relating to future changes in regulatory conditions
- Environmental Risk – Relating to future event resulting in environmental damage
- Health & Safety Risk – Relating to future event with an impact on health or safety
- Incidents – Incidents having occurred, with a potential for environmental damage
- Accidents – Accidents having occurred, resulting in environmental damage

Environmental risks (qualitative as well as quantitative estimations of probability and consequences) are reported and aggregated at the Vattenfall Group level annually.

Training and awareness on environmental issues

Training is important as a foundation for awareness and environmental work. E-learning on important environmental issues is available for all employees. Environmental issues are included in management training programmes.

Compliance with codes, agreements and frameworks

Vattenfall is a signatory of the UN's Global Compact, which is the underlying framework of Vattenfall's overall sustainability work, and as such it has the most important influence. Environmental law sets an important regulatory framework for Vattenfall's operations, and a wide range of legal instruments in this field are relevant for Vattenfall.

Environmental indicators

Materials used (EN1)

(Fuels are reported under EN3–4)

Limestone, ammonia and urea are used in flue-gas cleaning equipment. Use of these chemicals results in lower emissions, with considerable positive effects for the environment. Long-term structural changes leading to reliable trends can only be seen over at least a 10-year period. The proper measurement time frame would be an investment

cycle that lasts 30–40 years. Across the Group, inventories have been taken of hazardous substances such as asbestos and PCBs, and a plan has been applied to phase out these substances. The result in Poland, for example, indicates that there is no asbestos and no PCB in the heat operation, and a plan to phase out PCB in the electricity distribution operation has been launched. In Germany PCB has been phased out. Materials used for construction in the Nordic power plants can be found in Environmental product declaration (EPD) on www.environdec.com.

Materials used

ktonnes	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Lime expressed as CaO	6.33	0.05	19.1	926	7.00	958	1,010	1,050
Ammonia	0.779	0	2.26	4.34	0	7.37	7.77	8.55
Other chemicals for flue gas cleaning	0.878	0	23.9	4.38	0	29.1	25.6	7.86

The lower use of lime in 2008 compared with 2007 is due to decreased fossil-based generation in Germany. Other chemicals for flue gas cleaning consist mainly of ammonium hydroxide and the dry scrubber by-

product from the Fyn power plant in Denmark, which since 2007 is recycled in flue gas cleaning at the Amager and Nordjylland power plants.

Materials used that are waste (EN2)

Waste, both industrial waste and household waste, is a small but important part of Vattenfall's fuel mix. It is used for heat production and electricity generation, both in waste incinerators as well as in co-combustion with other fuels. Almost 100% of the waste is from external sources, and the use of waste as a fuel is increasing since society is depending on efficient energy recovery, with low emissions, of combustible waste fractions that cannot be recycled. Power plants that have a permit to combust waste are strictly regulated in terms of flue gas cleaning and ash management (see EN22).

Waste incinerators are located in Uppsala, Sweden, and in Hamburg

and Lauterbach, Germany. Waste incineration plants in Rostock and Rüdersdorf, Germany will be commissioned in 2009.

Co-combustion of waste is carried out at four large lignite-fired power plants in Germany. A maximum of 5% waste is combusted together with the lignite. Vattenfall will continue trials and evaluations for further co-combustion.

Some small and medium-sized heating plants in Sweden also use industrial waste. Vattenfall does not currently use waste for electricity or heat production in Poland, but investigations regarding different options are being made with the support from Vattenfall in Germany and the Nordic region.

Materials used that are waste

	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Amount of waste as fuel for electricity and heat generation (TWh)	1.76	0.04	0	5.41	0	7.21	6.64	5.71
Percentage of combustion fuel input that is waste	37.8%	1.8%	0%	2.8%	0%	3.1%	2.8%	2.4%

The use of waste as fuel is rising steadily, since using non-recyclable waste for energy recovery is an important service to society. No new waste incinerators were commissioned in 2008. The higher use of

waste as fuel in 2008 is due to increased generation in existing facilities and increased co-combustion.

Energy use (EN3–4)

Vattenfall's major energy use consists of fuels. Uranium is used in nuclear power plants to generate electricity. Fossil fuels (lignite, hard coal, oil and natural gas), peat, biomass fuels and waste are used for the generation of electricity and heat. Electricity is also generated in hydro power plants and wind power plants, where there is no fuel.

The generation of heat and electricity is dependent on many factors, such as the weather and market conditions. During cold winters, demand for heat and electricity is higher, resulting in more generation, often with higher emissions. In a very dry year, there is less availability of hydro power, and other generation – possibly fossil-based – will increase. This is also the case when nuclear power plants are not in operation. The energy market is also affected by the overall economy, fuel

prices, etc. For additional information, see the 2008 Annual Report.

The largest energy consumption, other than fuels, is electricity for operating power plants. This electricity is derived primarily from own generation, and data is not gathered at the Group level. The environmental impact from this electricity is accounted for in reporting. Reported energy generation is net generation, after subtracting internal consumption in power plants. The second largest source of consumption consists of losses in energy transfer. Electrical resistance in power lines and transformers inevitably causes technical distribution losses. Mining is the third largest source of energy consumption after Vattenfall's power plants, consuming 1.3 TWh electricity from Vattenfall's own generation, since large amounts of ground water and overburden material (mostly sand) have to be redistributed.

For energy efficiency measures, see EN5–7.

Total use of fuels for generation of electricity and heat

TWh (uranium in tonnes)	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Lignite	0	0	0	144	0	144	149	145
Hard coal	0	0	14.8	26.9	17.6	59.3	61.6	64.0
Gas	0.002	0.851	0.975	10.9	0	12.7	12.5	14.2
Waste biogenic	1.53	0.039	0	3.45	0	5.02	4.62	3.70
Electricity (used in electric boilers, heat pumps and pumped storage plants)	0.042	0	0	3.8	0	3.9	3.90	4.67
Biomass excl. peat	1.69	0.709	0.501	0.349	0.159	3.41	3.53	3.53
Waste non-biogenic	0.231	0	0	1.97	0	2.20	2.02	2.01
Oil	0.198	0.052	0.297	0.863	0.134	1.54	1.25	1.32
Peat	0.837	0.487	0	0	0	1.32	1.06	1.14
Other	0.129	0.005	0	0.9	0	1.0	0.940	0.969
Total	4.66	2.14	16.6	193	18	234	241	241
Uranium	146	0	0	0	0	146	136	169

Total external sales excluding trading of electricity, heat and fuel

	Sweden	Finland	Denmark	Germany	Poland	Other countries	Spotmarket	Total 2008	Total 2007	Total 2006
Electricity (TWh)	44.8	5.23	2.05	88.0	10.2	7.68	31.4	189	194	
Heat and cooling (TWh)	4.05	1.59	4.71	14.7	10.6			35.6	36.2	35.0
Lignite (million tonnes)				2.4				2.4	2.6	2.6

Total generation of electricity

TWh	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Hydro power	33.0	0.7	0	3.0	0	36.7		
Wind power	0.417	0.006	1.30	0.026	0.065	1.81		
Nuclear power	46.2	0	0	0	0	46.2		
Combustion (fossil, biomass etc.)	0.38	0.30	5.95	65.8	3.66	76.1		
Total	80.0	1.01	7.25	68.8	3.73	161	166	169

	BG Nordic	BG Central Europe	Total 2008	Total 2007
Electricity generation 2008 Annual Report	90.7	72.4	163	168

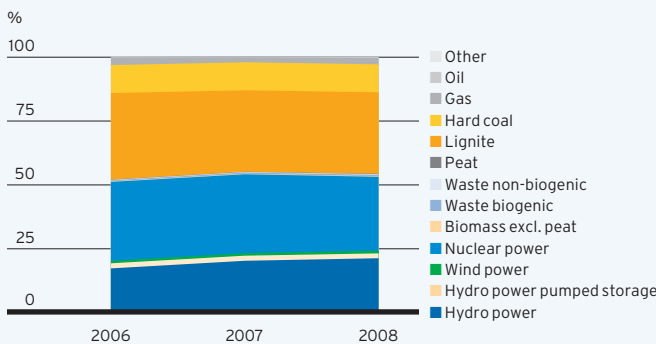
Total production of heat and cooling

TWh	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Heat and cooling	3.90	1.55	4.71	17.6	10.7	38.5	38.1	40.1

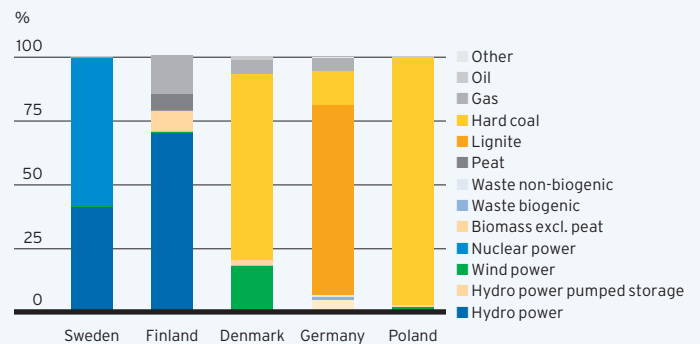
Generation data is reported in the CSR report as well as the annual report. Definitions in the CSR report have been adjusted to enable comparisons of environmental performance, while some annual report definitions include effects from commercial agreements such as deliveries to and from minority owners etc. For electricity generation, adjustments of definitions mainly apply to hydro power plants in Business Group Nordic. For heat and cooling, the CSR report refers to heat produced, while the annual report refers to heat and cooling sold. Heat production figures for 2007 have been adjusted to the CSR report definition.

Total electricity generation decreased in 2008 compared with 2007. Hydro power generation increased. Nuclear power generation decreased, mainly due to the outage of the Brunsbüttel nuclear power plant in Germany, but also to shutdowns and planned outages at the Ringhals and Forsmark nuclear power plants in Sweden. Fossil-based generation decreased mainly due to lower availability and planned outages of coal-fired plants in Germany and lower generation in Denmark. Wind power generation increased as a result of the new Lillgrund wind farm and favourable wind conditions. Electricity generation based on biomass and waste increased.

Electricity generation mix 2006–2008

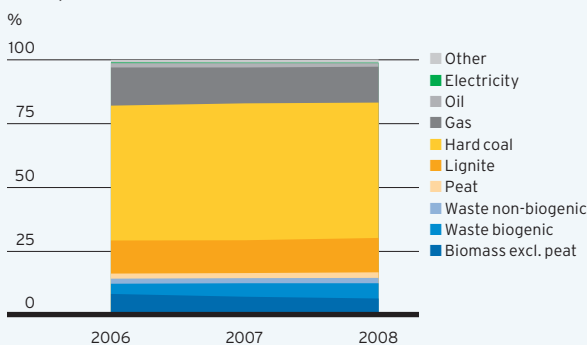


Electricity generation mix 2008

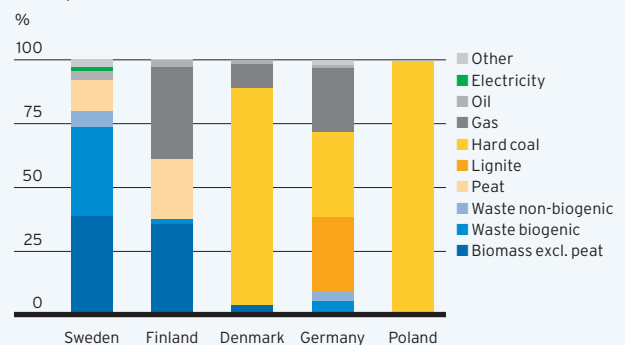


The allocation of electricity generation to fuel is a calculation based on simplified assumptions for multifuel power plants.

Heat production mix 2006–2008



Heat production mix 2008



The allocation of heat production to fuel is a calculation based on simplified assumptions for multifuel power plants.

Energy-efficient and renewable energy-based products (EN5–7)

Energy efficiency and increased generation from renewable energy sources are fundamental components of Vattenfall's environmental strategy. Declaration of origin for electricity sales is being implemented across the Group.

Initiatives to improve efficiency

Initiatives and activities to increase efficiency are performed across Vattenfall's operations, and efficiency measures in power plants target both direct and indirect energy use. Continuous improvement work is long-term, and data on energy savings is not currently gathered at the Group level, since measurements are very complex. Each unit strives to increase energy efficiency, since this has a direct impact on financial and environmental performance, which is measured. Examples of specific energy efficiency projects in the Group:

- Upgrading programmes, capacity increases and improved environmental performance of hydro power plants and nuclear power plants in the Nordic countries are ongoing.
- The new coal-fired power plant in Moorburg-Hamburg, Germany (see Coal-based power – new and improved, pages 14–19) will increase the energy efficiency ratio of the German portfolio thanks to the combination of heat and power generation

- In Germany, continuous improvements are being made in generation efficiency. Examples of measures in 2008 include the start of a test plant for pre-drying lignite, efficiency improvements at several pumped storage plants, and improvements of heat exchangers at the Boxberg power plant.
- In Warsaw, Poland, generation has been concentrated to the biggest and most efficient plants, CHP Siekierki and CHP Żerań. This is a result of co-operation with the local heat distributor, which is owned by the local government. The central generation dispatch centre plays a key role in optimising the generation process as well as enabling the selection of the most efficient generation devices. The solution is based on the Scandinavian model of heat market management. As a result, two peak-load plants (HP Wola and HP Kawęczyn) remain inactive even in winter-time, which means that the combustion of 80,000 tonnes of heavy oil has been replaced by high-efficiency cogeneration combustion instead.
- The second step of Polish emission reduction involves a large-scale project to exchange and modernise power generation, which is currently being planned. The new units will have the highest technical generation efficiency and will be CCS-ready.
- In January 2009, the heat accumulator at CHP Siekierki was commissioned. It is the first large-scale Polish implementation of this solution, which is taken from Scandinavia. It enables the accumulation of heat during the day for distribution during the evening and night. This leads

Continued on page 52

to improved efficiency from co-generation while at the same time meeting daytime demand for electricity. Also, there is less need to start-up peak water boilers at nighttime, when heat demand increases. It is estimated that the use of peak load units will be reduced by nearly 30%.

- In Poland, where improvement potential remains high, investments are being made in the electricity distribution grid to reduce distribution losses, thereby improving energy efficiency and reliability.
- A number of research and development efforts are targeted at energy efficiency, see EU7.

Vattenfall's energy consumption related to other operations than energy generation is minute compared to the generation operations. Work targeting this consumption includes:

- Monitoring business travel and improved travel policies. In 2008, the decision was made to offset CO₂ emissions from all business travel in the Group. This is co-ordinated centrally at the Group level based on reported travel data and will be implemented in 2009.
- Improved energy efficiency in administrative office facilities.
- In 2008 a Green IT initiative was established at the Group level to ensure that IT use is efficient and contributes to reduced CO₂ emissions, for example through improved energy efficiency and increased video-conferencing capacity.

Promoting renewable electricity and heat production

Renewable energy is sold directly to consumers in all of Vattenfall's main markets.

- In Sweden, customers can choose to purchase electricity with Environmental Product Declaration (EPD) from wind power and hydro power. Electricity from nuclear power with EPD is also available.
- In Germany, electricity with declaration of origin is offered to industrial and private customers.
- In Poland, electricity with environmental declaration is offered to industrial and private customers.

Vattenfall has significant investment programmes to increase renewable energy generation across the Group. See Economic performance management approach, page 73. For additional information on the fu-

ture generation portfolio, see The challenges of investing in new energy, page 8.

Promoting customer energy savings

Vattenfall actively supports industrial and retail customers in energy efficiency improvements. (See also Product responsibility management approach and PR5.) Examples across the Group are:

- Customers can get advise on energy savings at customer centres in all countries.
- An energy efficiency programme launched in 2007 by Vattenfall BG Nordic continued providing customers advice in 2008 on how to improve their energy efficiency. The programme also included participation by Vattenfall experts on nationwide TV.
- An energy advisory service is provided to industrial customers in Poland in co-operation with Silesia technical university.
- The continued launch of Cobra, an innovative street lighting product developed by Vattenfall in Sweden.
- Vattenfall engineering consultants offer energy advisory services to industrial customers, including consultation, data acquisition, analysis and solution design.
- 1,000 households in Hamburg, Germany have been given the opportunity to apply for "energy checks", which entitle them to a visit by Vattenfall experts to give advice on how to save energy.
- Vattenfall offers energy advisory services at the new Vattenfall customer centres in Berlin and Hamburg, Germany. Vouchers were distributed from October until December in the city centres and via newspapers. Every visitor also received a low-energy light bulb.

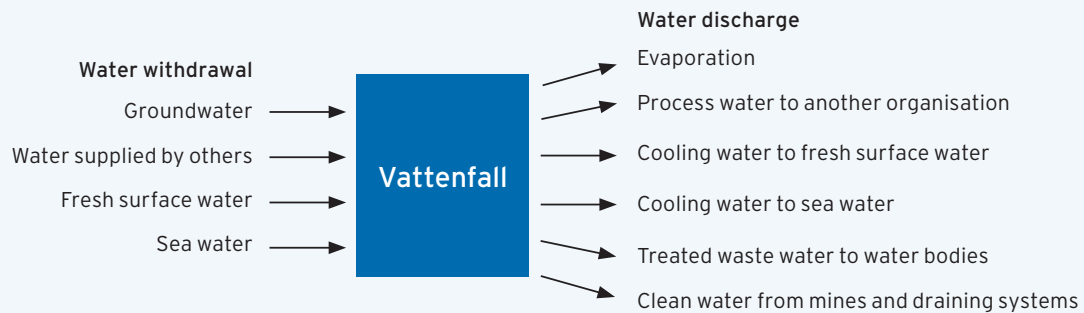
Vattenfall also supports research and development on future use of electricity to improve energy efficiency in society. Examples are:

- Development of plug-in hybrids in co-operation with Volvo
- Vattenfall Germany is taking part in a project to test and develop hydrogen busses.
- Testing of MINI E electric cars together with the BMW Group in Berlin. The first ever test drives on the streets of Germany's capital Berlin are now a reality. The cars are being charged up at Vattenfall's first charging station in Berlin-Treptow.

Water use, discharge and effects on biotopes (EN8-9, 21, 25)

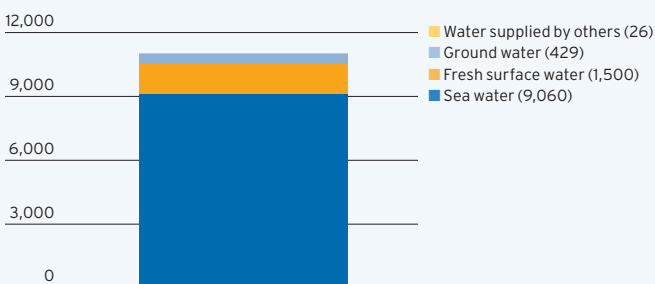
Vattenfall has performed a thorough analysis to assess the largest streams and impacts from the use of water in the Group. This analysis

has resulted in the reporting of a total of ten water parameters, covering both water withdrawal and water discharge.



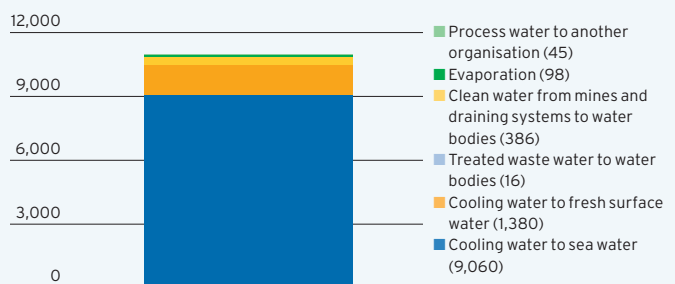
Water withdrawal 2008

Million m³



Water discharge 2008

Million m³



Use of water for cooling

The cooling process at nuclear power plants and combustion power plants requires water, and cooling water is taken from rivers, lakes and the sea.

The largest amount of cooling water is used in Vattenfall's nuclear power plants in Sweden and Germany, and most of the water is taken from the sea. The temperature increase from discharges of cooling water is monitored and kept within specific limits for each respective plant. In terms of the plant's environmental performance, the benefits of efficient cooling radically exceeds the small temperature increase that is the effect of discharging cooling water into a large water body.

Power plants with inland locations, using cooling towers, use significantly less water. For example, Vattenfall's lignite power plants use state-of-the-art industrial cooling systems, with cooling towers and closed cooling cycles, demonstrating water consumption generally less than 2 m³/MWh.

Use of water in lignite mining

The water sources most significantly affected by withdrawal of water are around Vattenfall's lignite mines in Germany: Jänschwalde, Cottbus-Nord, Welzow-Süd, Nochten and Reichwalde (no mining is currently being conducted at Reichwalde).

In 2008, approximately 411 million m³ of groundwater was removed to make fuel extraction possible. The removed groundwater is cleaned and thereafter used to cover the freshwater requirements of the nearby lignite-fired power plants, thereby sparing other water sources. Vattenfall's need for freshwater is well below the amount of removed groundwater, and the treated excess groundwater is made available to nearby municipalities and industries. Even though Vattenfall and the surrounding municipalities and industries make use of the water, most of the cleaned groundwater is returned to rivers and lakes.

"Eco-water inlets" are used to support protected rivers and watercourses around the mines from running dry as a result of lowered groundwater levels during mining. About a fourth of the extracted mine water is used for this purpose.

To further limit the impact of lowering the groundwater when draining the mines, "sealing wall" technology has been developed by Vattenfall. Inflows from watercourses, valley plains or wetlands are sealed off by underground sealing walls on the periphery of the open-cast mine, when this is required depending on the geological and hydrological conditions. To date, Vattenfall has built sealing walls 7 km and 9 km in length along the Jänschwalde and Cottbus-Nord open-cast mines, respectively. In 2009, construction of a further sealing wall will be started at the Reichwalde open-cast mine, and in 2010 a sealing wall will be dug at the Welzow-Süd open-cast mine.

Hydro power

Vattenfall owns and operates hydro power plants in Germany, Sweden and Finland. In Germany, pumped storage power plants are used to store energy from other energy sources. River regulation and reservoirs for hydro power and pumped storage power have an impact on the natural water flow of rivers as well as on the surrounding landscape. For each hydro power plant, permits regulate how flows are allowed to fluctuate. In some cases, it is ecologically motivated to determine a so-called instream flow, or minimum flow, to ensure a continuous water perimeter. This means that the flow is never allowed to fall below a set minimum level. It can be adjusted over time so that it reflects the variations of the natural flow, but at a lower water level. A combination of instream flow, weirs and other physical adjustments can be very efficient at enhancing the conditions for aquatic organisms. The area of suitable fish habitat increases and the flow acquires a more diverse pattern, which benefits most aquatic life but also riverbank vegetation. Re-creating spawning areas is another way of promoting fish populations. These measures have been performed in some of the rivers where Vattenfall operates hydro power plants.

Hydro power plants have a significant impact on biodiversity in rivers and streams, especially fish spawning grounds and the ability of fish to reach them. For this purpose, fish ladders for salmon and trout have been constructed on some of the regulated rivers where spawning areas exist upstream of the power stations. Every year, Vattenfall Nordic plants more than 1.3 million fish in rivers and streams.

A number of initiatives and investments are taken to improve the efficiency and environmental standard of Vattenfall's hydro power (for additional information, see www.vattenfall.se):

- Mobile environmental ambulances – an emergency response system for oil leaks in both flowing and still waters – have been developed by Vattenfall in Sweden together with Skellefteå Kraft and Statkraft. Three such ambulances are stationed along the Skellefte River and are equipped with absorption material, pumps, petrol-fuelled generators, inflatable dingies, outboard motors, etc.
- Expenditures on dam safety and improvement programmes amount to more than SEK 1 billion during the period up until 2013. Planned activities include modernisation and improvements of construction as well as installation of monitoring equipment.
- A research programme aimed at proposing socially and economically viable measures for improving environmental conditions for hydro power is currently being conducted by Vattenfall in co-operation with Swedish government agencies for energy, fishing and environmental protection and Elforsk, the Swedish electrical utilities' R&D company.
- A new and improved fish passage is being built at Stornorrfor, and will be ready in summer 2009. The new ladder will improve both upstream and downstream migration of fish past the power plant. A large development project is currently studying the possibilities to further improve the conditions for fish populations as well as for recreational fishing in the area.
- At the Nordic hydro power plants, several projects are aiming to reduce the amounts of oil used to reduce the risk of oil leaks. When upgrading plants, one standard measure involves replacing oil-lubricated bearings with water-lubricated bearings. A pilot project in Älvkarleby in 2008–2009 will be testing the use of water and glycol in the hydraulic systems of dam hatches.

Biodiversity values of water bodies

Due to the diverse nature of Vattenfall's operations and large number of sites, information on protected status and biodiversity values of water bodies is handled locally as it is most efficient. Information is therefore not gathered at the Group level.

Examples of activities to protect and support biodiversity have been provided in the sections "Use of water in lignite mining" and "Hydro power" above. A further example can be seen on the Vistula River in Warsaw, where Vattenfall operates CHP plants and discharges heated water into the river. This is a so-called Natura 2000 area, where Vattenfall is supporting a Life+ project initiated by the local government to protect biodiversity along the Vistula River.

Land use and biodiversity (EN 11–15)

Vattenfall's most significant land use pertains to electric distribution corridors, power plants – especially hydro power plants – and lignite mining operations in Germany. Due to the diverse nature of the operations and the large number of sites, information on protected status and biodiversity values of sites is handled locally as it is most efficient. Information is therefore not gathered at the Group level.

Vattenfall has developed the Biotope Method, an assessment tool for quantifying the impacts on biodiversity of land and water use. Impact assessments of Vattenfall's Nordic generation are described in Environmental Product Declarations (can be found at www.environdec.com). For impacts in the supply chain, see HR2.

Land use in lignite mining

Vattenfall's lignite mining in Lausitz, Germany, is conducted in open-cast mines, which claim land areas. The impact on the landscape is considerable when the cast is open, but mining and re-cultivation of mined areas are two phases of the same operation.

Re-cultivation planning starts during the early planning stages of mining. The interests of authorities and business as well as the concerns of the local community are taken into consideration in the early planning. All affected stakeholders are invited to take part in the process. (See also Impact on society, management approach and SO1, EU19, EU21.)

All land used for open-cast lignite mines is acquired by Vattenfall. Co-operation with potential future land users and local stakeholders creates a solid basis for making productive use of the land after concluding mining activities.

Continued on page 54

Re-cultivation programmes aim to achieve a natural, pre-industrial landscape. The objective is to allow for sustainable agriculture, forestry and water management in the post-mining areas in combination with desirable biodiversity, a harmonic landscape and possibilities for outdoor life. The factors that characterise the new landscape are soil quality, land and water distribution, and topography. Lakes are planned into the post-mining landscape. The preparatory shaping work for lake creation is done already during the mining operation.

During the active operational period of Vattenfall's five lignite mines in Germany, 159 km² have been claimed up until now. Land use in 2008 was 5.77 km² (5.66 km² in 2007). Large quantities of land mass are redistributed in order to enable lignite extraction from the open-cast mines. In 2008, a total of 459 million m³ of land mass (449 million m³ in 2007), mainly sand, was moved to extract 58 million tonnes (59.5 million tonnes in 2007) of lignite. A total of 4.2 km² (4.9 km² in 2007) were re-cultivated, of which 1.33 km² have become forestlands.

Vattenfall owns and operates 380 km of railway in Germany. Rail is used for transporting lignite from mines to power plants. Rail is also used to transport lime to the power plants and ash and gypsum from the plants. The railway is connected to Deutsche Bahn at two junctions. Vattenfall owns and operates its own fleet of engines and wagons.

Land use and biodiversity around electricity distribution corridors

Electricity networks also have an impact on large land areas. Overhead transmission and distribution lines, in particular, claim significant land areas. In some cases, this has a positive impact on biodiversity. In Sweden, studies show that many rare species have found refuge around overhead distribution grid lines thanks to the regularly recurring right-of-way clearance. Sections of Vattenfall's Swedish power line corridors have been declared "Natura 2000" areas. This means these areas

represent valuable natural habitats to be preserved with the help and support of the EU, with the aim of protecting biodiversity.

Electricity networks claim land areas, and the length of transmission and distribution grid lines provides an indication of the land areas used. The lengths of Vattenfall's local and regional distribution grid lines are 187,800 km in the Nordic region, 26,200 km in Poland and 77,000 km in Germany. In the cities of Berlin and Hamburg, the networks are mainly served by underground cables. In addition, Vattenfall has 10,000 km of transmission grid lines in Germany.

In 2008 Vattenfall's Nordic Distribution operations were certified according to ISO 14001.

Land use for power plants

Power plants, offices and other buildings use limited land area.

Reservoirs and hydro power plants have a significant impact on the landscape. Vattenfall's most significant impact comes from the large reservoirs for river regulation in Sweden, involving both natural lakes and inundated land. Inundated land area amounts to approximately 640 km². Storage capacity varies from a few months to more than a year. The change in water levels of the various reservoirs varies from 2 metres to 34 metres. Storage capacities of the reservoirs range from 300 million m³ to 9,500 million m³. Some of the Swedish reservoirs are natural lakes. Vattenfall has established a number of protected areas along the Lule River in Sweden, which has proved to harbour several rare and threatened species, protecting them from future exploitation.

In Poland, Vattenfall has decided to reclaim a former ash disposal field located in the Greater Warsaw area. The ash may be reused in the construction of a bridge nearby, thereby reducing the need to transport material from other locations to the site. The reclaimed area may be used for city development once Vattenfall has completed ground decontamination operations.

Greenhouse gas emissions (EN16-18)

The predominant greenhouse gas emission, and most significant environmental impact of Vattenfall's operations, consists of the direct CO₂ emissions from fossil fuel combustion for electricity and heat production. Emissions of other greenhouse gases than CO₂ and emissions from other activities than direct energy generation amounts to 0.7 million tonnes of CO₂-equivalents, which corresponds to approximately 1% of the reported CO₂ emissions¹⁾. Emissions from use of electricity (scope 2 according to the Greenhouse Gas protocol) are included in direct

emission, since most electricity used is from Vattenfall's own generation.

CO₂ emissions are dependent on weather conditions (see also EN3-4). During cold winters, demand for heat and electricity is higher, resulting in more generation and consequently more emissions. During a very dry year, when there is less availability of hydro power, generation from other – possibly fossil-based – energy sources will increase. This is also the case when nuclear power plants are not in operation. This makes it difficult to monitor short-term trends in CO₂ emissions.

CO₂ emissions

Million tonnes	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
CO ₂ from electricity generation	0.099	0.062	3.03	67.6	2.03	72.8	75.0	74.5
CO ₂ from heat production	0.324	0.267	2.23	2.87	4.02	9.71	9.73	10.3
Total	0.424	0.328	5.26	70.4	6.06	82.5	84.7	84.8

Rounding differences, affecting the last significant digit, may occur in this table. Only CO₂ from fossil fuels is reported. Peat is included as a fossil fuel, although the Intergovernmental Panel on Climate Change (IPCC) classifies it as a category of its own, between renewable and fossil. Allocation between electricity and heat in combined heat and power (CHP) production is done according to local practice.

Total CO₂ emissions from Vattenfall's power plants were lower in 2008 compared with 2007. This is a result of a decrease in fossil-based generation, mainly due to lower availability and planned outages of coal-fired plants in Germany and Denmark. In Sweden, CO₂ emissions increased

in 2008 compared with 2007 mainly due to an outage in the CHP plant in Uppsala in 2007, which resulted in a changed fuel mix. In addition, reduced nuclear power generation in 2008 caused the start-up of fossil-based peak load plants in the fourth quarter.

1) 90% of these emissions are N₂O emissions and the remaining 10% are CO₂ emissions from operations, business travel and facilities, and emissions of other greenhouse gases.

Emissions of CO₂ per kWh generated energy

g/kWh	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
CO ₂ from electricity generation	1.24	61.3	418	981	545	453	453	441
CO ₂ from heat production	83.1	172	473	163	377	252	255	255

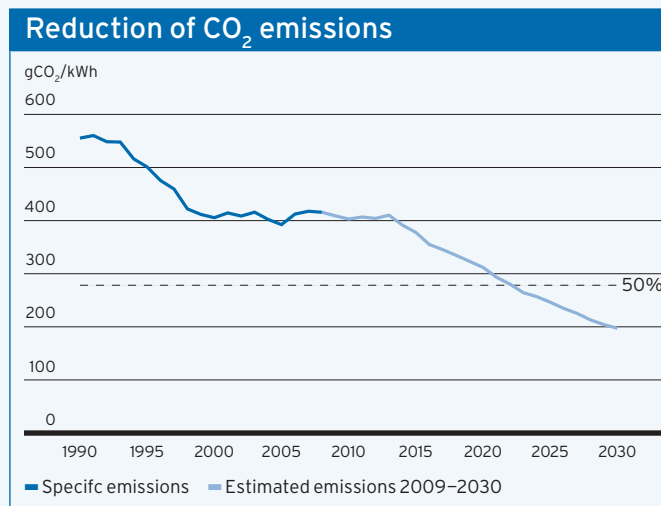
Only minor variations exist in specific CO₂ emissions (per generated kWh) between 2007 and 2008 at the Group level while there were variations at the country level. In general, increased generation in low-emitting generation such as nuclear power, hydro power and biomass combustion leads to a reduction in specific CO₂ emissions. This is also the case for increased energy efficiency in power plants. Vattenfall's long-term targets for CO₂ reductions are set on specific emissions rather than total, since society's need for energy must be met while CO₂ emissions are reduced.

Reduction of greenhouse gas emissions

Vattenfall has set targets for reduced CO₂ emissions. The long-term target is a 50% reduction of CO₂ emissions per unit of generated electricity and heat in existing own operations until 2030, compared with 1990 levels. The short-term business planning target is a 2% reduction, corresponding to 2 million tonnes, in own operations from 2009 to 2011. Vattenfall's climate vision is to be climate-neutral by 2050 (2030 in the Nordic region). These radical reductions will be made possible by developing the generation portfolio towards low CO₂ emitting generation.

Activities and investments to reduce CO₂ emissions include increasing generation from renewable energy sources, equipping coal-fired power plants with Carbon Capture and Storage (CCS) technology, and increasing capacity of nuclear power. In addition, improvements are being made to existing technology in an effort to increase efficiency, resulting in reduced emissions per generated unit of electricity and heat. See EN 3-4 Energy efficiency.

Investments and work on reducing emissions are long-term. A fundamental requirement is that society's need for secure energy supply and stable energy prices is met.



Renewable energy

- In 2008 significant investments were made in wind power projects, making Vattenfall a world leader in offshore wind power. The Thanet Offshore Wind project in UK will have installed capacity of approximately 300 MW. The acquisition of UK-based Eclipse Energy, an energy developer primarily focused on wind, as well as of AMEC Wind Energy Ltd, enables Vattenfall to take an active role in UK wind development. Furthermore, Vattenfall has entered into a partnership with the Scottish giant in the industry of renewables, ScottishPower Renewables, to make joint bids for additional offshore wind development.
- Co-combustion of biomass fuels is increasing. In Poland, the aim is to diversify the fuel mix and 5% of the Żerań and Siekierki power plants' fuel source will be converted to biomass by 2011.
- The "MaxBio" programme in the Danish power plants was established in 2008 and will lead to a dramatic increase in biomass use. An estimated 724,000 tonnes of coal per year will be replaced by biomass by 2018, which will lead to a 27% reduction of CO₂ emissions.
- Development of ocean energy continues and is expected to be the next commercial renewable energy technology after wind power. Vattenfall is co-operating in wave power pilot plants off the coast of Norway and western Sweden. A co-operation agreement regarding wave power development was signed with Irish Wavebob in March 2008, and in January 2009 Vattenfall acquired 51% of the Irish site development company for ocean energy, Pandion Ltd.
- In June 2008, Vattenfall's plans for a new hydro power plant in Abelvattnet, Sweden, were approved by the environmental court, which will enable the construction of a new hydro power plant that will generate 14.2 GWh electricity per year. The planned completion date is 2010.

Coal using Carbon Capture and Storage (CCS)

Vattenfall is a leader in the development and commercialisation of CCS technology. See also Technology as a tool to cut emissions on page 20 and 2008 Annual Report page 16.

- In September 2008, a 30 MWth CCS pilot plant was inaugurated in Schwarze Pumpe, Germany, which will provide valuable experience needed to develop demonstration plants and full-scale commercial power plants.
- In February, 2008 Vattenfall announced the intention to develop a full-scale CCS demonstration plant in Denmark. By 2013, the Nordjylland power plant (Nordjyllandsværket) will be equipped with CCS.
- A demonstration plant is planned for Jämschwalde, Germany, by 2015. Feasibility studies were initiated in 2008.

Nuclear power

Nuclear power generation has very low emissions and plays an important role in Vattenfall's strategy to reduce CO₂ emissions from electricity generation in the markets where it is accepted. Significant investments are being made to further improve operational efficiency and fuel efficiency in the Group's nuclear plants, thereby reducing environmental impact per generated kWh of electricity. In parallel, continuous efforts are being made to ensure excellence in safety management. For additional information see EU20.

Ozone-depleting substances (EN19)

Ozone-depleting substances are used to a very limited extent within Vattenfall's operations and are not a significant issue in the context of overall environmental impact. Hence, there is no aggregate reporting at the Group level.

Emissions to air (EN20)

CO₂ is the predominant emission to air from Vattenfall's operations, see Greenhouse gas emissions (EN 16–18).

Other emissions to air include SO₂, NO_x and particles, which have decreased in recent decades due to the modernisation of generation

facilities and installation of flue-gas cleaning equipment. In 2008, decisions were made to further invest in flue gas cleaning in Poland, see also Technology as a tool to cut emissions, page 20.

Emissions of SO₂, NO_x and particles¹⁾

ktonnes		Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
SO ₂	From generation of electricity	0.092	0.038	0.769	46.5	7.79	55.2	59.1	56.0
	From production of heat	0.308	0.272	0.720	1.18	14.7	17.1	19.8	21.2
	Total	0.401	0.310	1.49	47.7	22.4	72.4	78.9	77.2
NO _x	From generation of electricity	0.155	0.121	1.71	44.1	3.16	49.3	52.3	50.9
	From production of heat	0.734	0.637	1.48	1.72	6.02	10.6	13.2	13.2
	Total	0.889	0.758	3.19	45.9	9.18	59.9	65.5	64.0
Particles	From generation of electricity	0.005	0.005	0.143	1.30	0.429	1.89	2.09	1.76
	From production of heat	0.070	0.051	0.093	0.034	0.918	1.17	1.49	1.82
	Total	0.076	0.056	0.24	1.34	1.35	3.05	3.58	3.58

1) Rounding differences, affecting the last significant digit, may occur in this table.

Emissions of SO₂, NO_x and particles per kWh generated energy

g/kWh		Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
SO ₂	From generation of electricity	0.001	0.049	0.093	0.636	2.07	0.334	0.357	0.331
	From production of heat	0.070	0.197	0.153	0.070	1.35	0.449	0.518	0.530
NO _x	From generation of electricity	0.002	0.155	0.206	0.604	0.838	0.298	0.316	0.301
	From production of heat	0.166	0.460	0.315	0.102	0.556	0.278	0.346	0.329
Particles	From generation of electricity	0.000	0.006	0.017	0.018	0.114	0.011	0.013	0.010
	From production of heat	0.016	0.037	0.020	0.002	0.085	0.031	0.039	0.045

Emissions of SO₂, NO_x and particles per kWh of generated energy from Vattenfall's power plants are decreasing steadily as a result of improved flue gas cleaning and increased generation from low-emitting energy

sources. A significant proportion of the reduction of NO_x emissions is a result of the installation of SCR equipment at the Fyn Power Plant in Denmark in early 2008.

Waste and mineral by-products (EN22)

Waste includes radioactive waste from nuclear power plants, by-products from combustion power plants (including ash), and other treated waste.

Radioactive waste

Nuclear power plants in Sweden and Germany generate radioactive waste. The handling of radioactive waste is further described under management approach. The amount of spent nuclear fuel was lower in 2008 and 2007 compared with 2006 due to outages at nuclear power

plants. The amount of medium and low-level radioactive waste and nuclear core components depends on ongoing projects in the nuclear power plants and which year the waste is deposited.

Radioactive waste

	Sweden	Germany	Total 2008	Total 2007	Total 2006
Medium and low-level radioactive operational waste (m ³)	3,650	21.8	3,670	1,290	488
Nuclear core components (tonnes)	0.273	0	0.273	10	4.5
Spent nuclear fuel – assemblies taken out (tonnes)	206	0	206	202	245
Spent nuclear fuel – original uranium content (tonnes) ¹⁾	147	0	147	148	176

1) Original uranium content is a subset of assemblies taken out

Treated waste

Handling ash from waste incineration is strictly regulated. Ash is reused to the greatest possible extent, and smaller fractions with high metal content are deposited at special sites. Fly ash from Uppsala waste incineration plant is sent to Langøya, Norway for reuse as filling material. Amounts of waste vary from year to year depending on type of operation, ongoing construction work ,etc.

A significant quantity of waste in the Nordic distribution operation consists of discarded poles from overhead distribution grid lines. The Swedish distribution network alone uses approximately 1.2 million poles, most of which are impregnated with creosote. When poles are replaced, the discarded poles are used as fuel at the Ludvika Heat power plant. In 2008, 15,000 poles were used as fuel.

Treatment of waste

Treatment of waste		Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Hazardous waste excl. radioactive	Recovered	1.58	0.051	0.058	75.1	0.137	77.0	79.0	45.3
	Deposited	0.233	0.23	1.20	19.5	0.540	21.7	19.5	43.3
Non-hazardous waste	Recovered	4.10	2.39	3.79	173	9.90	193	267	156
	Deposited	17.7	0.117	0.377	19.0	1.25	38.4	24.3	27.7

By-products

The most significant by-products are ash from lignite and hard coal-fired plants, and gypsum from flue-gas desulphurisation. This gypsum is sold to Europe's gypsum and cement industry.

Ash from lignite power plants is mainly used in the open-cast mining area for landscaping the post-mining environment. Ash from Vattenfall's hard coal combustion in Germany is used as a component in construction materials. In Poland, 100% of the ash from coal combustion is currently used, for example in road construction. Most of ring roads of the neighbouring cities have been built using ash from Vattenfall plants.

Ash from the CHP Siekierki plant meets the requirements of the EN 450 norm and is therefore a product that may be used for production of concrete. In Denmark, all coal ash and gypsum is used primarily for industrial purposes, e.g., in the building and construction industry. Almost all ash from heat operations in Sweden is recycled, mainly as construction and filling material, such as in road construction. Some of the ash from biomass combustion is spread in forests as fertiliser.

In 2008, in countries where fossil based generation decreased, this also resulted in less ash produced. As biomass fuel use increases, ash from biomass fuels also increases.

Total by-products¹⁾

Total by-products ¹⁾	Sweden	Finland	Denmark	Germany	Poland	Total 2008	Total 2007	Total 2006
Fly ash	10.3	14.5	250	4,430	475	5,180	4,980	4,930
Furnace bottom ash	5.29	1.06	25.8	1,070	55	1,160	1,170	1,250
Ash from biomass fuels	47.5	2.99	0.165	13.6	0.0	64.2	55.2	46.9
Slag from waste incineration	56.4	0	0	231	0.0	287	275	276
Gypsum	0.608	0	51.4	2,860	0.0	2,910	3,060	3,090
Other by-products	4.24	0	28.5	44.6	0.0	77.4	61	86.2
Total	124	18.6	355	8,650	531	9,680	9,590	9,690

1) Rounding differences, affecting the last significant digit, may occur in this table.

Spills and contamination (EN23)

No significant spills were recorded in 2008.

Risk for spills and other contamination is monitored, managed and mitigated locally. Incidents that could possibly result in significant environmental impact, such as spills, leaks and contamination, are reported according to Vattenfall's Incident and Crisis Management (ICM) framework, see EU20.

Many of Vattenfall's facilities have been operating for a long time. Work is under way to identify land that was contaminated during times when environmental awareness was lower and environmental legislation was less rigorous. Contaminated land exists in the Nordic countries, Germany and Poland. Known contaminated sites have been identified and characterised. Action to restore such land is taken when necessary and in dialogue with the authorities.

Monitoring programmes have been developed. For example, all potentially contaminated sites around Vattenfall's facilities along the Lule River have been identified, and potential risks associated with the contamination have been assessed. In accordance with established programmes, necessary measures will be adopted no later than 2010. The plan for taking care of contaminated land is progressing on schedule.

In order to reduce the risk for oil leaks from electricity distribution operations and transformers in water protection areas, Vattenfall has a programme in force in Sweden for exchanging pole-mounted transformers with ground stations. An inventory taken in 2008 shows that out of a total of approximately 40,000 transformation stations, 1,474 are situated in water protection areas, and out of these, 200 are pole-mounted.

Fines and incidents (EN28)

During 2008, Vattenfall implemented a Group-wide Incident and Crisis Management (ICM) organisation. For additional information, see EU20.

Environmental incidents and the handling of fines are regulated under Vattenfall's environmental policy, stating that Vattenfall shall comply with existing laws, regulations and permits and take preventive and/or remedial action in order to reduce environmental impact as well as make advance assessments of the environmental impact of new activities. When accidents occur, Vattenfall acts to minimise the damage, restore any damage caused and take precautionary measures to avoid future incidents. On a quarterly basis, all Group functions, business units and shared service centres report on progress in environmental protection as well as on accidents and incidents regarding environmental impact.

In Sweden, two legal actions have been reported pertaining to remediation costs for after-treatment measures to repair damage to the environment on an industrial site. The two claimants state that according to the Swedish Environmental Code, liability for remediation of the polluted site still rests with the Swedish state. The liability claim rests on the Swedish state's role as previous owner of the property and operator of the now closed-down thermal power plant. The Ministry of Enterprise, Energy and Communications has decided that both cases are to be handled by Vattenfall Nordic. The likely outcome for Vattenfall is hard to predict.

Environmental protection expenditures and investments (EN30)

Vattenfall strives to take environmental aspects into account in all decision-making and investment planning. Investments aiming to improve environmental performance are not specifically reported.

For information on investments made in 2008 and planned investments, see page 73, Economic performance management approach.

For information on research and development (R&D) spending, see EU7.