Energy transition in Europe

An overview of status and policy strategies for transforming European energy systems

EPTA

European Parliamentary Technology Assessment

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Introduction

Climate change and increasing energy demand have made the transition to new energy systems a major challenge for Europe. Countries and regions aim to reduce emissions of CO_2 and other climate gases, to increase production of energy from renewable and other sources, and to improve security of supply.

This report provides an overview of energy transition issues in 12 European countries, the region of Flanders, and the European Union. It presents both an overview of the current energy mix, and the range of different policies to change energy systems in the respective countries. The presentations share a common structure, while at the same time allowing for a focus on country-specific issues:

- *Present status*: what are the main energy sources, and what is the relative contribution from renewable energy?
- *Renewables*: which renewable sources are used for energy production, and what are the political strategies for the future?
- *Clean fossil fuels*: is there current or planned activity to capture and store carbon from coal and gas in environmentally safe ways?
- *Nuclear energy*: is it important for electricity supply, and what are the future prospects within each country?

Presentations have been kept short to ensure readability, accessibility and oversight. As this report shows, renewables still play a limited role in the energy production of most countries. The report also gives an overview of the different policy tools, strategies and technologies that are being developed around Europe. We hope that this will be valuable to parliamentarians and other policy makers.

This report is the result of a joint project of the following members of the European Parliamentary Technology Assessment network (EPTA):

- *Austria*: Institut für Technikfolgen-Abschätzung - Institute of Technology Assessment (ITA).
- *Denmark*: Teknologirådet - Danish Board of Technology (DBT).
- *European Parliament*: Scientific and Technological Options Assessment (STOA).
- *Finland*: Tulevaisuusvaliokunta - Committee for the Future, Finnish Parliament.
- *Flanders*: Vlaams Instituut voor Wetenschappelijk en technologisch apectenonderzoek (viWTA) - Flemish Institute for Science and Technology Assessment.
- *France*: Office Parlementaire d'evaluation des choix scientifiques et technologiques (OPECST) - Parliamentary Office for Evaluation of Scientific and Technological Options, French Parliament.

- *Germany*: Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag (TAB) - Office of Technology Assessment at the German Parliament.
- *Greece*: Committee on Technology Assessment, Greek Parliament.
- *Italy*: Comitato per la Valutazione delle Scelte Scientifiche e Tecnologiche (VAST) - Committee for Science and Technology Assessment, Italian Parliament.
- *The Netherlands*: Rathenau Institute.
- *Norway*: Teknologirådet - Norwegian Board of Technology (NBT).
- *Sweden*: Association of Swedish Members of Parliament and Researchers (RIFO).
- *Switzerland*: Zentrum für Technologiefolgen-Abschätzung - Centre for Technology Assessment at the Swiss Science and Technology Council (TA-Swiss).
- *United Kingdom*: Parliamentary Office of Science and Technology (POST).

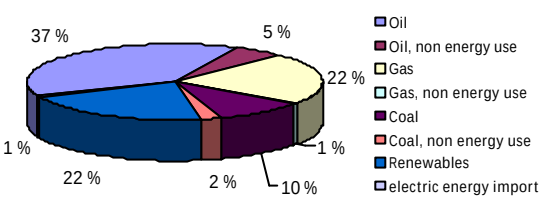
The different institutions are responsible for the description of the country or region where they belong. The project has been coordinated and managed by the Norwegian Board for Technology (Teknologirådet), which holds the EPTA presidency for 2006. We would like to thank all participating institutions for their contributions to this extremely important topic.

Tore Tennøe, Director and Jon Fixdal, Project coordinator

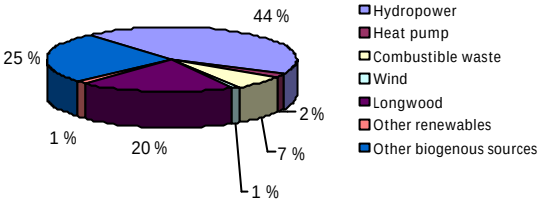
Oslo, 13 October 2006

AUSTRIA

PRESENT STATUS



Primary energy consumption 2004. Total: 1.394,6 PJ



Energy production from renewables 2004. Total 300,1 PJ

Austria is able to produce 30.0%[1] of her annual energy needs by indigenous sources. Indigenous sources are mainly renewable resources, while the main share of fossil fuels has to be imported.

ENERGY TRANSITION

1. Renewable energies

Hydroelectric power

In 2004, about 10.2 % of Austrian energy needs were produced by hydroelectric power plants. Large scale plants (above 10 MW) produce about 33 TWh electric energy annually[2]. Small scale plants (below 10 MW), produce an additional 4.2 TWh. The Austrian Eco-Electricity Act of 2002 which expires for small hydroelectric power plants on Dec. 31st, 2007, sets strong incentives for the refurbishment of old small hydro power plants and the construction of new ones. Some large scale plants are planned in the Alps, especially in the western part of the country, with one already under construction. More large scale plants are not planned due to their intensive environmental impacts.

Bio-energy

Bio-energy accounts for some 157 PJ of annual production, which is 12.24 % of primary energy demand (if non-energy uses are disregarded). Logwood still dominates. The highest growth rates can be seen for pellets and bio-diesel.

In January 2006, 231 biogas plants were in operation throughout the country with a total capacity of 50.7 MW, producing about 217 GWh of electricity in addition to heat. At the end of 2006, about 187,000 tons of bio-diesel will be produced in Austria. Important discussion points are Public support for bio-energy systems concerning energy transition in Austria and feed-in tariffs.

Heat

More than 1,000 district heating plants were operated in the country at the end of 2005. They burn some 8 to 10 PJ of primary energy (mostly bark and sawmill residues) to produce district heat. Some larger plants are equipped with additional solar collectors and/or with CHP units (Combined Heat and Power production). Waste combustion is an important energy source for district heat production in big cities such as Vienna.

Wind

Although a landlocked country with relatively limited wind conditions, as compared to countries with sea-coasts, more electricity from wind energy is produced in Austria than in comparable European countries with favourable coast lines (for example Greece, Ireland and Norway).[3]

Annual electricity produced from wind, based on installed capacity as of June 2006, will amount to about 2 TWh or some 2.9 % of Austrian gross electricity consumption. IG Wind, the Austrian Wind Energy Association, proposes to provide some 10 % of Austrian electricity from wind energy by 2015. Environmental and social impacts of the further construction of wind energy farms are important discussion points.

Solar energy

Solar Thermal Energy plays an extraordinary role in Austrian energy supply, the country ranks second or third in the world in terms of collector area installed per capita. At the end of 2005, 3 million m^2 were installed in Austria, representing an installed thermal power of roughly 2.1 GW, producing some 1.03 TWh of useful heat energy per year. 232,000 m^2 of solar collectors were added in 2005, mostly produced in the country itself.[4] Some 24 MW of solar electricity were installed in Austria at the end of 2005, 3 MW of it in island mode, the remainder connected to the grid.

Financial mechanisms for renewables

The nine Federated States (Länder) have different support schemes. The Ministry of the Environment supports measures in companies that increase energy efficiency or make use of renewable energy resources. The Eco-Electricity Act encourages production via feed-in tariffs. The tariffs will in the future be supplemented by a total limit to the overall amount of financial support; this will practically limit the number of new projects to be supported.

2. Clean fossil fuels

Research is being conducted on CO_2 Separation and Sequestration technologies (CSS). The Austrian company OMV is a partner in the IEA Implemention Agreement „Enhanced Oil Recovery". CSS activities in Austria are mainly restricted to almost empty oil and gas fields in the eastern part of the country, where space for about 400 million tons of CO_2 would theoretically be available.

3. Nuclear energy

Austria has no nuclear power plants. A ready-to-run plant in Zwentendorf did not start operation due to the result of a referendum in 1978 (50.5 % against operation). In the aftermath of the referendum, a law was adopted by the Austrian Parliament which practically stopped the construction and operation of nuclear power plants for the future. There has recently been a debate in parliament about Austria's participation in the Euratom program and the support of the ITER project.

Austria does, however, import electricity via the international grid system, which is mixed with nuclear energy. There is broad national consensus that the country should not operate nuclear power plants. The discussion about potential environmental and health risks originating from nuclear plants has for a long time been a source of conflict between Austria and her northern and eastern neighbour countries.[5]

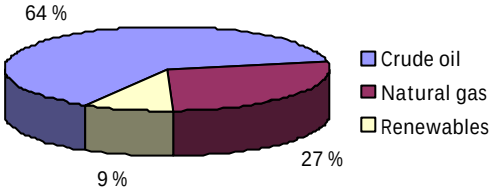
4. Energy efficiency

Energy efficient buildings (passive houses) will be an important issue in the coming Austrian National Action Plan for Energy Saving Innovations. There are also debates on supply security and resource management to prevent the intensive use of natural resources. Important points for discussion are among others:

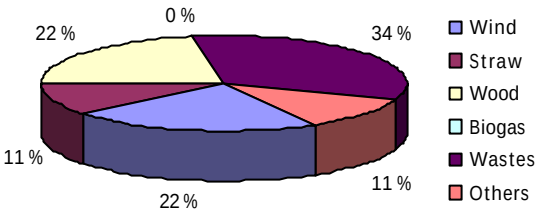
- Implementation of climate protection measures in factories versus competitiveness
- Support of central large-scale power plants versus fostering decentralised energy systems.

DENMARK

PRESENT STATUS



Primary energy production 2004. Total: 1302 PJ



Primary energy consumption renewables 2004.

In 2004, Denmark's production of crude oil, natural gas and renewable energy etc. was 1302 PJ. Biomass currently accounts for approximately 80 % of the production of renewable energy, mostly in the form of straw, wood and wastes. The degree of self-sufficiency for energy was at 156 per cent in 2004, meaning that the production of energy exceeded consumption by 56 per cent. Production of crude oil was 2.4 times higher than oil consumption, so most of the crude oil was exported. Domestic energy consumption (excluding transport) is at 839 PJ, and is covered by roughly equal parts natural gas, coal, crude oil and renewable energy etc.

ENERGY TRANSITION

1. Renewable energy

Year by year, renewable energy is accounting for a greater share of the total energy consumption. Production of renewable energy has increased by almost 90 % between 1994 and 2004. In 2004, the domestic production of renewable energy covered 14.2 per cent of the domestic energy consumption.

Bio-energy

Denmark has more than tripled the share of biomass in the energy supply since 1980. In 1993 a majority of the political parties agreed on the Biomass Agreement, which increased the use of biomass at co-generation plants, bringing the use of biomass in energy production up to 100-105 PJ per year. Today there are no official plans of increasing the use of biomass beyond the objects of the Biomass Agreement.

Modest targets have been laid down for the use of gaseous and liquid biofuels. Biogas is subsidized, but there is a ceiling on the subsidies, setting a maximum limit of 8 PJ of biogas annually by the end of 2008. The Danish government has decided on a biofuel target of 0,1 % biofuel for transport in 2006. A biofuel target for 2010 has not been decided yet.

Wind

Wind power accounts for an important share of the total production of renewable energy in Denmark. In January 2005 the total capacity of wind turbines was 3118 MW, of which 424 MW was offshore wind turbines. In March 2004 a majority of the Danish Parliament (Folketinget) agreed that another two offshore wind farms of 200 MW each should be built and ready to operate in 2008. The agreement also includes scrapping of windturbines on land in order to expand the total capacity, while older, inconveniently positioned wind turbines are decommissioned. The replacement scheme aims at increasing the wind power capacity on land by 350 MW in the years 2005-2009.

Co-generation of heat and power

An extended co-generation of heat and electricity characterizes Danish energy supply. About half of the total generation excluding wind power and hydropower is generated in combination with heat, and about 80 % of the district heating is generated together with electricity. The co-generation also has a high priority in the current Danish energy policy.

2. Energy savings

Since 1980 the domestic energy consumption has been fairly constant, even though the Danish GNP has increased by about 50 %. The explanation for the stabilized energy consumption is partly commercial shifts to less energy consuming activities, but also a greater efficiency in the production of heat and power. Furthermore, a better exploitation of the energy has also played a role; isolation of buildings etc.

In June 2005 Folketinget agreed on a new plan of action for energy savings in the years to come. The objective is to implement energy savings corresponding to an average of 7,5 PJ per year in the period 2006-2013. It is the assumption that these energy savings will surpass the increasing energy consumption in the same period so that the overall energy consumption will be reduced.

3. Clean fossil fuel

In the 1990s, Danish energy planning resulted in a widespread conversion from heat production using oil and coal to natural gas-based co-generated heat and electricity and biomass-based heat production.

Clean coal

As a consequence, since 1990 coal as a fuel in domestic production of heat and electricity has been severely reduced – by almost 50 %. However, as coal still accounts for a substantial share of domestic energy supply, efforts are made to reduce the harmful emissions from the coal-fired plants. These efforts include increasing the efficiency of the plant and developing technology for exit gas cleaning.

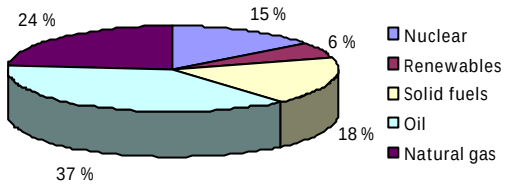
Natural gas

The use of natural gas to cover domestic energy consumption has gone up by 137 % in the past 15 years. The increased use of natural gas is due to political objectives of reducing dependency on foreign oil and coal and reducing emissions of CO_2, SO_2 and NO_x. There is still a political agreement on reducing these emissions, and natural gas will probably continue to play an important role in these efforts.

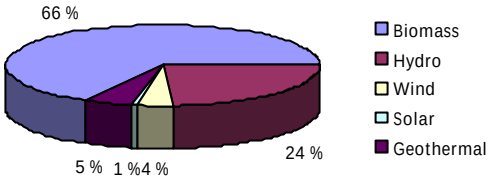
4. Nuclear energy

Since it was decided in 1985 that Denmark should definitively avoid nuclear power in the energy production, nuclear energy has not been on the political agenda.

EUROPEAN UNION



Relative gross inland consumption EU25 (2003)



Relative gross inland consumtpion renewables (2003)

The major challenges: Security of energy supply and climate change

50 % of EU energy requirements are currently met by imported products. In 2003 the EU imported 76.6 % of its oil demand, 53 % of its gas demand and 35.4 % of its coal demand. Foreign dependence is projected to reach 70% in 30 years if domestic energy does not become more competitive. By 2030 it is estimated that the EU will be 90 % dependent on imports of oil and 80 % of gas. This is happening in an environment of increasing world energy demand, which is expected to be higher by some 60 % in 2030.

Against this background, the recent energy disputes between Russia and its neighbours, and an increase in crude oil and gas prices demonstrate the vulnerability of both the supply and distribution of energy and show the need for action. Secure energy supply requires a combination of internal and external policies. The development of a coherent external EU energy policy would enhance the collective external energy security of the EU (e.g. diversi-fication of energy sources and geographical origin; see first diagram for current energy mix).

Climate change is the second major challenge confronting the EU and, given that most of CO_2 emanates from the energy sector, is intrinsically connected with future European energy policy. The EU adopted the first Emissions Trading System (ETS) worldwide in order to attain its commitments under the Kyoto Protocol. We will see below some further aspects of EU energy policy which should contribute towards combating global warming.

"A European strategy for sustainable, competitive and secure energy"

In March 2006 the European Commission adopted a Green Paper with the above title.[6] The Commission proposes a framework for developing a European energy policy comprising a clear common approach and a capacity of periodic updating following a

regular "Strategic EU Energy Review". Six priority areas are identified: completing the internal electricity and gas markets, ensuring that the internal energy market guarantees security of supply and solidarity between Member States, moving towards a more diverse energy mix while respecting Member State choices, dealing with the challenges of climate change by promoting energy efficiency and the use of renewable energy sources, encouraging innovation via a strategic European energy technology plan and establishing a coherent external energy policy.

The EP welcomed the Green Paper and is currently preparing a report which is expected to be voted upon in November 2006. As a follow-up to the Green Paper consultations and the responses of the European Council, the Council and the Parliament, the Commission will present a Strategic EU Energy Review and energy package, seeking to establish a new coherent framework ensuring better coordination of energy actions within Europe.

Completion of the Internal Market for electricity and gas

A 2006 EP external study,[7] commissioned on behalf of the Committee on Industry, Research and Energy, has shown that there is still a significant lack of market integration in the electricity market. While some local or regional markets clearly profited from liberalisation, there is relatively little progress at EU level. The markets of several Member States are still government-dominated with little regulatory independence.

While acknowledging the diversity of regional EU electricity markets, the study asserts that price structures are largely similar, with a wider choice of tariffs for industrial than for domestic consumers. The study considers that it would be desirable to increase cross-border connectivity between Member States and that long-term contracts would improve efficiency in the electricity industry, while recommending enhanced market (price) monitoring.

As from 1 July 2007 both industrial and domestic EU energy markets will be fully open, there is a pressing need for speeding up implementation of the Internal Market directives on energy and reacting appropriately to market failures. To guarantee fair competition amongst suppliers, the formation of oligopolistic energy markets will have to be avoided, while the unbundling of generation, supply and distribution grids will have a key role to play.

Enhancing energy efficiency

This is an efficient and cost-effective reaction to current energy concerns (regarding security, rising and volatile energy prices and climate change). To this end, it is important that existing EU legislation in this field (notably the directives on energy performance of buildings, combined heat and power, eco-design, emissions trading,

liberalisation of energy markets and energy end-use efficiency) is implemented properly and in a timely fashion.

The EU could save at least 20 % of its present energy consumption in a cost-effective manner. In order to make this happen, action is needed at all levels, from local to global, and with participation of all stakeholders. This should primarily include full implementation and extension of existing legislation, but also mobilisation of European financial instruments (Structural Funds, R&D and innovation programmes), fiscal measures, information / awareness-raising campaigns and the creation of an Energy Efficiency Fund. Energy efficiency should also be integrated into EU transport, agricultural and foreign policies.[8] In fact, the Commission will soon be adopting an Action Plan on Energy Efficiency.

Renewable energy sources

In 2001 the EU set a target for increasing the overall share of renewable energy sources (RES) in energy consumption from 6% to 12 % by 2010, with the RES contribution to electricity production to increase from 15.2% to 22.1 %[9] and that of biofuels to the total fuel energy production to 5.75 %.[10] Taking stock of the progress made, the EP has called for a 20 % RES target in energy consumption by 2020, while, with the right conditions, a more ambitious target would be feasible[11] (see second diagram above for current relative RES use).

Demand for energy for heating and cooling is growing rapidly in the EU. Legislation is urgently needed if the share of renewable energy in these sectors - mainly RES with a high but largely unutilised potential, such as geothermal, solar thermal and biomass - is to be increased from its present level of around 10 %. The EP called for legislation to at least double by 2020 the share of renewable energies used in Europe for heating and cooling.[12]

Nuclear energy

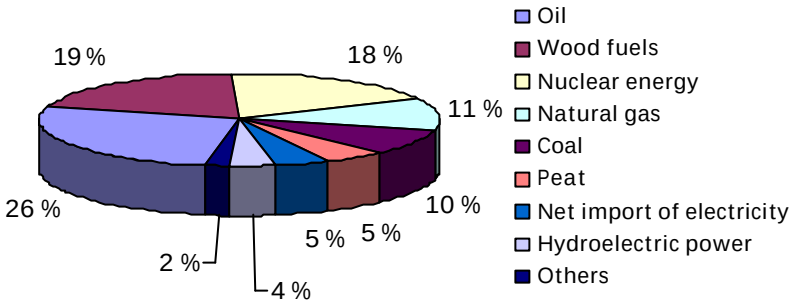
Nuclear energy belongs to the political debate on the energy mix. One has to recognise the role it plays in some Member States in maintaining security of electricity supply and as a way of avoiding CO_2 emissions. Decisions on the nuclear option will continue to be taken at Member State level within the framework of subsidiarity[13].The EU is dependent on imported natural uranium for its utilities. In 2005 more than three quarters of this uranium was supplied by Canada, NIS (countries of the former Soviet Union), Australia and Niger.

The Euratom Research Framework Programme 2007-2011 contains substantial funding for fusion energy research, in line with the international commitments undertaken by the EU for the realisation of ITER (International Thermonuclear Experimental Reactor) together with the US, Japan, Russia, India, China and the Republic of Korea. In June 2005 the partners agreed to build the demonstration plant in Cadarache, France, and the first

plasma operation is expected in 2016. The aim of the ITER experiment is to establish the technical feasibility of fusion power generation, but commercial deployment is not expected before the 2030s.

FINLAND

PRESENT STATUS



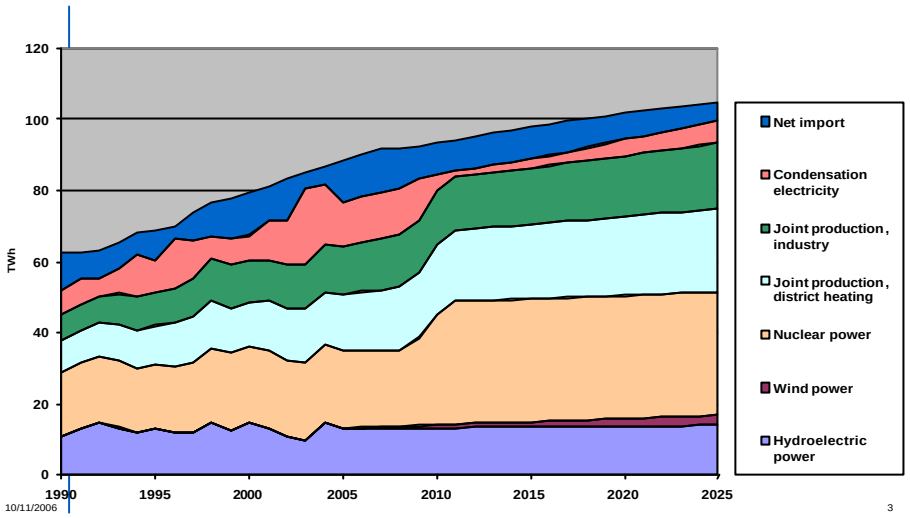
Share of total energy consumption 2005

Electricity is versatilely produced in Finland using different energy sources and production forms. The most important production sources for electricity are nuclear power, hydroelectric power, coal, wood fuels and peat. The share of wind power is small but it is increasing. The share of hydroelectric power, and in conjunction to it, that of fossil fuels, mainly coal, in electricity production varies considerably according to how much the Nordic market can provide hydroelectric power from Norway and Sweden. Nearly one-third of electricity is produced as joint production in conjunction to heating production, when the respective share in the EU amounts to 9 percent. Finland is globally a leading country in combined heat and power production (CHP). Nearly 80 percent of district heating production is based on CHP.

Electricity production in Finland is rather decentralized compared to many other European countries. A versatile and decentralized electricity production structure increases the security of electricity procurement.§By far the most energy was imported from Russia to Finland, the share of which in the total import amounted to 70 percent. Mainly raw oil, natural gas, coal and electricity were imported from Russia. The next biggest import countries were Sweden, Denmark and Norway.

The Finnish Parliament adopted recently a report made by the Commerce Committee on the defining of the energy and climate policies in the near future – the national strategy for the realization of the Kyoto Protocol. The starting point in this report is that the drafting of a national energy and climate strategy requires the extensive examining of the entirety related to the issue on a rather long-term basis. A scenario analysis has

been conducted for the work ranging to the year 2025, which is a traditional way of approach in projects like this, according to the report.



Electricity procurement strategy. Source: Ministry of Trade and Industry

The report states that one of the strengths of Finland's energy supply is the versatility of procurement and the larger share of bio energy and renewable energy sources compared to the European average both in primary energy and electricity. It is essential that, also in the future, electricity procurement remains versatile and the capacity remains sufficient.

Finland is one of the leading countries in the world in exploiting renewable energy sources and especially bio energy. Renewable energy forms provide one-fourth of the total energy consumption in Finland. Their share in electricity production amounts to nearly 30 percent. The most important renewable energy forms used in Finland are bio energy, especially wood and wood-based fuels, hydroelectric power and wind power.

1. Nuclear energy

The most important energy development in Finland is the development of a new prototype nuclear power plant, scheduled to come on line in 2009. Finland already has two such facilities providing 30 % of the country's power generation with four reactors. In May 2002, the Parliament ratified the government's earlier decision-in-principle in favour of the plant.

2. Renewables

Bio energy

In Finland, wood-based fuels produce 20 percent of the consumption of primary energy and 10 percent of electricity. The share of black lye produced as a by-product in cellulose production amounts to approximately 50 percent of the total consumption of bio energy in energy production in Finland and 45 percent of the electricity needed by paper mills. The main objectives of research and development work related to soda recovery units are to improve reliability, the management of emissions and a higher efficiency of electricity production.

Hydroelectric power.

Along with bio energy, hydroelectric power is the most remarkable renewable energy source in Finland. In the year 2005, hydroelectric power produced 13.6 terawatt hours of electricity. The unbuilt hydroelectric power potential theoretically responds to an annual electricity amount of approximately 10 terawatt hours.

Wind power.

The construction of wind power has progressed more slowly than anticipated. At the end of the year 2005, Finland had wind power production at 94 plants amounting to 82 megawatts, when the objective set in the renewable energy promotion programme was 500 megawatts by the year 2010. This has been influenced by the bad profitability of wind power without considerable investment support.

Waste

A great deal of *recyclable fuels and municipal waste* remains unexploited in energy production due to the tight conditions set to it. One should draft an action plan for the developing of its treatment and recycling. The energy advantage received by waste incineration and new waste technologies is considerable and, at the same time, greenhouse gas emissions can also be directly reduced.

Heat pumps and ground heat

According to an expert statement, heat pumps are one of the most efficient single ways to improve the total efficiency of used energy and to diminish greenhouse gas emissions.

Solar energy.

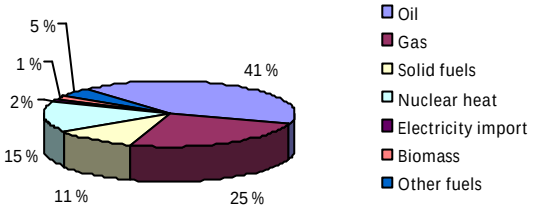
To develop the market for solar energy Government promises to support research and development in the field and experimental actions.

Peat.

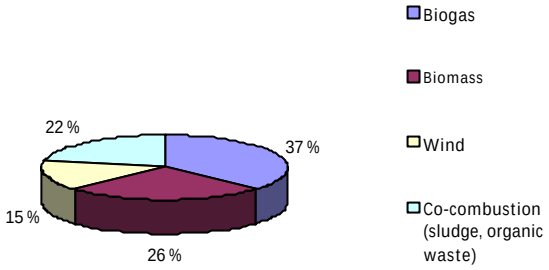
After the launching of emissions trading, the state of peat has become more difficult and it has been profitable to replace peat with other fuels.

FLANDERS

PRESENT STATUS



Gross domestic energy consumption of Flanders 2004. Total: 1600 PJ



Energy production from renewable sources 2004. Total: 627 GWh

ENERGY TRANSITION

1. Renewable energies

Domestic energy production from renewable sources was 627 Gwh (2004), or only 1,3% of all electricity produced in Flanders.

Small scale hydroelectric power

The share of hydropower remains restricted due to the limited differences in height. Total production potential is estimated to 1 MWe (included 0,689 MWe green certificates).

Wind

The installed on shore wind power is 102,342 MWe (2005). Several consortia are involved in installing a far off shore wind park at the Belgian coast of the North Sea. C-power started the engineering of a far shore wind park on the Thornton sandbank, at a distance of 30 km from the coastline (50 turbines , each 3,6 to 5 MWe, or an installed capacity of 216 MWe tot 300 MWe), to be connected in 2010. No near coast projects were allowed due to strong opposition mainly fear for esthetical pollution.

Photovoltaics

It is difficult to estimate power production by means of photovoltaic cells, but it probably amounts to less than 0,5 % of the electricity generation of renewable sources. Mid 2005 the amount of installed power from photovoltaic panels was 1,011 MWe.

Bio-energy

The area available for the production of rape seed is 185 ha, 60% for non food utilisation (Belgium: 5.891 ha). The production of bio-fuels started recently. At this moment two industrial plants are starting up (Ghent Bio-Energy Valley: 80 kton bioethanol, 300 kton biodiesel).

Bio-electricity

Installed power plants in Flanders:

- green electricity from biogas : 28,957 MWe (2005)
- (mainly one single wood gasifier unit in Ruien (17 MWe)
- green electricity from landfill gas 17,522 MWe (2005)
- electricity from co-combustion of wood, sludge, 147,8 MWe (2005, green certificates)
- electricity from waste: 36,5 MWe (only 26,1 MWe allowance of green certificates)

2. Capture and storage of CO_2

The Flemish research institute (Vito) is involved in geological research to examine the usefulness of the coal pits in Flanders, which are been closed for 10 to 15 years for economical reasons, for a storage of $C0_2$ in an environmental safe manner.

3. Nuclear energy

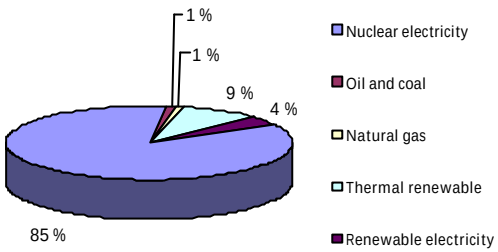
Nuclear energy counted for 46,4 % of the electricity production (2004) in Flanders (Belgium: 55,1 % from nuclear). Four units are located near Antwerp: two small units (1975) with a capacity of 400 MWe and two larger units with a capacity of 1.000 MWe (1980), in total 2.816 MWe. Three units are located in Tihange (Wallonia).

The Belgian government decided in 2003 to phase out the nuclear electricity production no new nuclear power plant should be build. The exciting units have to close down after a technical life time of 40 years (all smaller units in 2015 (2 in Flanders, 1 in Wallonia), and four units in 2022-25 (2 in Flanders, 2 in Wallonia)).

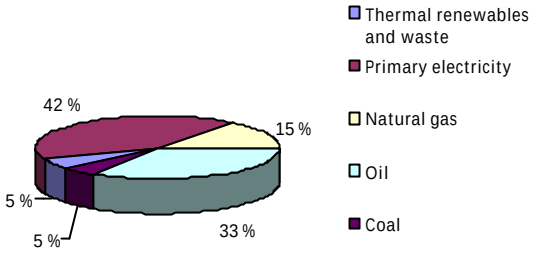
Several lobbies are active to change this law; no prediction can be made whether or not the next government might withdraw this decision. Due to the ongoing merging of Suez and GdF, by which Electrabel gets back its strong monopolistic situation as an Belgian electricity and gas provider, nuclear energy gets back into the picture. F.i. to end up with a competitive market (at least three players) the larger units are for sale, therefore the technical life time must be prolonged.

FRANCE

PRESENT STATUS



Primary energy production 2005. Total: 137,6 Mtoe



Primary energy consumption 2005. Total: 276,5 Mtoe

Compared with most industrialized countries, France undergoes the major disadvantage of having no noticeable fossil fuel resources since the shutdown of its last coal mine in 2004. As a matter of fact, its 2005 oil and natural gas production amounted to 2.4 Mtoe whereas its primary consumption of coal, natural gas and oil reached 146.5 Mtoe.

France already scored less than 30% for its energy self sufficiency during the 1970 decade. As a consequence, it was decided in 1973 to build up a nuclear power programme to increase the energy security of supply. Thirty years later, France's self sufficiency has reached 50%, thanks to the contribution of its nuclear plants.

An important pay-off of the French nuclear programme is that it allows a limitation of France's CO_2 emissions. As a matter of fact France has one of the best records among OECD countries, in terms of CO_2 emissions per capita. When the average in OECD countries stands out 3 tC per capita, France's record is 1.7, close to the best players which are Sweden and Switzerland.

Energy transition has in France several dimensions which read handling now the replacement of base load nuclear power plant with new generation nuclear reactors, energy savings and energy efficiency, development of renewable energy in the fields of electricity generation, residential and biofuels.

ENERGY TRANSITION

1. Preparing for the replacement of the nuclear generating capacity

France increased its nuclear generating capacity by 50 GW between 1980 and 1990. An equally rapid decrease could remove the bulk of the French capacity if its replacement was not dealt with in time. In order to cope with this potential cliff effect, France has decided in 2005 to start handling now the replacement of EDF base load power plants. Its first-of–a-series EPR (European Pressurized water Reactor) should start operation at Flamanville in 2012. Another major decision is to build by 2020 a Generation 4 reactor prototype.

In the next decades, France is likely to keep its nuclear generating capacity at the current level (65 GW). Gas combined cycle and wind or biomass electricity should fulfil the increase in electricity needs if the nuclear energy share in production was not to be emphasized.

2. Energy savings and energy efficiency

Inasmuch as fossil fuels represent 53% of the total primary energy consumption in France, consuming less fossil energies by better consumption is a priority. In accordance with the 2005 Act on energy policy, a system of energy saving certificates is being implemented which prescribes direct or indirect energy savings from energy suppliers. In the field of electricity generation, obsolete coal thermal power plants will be replaced by high energy performance facilities. As regards residential, energy savings are expected from solar water heaters and photovoltaic heating roofs, tax credits contributing to increasing their rate of installation up to respectively 200,000 and 50,000 units per year in 2010.

More rigorous technical norms and fiscal incentives are set in place, aimed at energy efficiency in the field of residential and of the automotive sector. The 2005 residential thermal regulations are aimed at reducing energy consumption in new buildings to be reduced by 15 to 20% compared with previous standards. Energy labels or minimum energy efficiency are set in place for domestic appliances and voluntary agreements by car makers to lower average CO2 emissions level for new vehicles.

Thanks to these various policy measures, the energy demand growth should slow down from +2%/year during the 1995-2002 period, to +1,7%/year during the 2006-2010 period and to +1,3%/year during the 2010-2015 period.

3. Renewables

In 2005 hydroelectricity has accounted for 56,9 TWh, that is 92.9% of electricity generation with renewable energies in France, wind energy for 1 TWh (1.6%) and thermal renewable for 3.4 TWh (5.5%).

While hydroelectricity is expected to increase slightly, mainly through micropower stations, wind energy is rapidly increasing. The wind installed capacity, which was less than 600 MW at end 2005, should reach 2000 MW at the beginning of 2007, the 2010 target being 13500 MW. At that time wind electricity generation should equate 30 TWh and hydroelectricity 70 TWh. Development of biomass electricity from wood and municipal wastes is another priority.

Two main mechanisms are used to reach these policy goals. Distributors are required to purchase renewable electricity through fixed tariffs which are beneficial to producers. If necessary, the Government submits to investors additional calls for tenders with specific incentives.

Biomass energy

Biomass energy in France amounts to 11.5 Mtoe per year. Wood energy and wooden residues represent the bulk of it (9 Mtoe). Municipal and industrial waste totals 2 Mtoe, and biogas only 0.3 Mtoe. Currently biomass energy is mostly used for domestic heating through individual installation but heating or cooling networks should take advantage of their competitive edge in the near future.

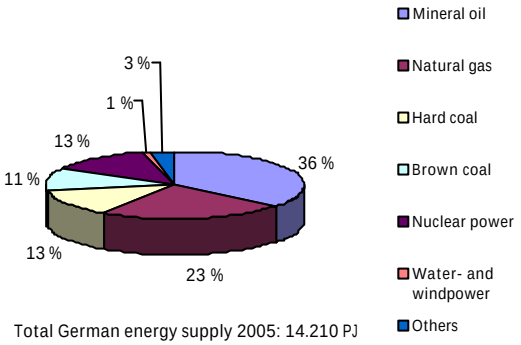
Biofuels

The European Union has set up two market share goals for biofuel consumption: 5.75% of the total fuel consumption in 2010 and 7% in 2015. The French Government has decided to speed up the biofuel transition inasmuch France shall meet the 5.75% target in 2008 and the 7% target in 2010. Major investments are required from industry to succeed in this roadmap, since ethanol from wheat or root of beets and biodiesel from soja and sunflower seeds accounted for less than 2% at end 2005.

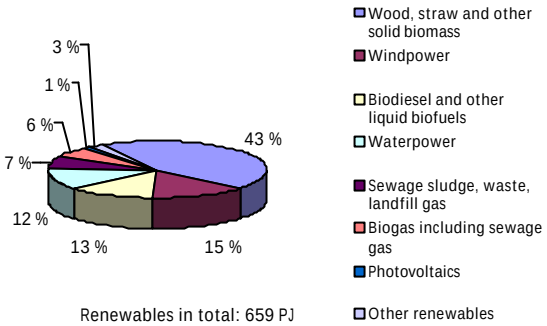
In parallel with this first generation biofuel promotion, research and technology investments in France are aimed at developing new biofuels. Second generation biofuels are produced from the whole plant lignocellulose, which should pave the way not only to considerably higher volumes without competing with food crops but also to hydrogen production for fuel cells.

GERMANY

PRESENT STATUS



Total German energy supply 2005: 14.210 PJ



Renewables in total: 659 PJ

Supply

The main source of Germanys primary energy supply (fig. 1) is mineral oil (36%) followed by natural gas (23%), almost equal shares of hard coal, brown coal and nuclear energy (each about 12%) and combined just over 4% renewable energies and other sources.

Almost half of the renewable contribution stems from wood and straw (44%) (fig. 2). Windpower (14%) and biofuels (13%) have just recently displaced waterpower (12%) from second place. Smaller shares are from sewage and biogas (7% and 6% respectively), 0,5% are from photovoltaics and 2,5% are others (solarthermal, geothermal, heat pumps).

Import dependency is very high (almost 75% overall) except for brown coal, which is a domestic resource, hard coal with a domestic contribution of about 40%, and the domestic renewable sources.

Demand

Of the 14.210 PJ of primary energy consumption 65% were converted into usable end-energy, about 28% was lost in conversion processes and ca. 8% were used non-energetically. The largest share of demand stems from households (28,8%) and transport (28,6%), third is industry (26,8%) last comes the service sector (15,8%).

ENERGY TRANSITION

In the last 15 years the German energy supply has undergone profound changes. Industry has lost its role as the dominating demand sector mainly because of the restructuring in East-Germany. On the one hand the use of brown coal has been cut to half, on the other hand the use of natural gas has increased by 50%. The use of renewable energies has

increased over the last 10 years from 275 PJ to 659 PJ with remarkable growth for some technologies: Wind power increased 15-times, liquid biofuels more than 50-times and photovoltaics more than 130-times (albeit from a low starting level).

These developments are driven by the commonly accepted need for CO_2-neutral energies and are backed by powerful support-schemes e.g. the feed-in law for renewable electricity and the tax-exemption for biofuels.

1. Renewable energies

Small scale hydroelectric power

Electricity generation via hydroelectric power has been stable in Germany for a long time. Most of the existing potential has been realised and no big increase is expected since new installations face strict environmental rules. However "repowering" of old installations holds some prospects for the future. A prominent example is a power station at the river Rhein, which is being upscaled from 25 MW today to 116 MW (planned). To realise this particular project, government has even lifted the exemption of large hydropower from the feed-in law.

Bio-energy, Bio-fuels

Bioenergy is used in Germany primarily for heat applications (e.g. wood-pellets), for electricity generation (e.g. biogas CHP) and in transport (biodiesel from rapeseed (RME)). The use of bio-energy has tripled in the last decade and this development is recently even accelerating driven by the increase in oil prices. Boilers fuelled by wood pellets have become economically favourable compared to fossil alternatives. Biogas is booming and a feed-in law for biogas into the gas-network is currently under consideration. RME has been supported by an exemption from fuel tax. However this is policy is right now being revoked in favour of an obligation to admix 5% biofuels into regular gasoline and diesel. The aim is to achieve the targets of the European biofuels strategy and at the same time increase the tax revenue from fuel consumption.

Some estimates of the total potential of bioenergy in Germany are as high as 15% of the total primary energy consumption in the year 2030.

Wind

Wind power has seen a remarkable growth in Germany through the last decade, inspired by the support via the feed-in law. The potential of good sites on the coast-line has been realised to a high degree. Future options for development are midland-sites and most notably sites in the coastal sea. A number of these offshore-sites are in the planning phase or under construction.

Geothermal

Geological conditions for geothermal energy in Germany are not particularly favourable. Nevertheless geothermal energy for heat applications (mostly near-surface installations in conjunction with heat pumps) has become technically and economically viable in recent years. Geothermal electricity via "hot dry rock" technology promises a huge potential (about 600-times the current gross electricity production) with base-load capability. That's why it is explored and developed further in a handful of pilot projects to date.

2. Clean fossil fuel

CO_2 sequestration at fossil fired power plants is increasingly being discussed as a greenhouse gas mitigation option in Germany. "Clean coal" is the buzzword here, because brown and hard coal are the only large-scale domestic fossil resources. Recently there was the ground-breaking ceremony for the first CO_2-free brown coal power plant worldwide at the site "Schwarze Pumpe". This plant is designed to operate with the so called "oxyfuel"-technology and is scheduled to open in 2008. These efforts are part of the COORETEC (CO_2 reduction technologies) initiative that plans to develop highly efficient fossil fired power stations with near zero CO_2-emissions by 2025. This program is financially supported by the ministry of economics and technology.

3. Nuclear energy

Germany currently produces about 25% of its electricity in 18 nuclear power plants. In order to put an end to the long-standing societal controversy about nuclear energy in Germany the Government has concluded in 2000 a binding agreement with the electricity utilities to phase out nuclear generation over the next ca. 20 years. Each existing nuclear power station was assigned a maximum allowance of electricity to be produced. When this quantity is reached the plant has to be shut off. The operating companies have some flexibility to shift output between plants. Two (rather small) power stations have already been shut in accordance with the agreement. Since the last federal election has changed the political constellation (from Social Democrats / Green to a big coalition Christian Democrats / Social Democrats) the debate if this agreement is to be maintained has surfaced again.

4. Demand side

It is widely accepted that effectively addressing the demand side (energy efficiency, rational use of energy and energy savings) will be of crucial importance for a transition to a more sustainable energy system to occur. In the past the energy intensity of the German economy decreased on average by about 1,5% per year cancelling the effect of economic growth (also about 1,5% p.a. on average) to lead to a stable energy consumption level.

In order to allow a net reduction in energy consumption it is therefore necessary to increase substantially the efficiency of energy end-use. To this end there are a number of policies in place in Germany e.g. eco-taxes on fossil energy and electricity, state-subsidised loans for energy efficient retrofitting of buildings, information campaigns for efficient energy use, the installation of a German energy agency (DENA) etc.

GREECE

1. Renewable energies

Small-scale hydroelectric plants

No new large-scale, i.e. over 15 MW of installed capacity, hydroelectric plants are going to be constructed due to environmental objections, high initial construction cost and non availability of sites with adequate hydro potential. Thus, the present combined capacity of the existing plants of some 3060 MW yielding annually some 4 billion KWh will not show a significant rise at least up to 2010. That situation could somehow be reversed should the plants of Messochora in Thessaly nearing completion and Ilarionas in Western Macedonia in search or proper funding and some minor others finally overcome the non-technical barriers that so far drag on their implementation course. However, there is a profound interest for the construction of small-small hydro schemes. Today 51 are operating with an installed capacity of 92 MW.

Bio-energy

Bio-energy usually in the form of gases released in the context of anaerobic processes in sanitary landfills and biological treatment plants of industrial plays only a small role in power generation. The same holds true also for biomass mainly due to logistics problems associated with its law calorific value, interrupted availability, small size of plants not permitting economies of scale to be achieved and so on. Finally, biofuels as a quite promising player in the sector of transportation fuels in a less polluting way do not lend themselves to power generation activities since they cannot compete cheaper power generation using conventional fuels.

Wind energy

At present some 1.5 billion KWh are produced from some 105 wind farms totaling some 545 MW installed capacity. For speeding up of their penetration rate Law 3468/2006 was recently passed (see hereafter).

The new legislative milieu

The new feed-in law 3468/2006 on renewable electricity was voted through by the Greek Parliament on June 6 and was published in the Official Gazette issue A' 129 of June 27. The law maintains the favorable regime of feed-in tariffs modeled in 1994 along the pattern of then German Stromeinspeisunsgesetz for all renewables in the range of 73-90 Euro/MWh except photovoltaics which henceforth will enjoy prices as high as 400-500 Euro/MWh, i.e. up to 600 percent higher than previously, whereas systems utilizing solar energy in a way other than of photovoltaics will accommodate themselves to a more moderate regime of 230-270 Euro/MWh.

Among numerous other breakthrough stipulations of the new law following may be outlined:

- Streamlining of the environmental permitting through the fixing of strict terms within which approvals should be granted or consensus rendered by services and bodies involved in the interim stages of the overall licensing procedure.
- Setting up of two central coordinating bodies, one of inter-ministerial character and the other on Development Ministry's service level, aiming both at the coordination of the licensing processes control and the provision of support and guidance to authorities involved therein.
- Introduction of a regime of strict follow-up procedures for the holders of generation authorizations, in order to keep them bound to their legal commitments, and making provisions for getting rid of those profiteering from license trading.
- Enabling the installation of offshore wind farms following the successful precedent of the implementation of corresponding projects in the North Sea.
- Direct indexing of the energy tariff regime applicable to hybrid stations that will be installed in island systems (not connected to the mainland's interconnected system) to the avoided cost of conventional plants whose operation is thereby supplanted to ensure the economic viability of the said stations. Abolishing the previous disposition providing for recourse to a bidding procedure for the licensing of hybrid stations.
- Completion of the series of efforts aimed at bringing national laws into line with the requirements set forth in article 5 of Directive 2001/77/EC through the set up of a system for issuing guarantees of origin for renewable energy with the System Operator as agency in charge of the mainland's interconnected system, the Public Power Corporation, (being the incumbent electricity utility) in the islands not connected to the mainland's inter-connected System, and the Centre for Renewable Energy Sources in the stand-alone electrical systems. At the same time, the Regulatory Authority for Energy is entrusted with the task of overseeing the overall issue mechanism of the guarantees and the settlement of any disputes that might arise.
- Redrafting and putting on legislative footage the 2 percent fee that had been imposed for the benefit of RES-affected local governments on the pre-tax proceeds from the sales of renewable energy which is now fixed at 3 percent.
- The threshold of the small-scale hydroelectric plants is set at 15 MW (in lieu of the previous 10 MW) so that a greater number of such facilities will enjoy feed-in tariffs and access priority by load dispatch.

The currently applicable regime for the support of heat produced from renewables is through the utilization of geothermal power under Law 3175/2003. On the other hand, a draft law is under preparation for transposing Directive 2004/8/EC regarding cogeneration with the aim to be voted by the Parliament later this year.

Additional information on the current status of RES in the broader context of energy policy can be drawn from the 3rd National Report on the degree of penetration of RES in the year 2010 compiled pursuant to article 3 of Directive 2001/77/EC and posted on the Ministry's website (www.ypan.gr).

2. Clean fossil fuels

Gas power plants providing for capturing and storing of CO2

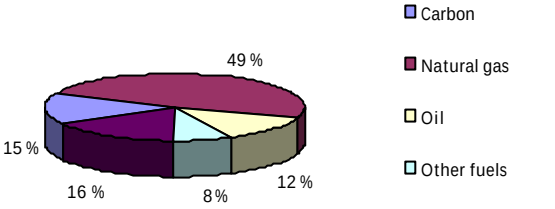
Today 13 percent of the country's electricity needs are met from gas-fired power plants run by the Public Power Corporation and located in Keratsini (360 MW), Lavrio (1140 MW) and Komotini (495 MW). Other companies operating a 147-MW plant in Boeotia and another 390-MW one in Thessaloniki face difficulties in competing with much lower prices offered by PPC deriving its generation output primarily from low-cost lignite-fired stations. Gas is not indigenously produced but imported either in as natural gas from Russia or in the form of liquefied petroleum gas from Algeria. In general the use of that fuel type cannot provide security of supply at all times as demonstrated recently by the dispute between Russia and Ukraine but rather may simply be seen as a diversification of energy sources. Currently there are no plans for capture and underground storage of CO_2 due to the high cost of the relevant facilities.

3. Nuclear energy

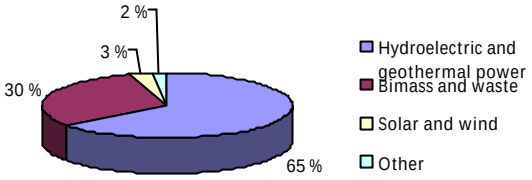
Greece has since long opted against nuclear energy for power generation.

ITALY

PRESENT STATUS



Electricity production in Italy



Electricity production from renewable sources in Italy

1. Renewable energies

The Italian energy policy has long focused on promoting renewable energy sources in the knowledge that such development is essential to achieve crucial goals, such as a secure supply of energy and environmental compatibility.

Currently the share of electric energy produced from plants using renewable sources amounts to 16.3% of the total energy production input to the national grid.

Hydroelectric power and geothermal energy jointly total 65% of this share. Energy obtained from biomass and waste represents around 30%, while the combined solar and wind energy share – the so called "new renewables" – represents less than 3%, solar energy supplying less than 0.15%.

According to directive 2001/77/EC on the promotion of renewable sources, absorbed in Italy by legislative Decree n. 387 of December 29, 2003, the share of electric energy produced from plants using renewable sources shall be increased to 25% of the gross energy production.

The need to rapidly boost development of the so-called renewable sources in Italy was underlined by the Committee on Productive Activities of the Italian Chamber of Deputies during two fact-finding investigations on the situation and future of the energy sector that said Committee carried out during the previous parliament.[1]

In particular, the Committee underlined the advisability to promote major and efficient expansion of renewable sources, and in particular to back research and development of the same renewable sources.

The Committee reached such conclusions also thanks to contributions given by the main players operating in the Italian energy sector who were heard during the aforesaid fact-finding investigations, the first of which terminated on April 18, 2002, while the second ended on February 9, 2006 (among others, representatives of the following were heard: Enel, Eni, Enea, AEM, Endesa, Edison, Unione Petrolifera, British Gas Italia, Energia Spa, GRTN, Terna Spa).

Incentives

In the Italian legal system renewable sources are defined as "renewable non-fossil energy sources (wind energy, solar energy, geothermal energy, tidal energy, wave energy, hydroelectric power, biomass energy, landfill gas, biogas and sewage treatment energy).

The main incentives to increase the production of electric energy from renewable sources are contained in the so-called green certificates absorbed into the Italian system by art. 11 of Italian legislative decree n. 79, 1999.

The new criterion adopted to promote the production of renewable sources is that, as of December 2002, producers and importers of electric energy obtained from non-renewable sources have to put a minimum share of electricity produced from plants using non renewable sources that started up after April 1, 1999 into to the electric grid.

This share was initially fixed at 2% and later increased by Italian legislative decree n. 387/2003 (art. 4) that set an annual increment of 0.35% for the three-year period 2004-2006. Nevertheless, the green certificates method is not the only national measure supporting the renewable energy sector.

Solar energy

Regarding photovoltaic energy, it must be pointed out that the previous incentive scheme based solely on a capital account was replaced by Italian legislative decree n. 387/03 that introduced a new method based on the so-called "energy account": incentives will be granted with the same energy produced, and it will be possible to sell the surplus energy to the electric grid at incentivised prices. Basically, it is a new incentivisation scheme directly aimed at enhancing production and guaranteeing recouping investments in a reasonable time span without burdening the State budget. The decree is geared to incentivise the installation of 500 MV photovoltaic plants – at present there are plants slightly over 20 MV – and its goal is to reach the target of 1,000 MV by 2015.

Biomass[2]

Biomass is an important source for the production of "clean" energy and fuel.

Regarding this issue, the Italian parliament has taken steps to promote energy produced from biomass mainly through tax breaks.

For example, the 2005 Italian State budget (art. 1, paragraph 521, law n. 311/2004) foresaw exemption of excise duty for a yearly quota of 200,000 tons of biodiesel within the framework of a six year- programme (2005 – 2010).

Waste

According to article 2 of Italian legislative decree number 387/2003, waste can benefit from the special scheme for renewable sources. In particular:

- plants using the biodegradable part of industrial and urban waste are not subject to environmental or energy authorisations;
- plants using waste and its non-biodegradable part benefit from a particular, simplified authorisation procedure.

Other incentives

The 2005 Italian State budget (art. 1, paragraph 248, of Italian Law n. 311/2004) set up a Fund with an allocation of 10 million euros to promote renewable resources. Its aim is to co-fund studies and research on the use of the hydrogen vector, produced from renewable sources, within the framework of new locomotion systems geared towards reducing polluting emissions in order to improve the quality of the environment, in particular in urban areas.

Furthermore, it is stated that works aimed at achieving energy saving, especially the installation of plants using renewable energy sources, are included in the restructuring works of buildings that benefit from the tax breaks provided for in art.1 of Italian Law n. 449/1997.

These tax breaks have been extended to December 31, 2006 and foresee a 41% deduction – up to a sum of 48,000 euros – of income tax.

Obstacles hindering the development of renewable sources

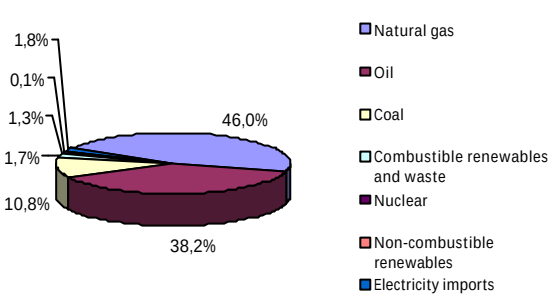
ENEA (the Italian National Agency for New Technologies, Energy and the Environment) recently published a paper entitled "Renewable sources 2005, development of renewable sources in Italy between necessity and opportunity" ("*Le fonti rinnovabili 2005, lo sviluppo delle rinnovabili in Italia tra necessità e opportunità*"3) revealing that the major obstacles to the development of renewables in Italy currently seem to be the lengthy time required to obtain authorisation and, in some cases, public consent to the construction of the plants. Indeed, public consent is rather fickle. Despite the fact that opinion polls show that the community agrees with the development of renewable energy sources, above all because they impact less on the environment, at the same time the public is against the construction of these plants for environmental reasons

and adopts what is known as the NIMBY (*not in my back-yard*) syndrome, just as it does for the installation of conventional energy producing plants.

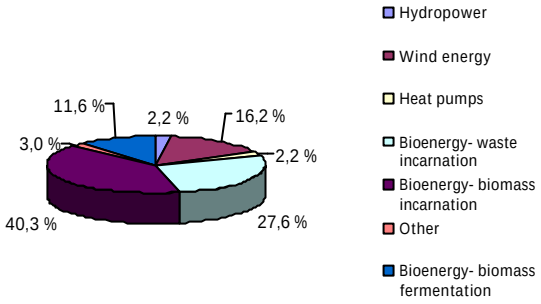
Some measures of Italian legislative decree. n. 387/2003 seem directed at overcoming these obstacles, on one hand by gaining public consent to renewable sources, and on the other, through a series of measures to rationalise and simplify authorisation procedures: plants using renewable sources are classified as "public utilities" and their realisation is defined as "undeferrable and urgent", moreover authorisation procedures are simplified by introducing a single authorisation granted by the regional authority or another institution delegated by it.

THE NETHERLANDS

PRESENT STATUS



Primary energy supply 2002: 77.9 Mtoe



Energy production from renewables 2002

The Netherlands are an important fossil fuel crossroad. The Netherlands are a main producer and exporter of natural gas and a main transit and refinery country for oil and oil products. Natural gas is very important for domestic use. [4]

In 2002, total primary energy supply of the Netherlands accounted tot 77,9 Mtoe. Main primary energy sources were natural gas (46%), oil (38,2%) and coal (10,8%). The Netherlands domestic production was 59,9 Mtoe in 2002, for which natural gas accounted for 91%. Domestic energy production from renewable sources was 1,15 Mtoe in 2002, accounting for 2% of total primary energy supply. Bio energy, mostly consisting of waste and biomass incineration and biomass fermentation (77,1%), and wind energy (15,7%) contributed most. (IEA, 2004).

The total final consumption within the Netherlands accounted to 60 Mtoe in 2002, main contribu tors were here the industrial sector (38%), the residential, services and agricultural sector (37%) and the transportation sector (25%) (IEA, 2004).

ENERGY TRANSITION

Dutch energy policy generally focus around three policy aims; security of supply, economic efficiency and environmental quality. The Dutch Ministry of Economic Affairs is mainly responsible for Dutch energy policy and responsible for the Energy Report series; a series describing the aims and measures in energy policy for the next few years. The 2005 Energy Report focuses on security of supply and climate on the tasks to

guarantee security of supply and to address the global climate problem, as the report states that these problems are urgent, and the deregulation process has been completed. In the long term the government aims for a emission reduction of 60-80 percent of CO_2 equivalents in 2050 compared to 1990 emissions.

The government aims in the 2005 Energy report to internationalise energy policy in order cost effectively reach the aims in the short, middle and long term. The Netherlands should, among other actions, engage in climate change and security of supply dialogues, separately as well as together with other EU countries. Another overall viewpoint regards the role of the government in energy policy: the government should intervene when the market falls short and public interests are not sufficiently assured. The publication of the 2005 Energy report generated discussion about ambitions set within the report, and, more specifically, about the ambitions concerning energy conservation the Ministry and different parties in parliament deem feasible

Dutch energy policy does not choose between options such as solar energy or wind energy. The responsible Ministry feel that this choice can not be made yet, as chances of failure or success are still uncertain. Instead of choosing for a certain options the government stimulates the transition towards a more sustainable energy system by means of transition management The government, together with businesses, environmental organisations and knowledge institutes have initiated a number of transition pathways; trajectories focusing on the development and diffusion of sustainable energy options. These options include clean fossil fuels, energy saving options and offshore wind energy.

Energy efficiency improvements

Energy efficiency improvements form the backbone of Dutch energy policy as energy efficiency improvements are the most cost effective way to improve security of supply and environmental quality. The government aims to improve energy efficiency by 1,3% per year for the period up to 2010. From 2012 the government aims to increase the energy efficiency rate to 1,5%. Possibilities to achieve higher energy efficiency rates are under discussion

1. Renewable energy

The share of renewables in domestic energy consumption is about 4,5% at present, including imports. The Energy Report sets the following aims:

- the share of renewables in renewable energy consumption should be 5% in 2010.
- in the same year the share of renewable electricity in domestic electricity generation should be 9%.
- In 2020 the share of renewables in Dutch energy consumption should be 10%.

Biomass and wind energy, both onshore and offshore, are likely to make the largest contribution to renewable energy supply in the Netherlands.

2. Fossil fuels

The Netherlands wants to consolidate it position as a natural gas country. The Energy Report proposes a number of measures, including continuation of the small fields policy and measures to strengthen the position of the Netherlands within the natural gas market.

Coal deserves renewed attention due to the concerns about security of supply, but is only allowed if it does not compromise the achievement of CO_2 emission targets or other policy aims. Carbon capture and sequestration will be an option. No specific targets were set but industry has proposed to set up an demonstration project for carbon sequestration. The Ministry sees this demonstration project as an important first step.

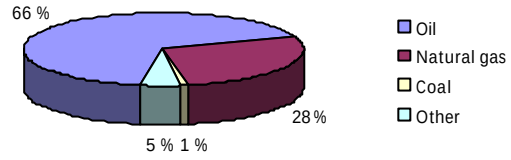
3. Nuclear energy

The Netherlands has one nuclear power plant. The 2005 Energy Report states that the use of nuclear energy is important on EU scale but that the implementation of new nuclear power plants in the Netherlands is not likely. In the summer of 2006 the State Secretary for the Environment started a debate on the likeliness of the implementation of new nuclear power plants in the Netherlands. The debate remained low key.

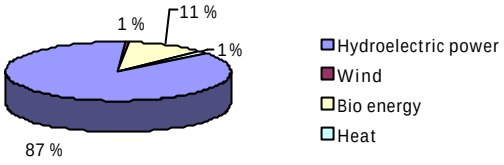
The Energy Report explicitly states that whether aims in the short or the long term are realised depends of on international development such as the implementation of a world wide climate coalition, stricter EU regulations and energy efficiency standards.

NORWAY

PRESENT STATUS



Total Norwegian energy production 2004.
Total: 233 Mtoe



Energy production from renewable sources 2004.
Total: 140 TWh

Oil and gas from the North Sea accounts for 95% of Norway's total energy production. More than 90% of this fossil energy is exported.

For energy used in domestic industry and households hydroelectric power is by far the main energy source. It is most likely to remain so for the foreseeable future. Electricity is also used for heating purposes. Production varies between 105 and 140 TWh/year, with an average of appr. 120 TWh. Electricity from hydroelectric power accounts for some 95% of the Norwegian stationary energy consumption.

ENERGY TRANSITION

1. Renewable energies

Small scale hydroelectric power

No new, large scale hydroelectric power plants are planned. There is broad consensus that the era for such developments is over. However, there is an increased focus on small scale hydroelectric power plants, with an installed effect up to 10 MW. Building and running such plants has limited environmental consequences. Total production potential is estimated to 5 TWh for the next 10 years, and the theoretical potential 25 TWh.

Bio-energy

Bio-energy is the largest renewable source (excluding hydroelectric power), accounting for some 9% of the total inland energy production. A large scale research programme for increased use of bio-energy was launched earlier this year, and the growth potential

is estimated to 7 TWh by 2010. Developers may seek financial support from public authorities.

Wind

At present, 1 TWh wind power is produced each year. However, there is an official policy target of 3 TWh by 2010. The policy target was formulated in a white paper in 1999 (White Paper no. 29 1998-1999 "On energy policy"). The target has been reaffirmed by all later governments. Although present production is limited, the potential for wind power is extensive, and a series of wind-mill projects has been announced during the last 10 years. If they are all built, production will reach more than 20 TWh/year, and the theoretical potential with today's technology is estimated to 30 TWh. However, the consequences of large scale wind mill parks with respect to biological diversity, animal life, esthetical pollution and terrain deformation make wind power controversial. There has been limited public debate about the accumulated consequences of such massive wind power development.

Financial mechanisms have been established to support development of wind power. Developers may seek financial support for building costs from the authorities. In addition, a system for green certificates is being analysed. Such a system may dramatically improve the economy of the projects.

Heat

The annual production of heat is appr. 35 TWh primarily from bio energy, oil products and gass. However, there is a political target to increase the production of heat from renewable sources, heat pumps and waste water with 4 TWh by 2010.

Commission on Low Emissions

On 4th October 2006 The Norwegian Commission on Low Emissions, appointed by the Government in 2005, delivered its final report, "A climate-friendly Norway". In the report the commission identifies and evaluates a series of initiatives that can be made to reduce greenhouse gas emissions by two thirds within 2050. The commission believes that it is necessary, feasible, and not prohibitively expensive to achieve such extensive greenhouse gas emissions by 2050. Without undue self-sacrifice, Norway can become a climate-friendly country by the middle of this century.

2. Clean fossil fuel

Gas power plants with capture and storage of CO_2

As of today, gas amounts for only 5% of the total energy production. However, large scale gas power plants, powered by gas from the North Sea, are likely to play a major role in future Norwegian energy production. There is an ongoing debate about whether or not such plants should be built before they have the capacity to separate CO_2 and store it in an environmentally safe manner. Power plants with no CO_2 emission can represent a major energy supply, without impeding our efforts to meet our obligations

in the Kyoto protocol. By re-injecting CO_2 to oil wells, oil recovery can increase. In March 2006 the oil companies Statoil and Shell launched a project for developing a system for re-injection.

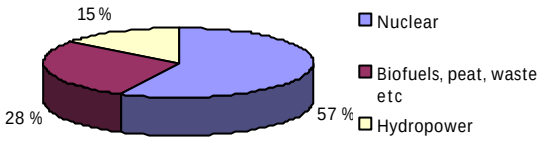
Domestic use of gas is also receiving political attention. A white paper from 2004 draws up a unified strategy for use of natural gas. It also outlines the government's policy on facilitating carbon-free gas-fired power stations. In addition, the report evaluates measures to boost transmission of land-generated electricity to offshore installations and a system of green certificates.

3. Nuclear energy

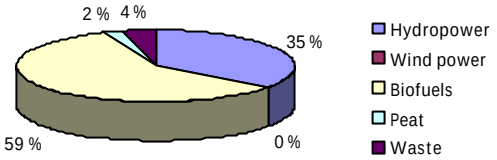
Norway has no nuclear energy production for commercial purposes. Two small reactors are run for research purposes. There is currently a broad political agreement that no nuclear power plants should be built in Norway, in the foreseeable future.

SWEDEN

PRESENT STATUS



Primary energy production 2004. Total: 1434 PJ



Primary energy consumption from renewables 2004. Total: 625 PJ

In 2004, Swedens's production of nuclear power (in accordance with the UN/ECE method for calculating contribution from nuclear power), biofuels, peat, waste, etc and hydro power was about 1434 PJ. Primary energy consumption from renewables in 2004 was total about 625 PJ[1]. (Hydro power about 216 PJ, Wind 3 PJ, biofuels 370 PJ, Peat 12 PJ and waste 24 PJ). The degree of self-sufficiency (hydro power, wind power, bio fuels, peat and waste) for energy was about 27 per cent in 2004. Total final use, losses and non-energy purposes (871 PJ) was 2329 PJ, and is covered by oil products (490 PJ), natural gas and gasworks gas (23 PJ), coal and coke (63 PJ), biofuels, peat, waste etc (241 PJ) renewable energy etc, electricity (472 PJ) and District Heating 171 PJ.

ENERGY TRANSITION

1. Renewable energy

Since 1970, the make-up of energy supply has changed. The supply of crude oil and oil products has fallen by over 40%, while the net production of electricity has increased by over 250% as a result of the construction of nuclear power stations and expansion of hydro power production. The supply of biofuels has more than doubled. Hydro power production varies widely, depending on the amount of precipitation during the year. 26% of the country's energy in 2004 was provided by renewable energy sources.

Wind, Co-generation of heat and power

The electricity certificate system was introduced in 2003, with the aim of increasing the use of electricity from renewable sources by 10 TWh/year between 2002 and 2010.

One of the planning objectives for wind power production is that local authorities must have agreed plans for 10 TWh/year of wind power production by 2015 (in 2005 0,85 TWh was produced from wind power).

Renewable motor fuels

Trials of various public transport systems powered by renewable or alternative fuels are being held in a number of Swedish towns. Two buses running on EcoPar. EcoPar is a synthetic motor fuel: it is at present manufactured from natural gas, but could also be made from woodchips and other biomass. Since the summer of 2001, buses in Malmö have been powered exclusively by natural gas. The city now wants to take a further step, testing the admixture of hydrogen in the natural gas. Biogas buses are at present in traffic in ten Swedish towns, with the numbers increasing constantly. June 2005 saw inauguration of the world's first biogas-powered train in Linköping.

2. Energy efficiency

Industry, and the residential and service sector, both use more or less the same amount of energy now as in 1970. However, much has changed: the total heated floor area of commercial premises, for example, is greater, population numbers have risen by about 11%, and industrial production is considerably higher than it was in 1970. The move away from oil to electricity as an energy source/carrier has 'transferred' some of the losses to the supply side of the energy system. However, total energy use by the transport sector (excluding foreign maritime traffic) has increased by 79% since 1970. For the industrial sector, variations in energy use from one year to another are due mainly to economic conditions, while for the residential and service sector they are partly due to differences in the climate from one year to another. The Swedish energy taxation policy is aimed at improving the efficiency of energy use.

In addition, the 2002 energy policy decision also includes measures to improve the efficiency of energy use, such as those concerned with energy advisory services, technology procurement projects and the market introduction of energy-efficient technology. January 2005 saw the start of the programme for energy efficiency improvements in energy-intensive industries (PFE). Participating and qualifying companies can be exempted from the new electricity tax that was introduced on 1st July 2004 if they fulfil certain conditions, which include the introduction of a standardized energy management system and application of physical measures to improve the efficiency of electricity use.

3. Clean fossil fuel

Present energy taxation policy is aimed at encouraging the use of biofuels.

Clean coal

In recent years, interest in CHP (now mainly biofuel-fired) has again revived in Sweden due to such factors as carbon dioxide taxation, changes in the taxation regime for CHP and the electricity trading certificate scheme. One of district heating's advantages is its flexibility in respect of choice of fuel. In 1980, over 90% of the fuel input for district heating and CHP plants was in the form of oil. Nowadays, the fuel mix is more varied, with biofuels being the main energy source. Total energy supply to the district heating sector in 2004 was just under 54 TWh, of which biofuels, waste and peat accounted for 33 TWh, or over 61%.

Natural gas

Natural gas was introduced to Sweden in 1985. The natural gas consumed in Sweden is imported from Denmark. Its use increased rapidly until 1992, after which growth continued at a more modest rate. In 2004, imports amounted to 927 million m3, equivalent to 9.3 TWh. Industry accounts for about 45% of total use, with CHP and district heating plants accounting for over 30%. Domestic consumers use almost 20%, and a small amount of natural gas is also used as motor fuel. Natural gas is distributed at present to about 30 districts, where it provides about 20% of energy use. On the national level, it supplies a little over 1% of total energy use.

4. Nuclear power

Nuclear power in Sweden was the built in the 1970's and 1980's. In 2004, nuclear power production was about 51% of total net electricity production in Sweden. After the accident in the Three Mile Island Nuclear Generating Station (USA) in 1979, a vigorous debate over the future of nuclear power developed in Sweden. In 1980, Sweden passed a non-binding public referendum which led to a decision in the Parliament calling for closure of all nuclear stations by 2010.

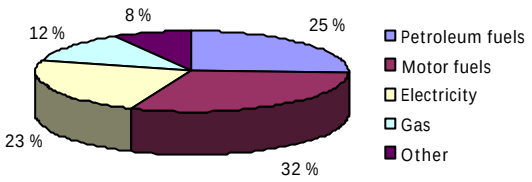
The Chernobyl accident resulted in a new political debate about the Swedish nuclear power programme. Parliament decided in 1988 that the phase-out of nuclear power would start in the period 1995 to 1996, with two units to be closed. After a few years, the industry and the labour unions started an intensive debate, because it was shown in official reports that the total cost of an early phasing out (after 25 years operation instead of 40 years. The parliament decided in 1991not to start the phase-out by 1995. A 1997 government bill abandoned the 2010 deadline but gave the government permission to revoke the operating license of any nuclear reactor.

The Energy Bill of 2002 addressed the country's planned phase-out of nuclear power. In particular, it discussed the German agreement for the controlled closure of nuclear reactors and proposed that the issue be further explored. The negotiations with the nuclear power companies that were started between the Government and the industry in 2003 were broken off in October 2004 without any agreement having been reached.

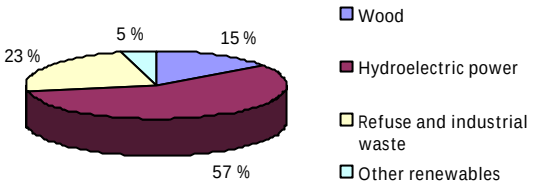
Two nuclear power reactors have been closed. Barseebäck 1 in was closed 1999 and Barsebäck 2 in May 2005. The power companies are planning to increase the output from some of the reactors.

SWITZERLAND

PRESENT STATUS[2]



End use by energy sources 2005. Total: 0,894 PtJ



Total Swiss energy production 2005. Total: 0,205 PtJ

The transport sector is the largest consumer of energy (32.3%), followed by households (29.9%), industry (19.5%) and the service sector (16.7%). Dependency on foreign sources amounts to 78.6%. Figure two shows the Swiss distribution of end use by energy sources in 2005. The total amounted to 890'440 Terrajoule.

Nuclear power stations generated a total of 22 000 GWh of electricity in Switzerland in 2005. In percentage terms, this is equivalent to 38.0% of the total electricity generated. Hydroelectric power stations had a 56.6% share and conventional thermal power stations and others (solar, wind, biogas) 5.4%.

ENERGY TRANSITION

1. Renewable energies

Renewable energies (hydroelectric power, wood power, refuse and industrial waste, along with the other renewable energy sources – biogas, solar, wind, environmental heat) cover one-sixth, or one-seventh if waste utilization is excluded, of end consumption of energy in Switzerland.

The renewable energy sources with a long tradition (hydroelectric power, timber) continue to dominate. New sources of renewable energy, however, are recording strong growth. The launch of the "Energy 2000" action program at the end of 1990 and the "SwissEnergy" follow-up program at the end of 2000, show the increasing determination with which the commitment to continued development and the introduction of renewable energy sources was and is being actively pursued.

The overlying quantitative goals of "SwissEnergy" are congruent with the objectives of the CO2 Act and with Switzerland's commitments within the scope of the International Climate Convention. These are as follows:

- *Climate:* To reduce CO2 emissions by 10 percent by 2010 versus the 1990 level, in accordance with CO2 legislation.
- *Electricity:* To limit the increase in electricity consumption to a maximum of 5 percent versus the 2000 level.
- *Renewable energy:* To increase the contribution of renewable energy towards electricity production by 0.5 TWh, and towards heat production by 3.0 TWh.

The main strength of this programme aimed at promoting energy efficiency and the use of renewable energy lies in close co-operation between the federal government, the cantons and municipalities, and numerous partners from trade and industry, environmental and consumer organisations, and public and private agencies. Right from the start, "SwissEnergy" has been making a valuable contribution towards Switzerland's climate and energy policies. Without "SwissEnergy" and its predecessor, "Energy 2000", CO2 emissions would be approximately 7% higher than they are today. Thanks to "SwissEnergy", energy efficiency has been significantly improved and the proportion of renewable energy has been greatly increased. Despite these successes, it is clear that it will not be possible to achieve the objectives of Switzerland's climate and energy policies with "SwissEnergy" alone. In accordance with the CO2 Act, its measures are primarily based on the principle of voluntary actions. The CO2 fee and "climate cent" are intended to complement the "SwissEnergy" programme.

Wind

Much of the *wind power* is generated by the wind power station on Mont-Crosin in the Bernese Jura. Three of the current four wind turbines were installed in the winter of 1995/96. The total of 28 installed plants produced a total of 8.4 GWh of electricity in 2005 (share of total electricity generated: 0.01%). There is resistance against future wind power stations from landscape protection organizations.

Sun

Solar collectors are used for heating water in residential buildings and service premises (tubular and flat-plate collectors) and in indoor and outdoor swimming pools (unglazed collectors). They are becoming increasingly popular, as is the use of solar collectors for drying hay. In 2005, the heat yield of these plants amounted to 289 GWh. Photovoltaics uses solar cells to convert sunlight directly into electricity. In recent years, a number of electricity power stations have begun to set up solar power exchanges to meet the substantial demand for solar power. In addition, the federal government's investment programme has also been promoting increased use of this technology. In isolated areas where there is no electricity supply, photovoltaics is being used comparatively cost-effictively. In 2005, 1900 plants produced a total of 19.3 GWh of electricity (share of total electricity generated: 0.03%).

Bio-energy

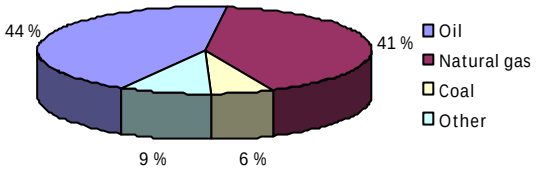
Biogas is obtained from agricultural manure and slurry, fermented household waste, waste disposal sites, sewage treatment plants and industrial effluents, and harnessed by means of combined heat and power generation technology. In 2005, the total yield produced from these plants in agriculture and in waste and effluent management was 295 GWh of heat and 148 GWh of electricity (share of total electricity generated: just below 0.3%).

Environmental heat

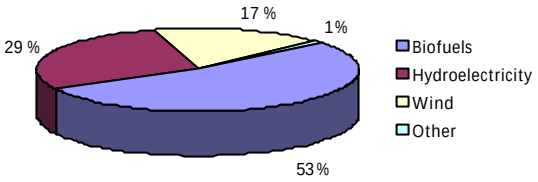
Heat pumps have been experiencing a veritable boom in recent years. The technique of harnessing environmental heat form the air, surface water or ground water, or geothermal energy, combined with an electrical propulsion system, now makes up a respectable share of new heating installations. In 2005, there were more than 96 600 electromotor heat pumps and some 50 gas and diesel heat pumps in Switzerland. These produced 910 GWh of heat and about 1600 GWh of electricity in 2005 (share of total electricity generated: 2.7%).

UNITED KINGDOM

PRESENT STATUS



Total UK energy production 2005 = 215.4 Mtoe



Electricity production from renewables 2005 = 17 TWh

Primary energy production

In 2005, the UK's primary energy production was 215.4Mtoe, with renewables supplying 4.25Mtoe. Oil and gas production from the North Sea accounted for 84% of the UK's total energy production in 2005. However, production of indigenous oil and gas is declining as UK Continental Shelf reserves deplete.

Electricity and heat generation

In 2005, the UK's total electricity demand was 407 TWh. Gas is the dominant fuel used to generate electricity in the UK (39%). Coal provides 34% of UK electricity, and nuclear 19%. Electricity generated from renewables was 4.2%, i.e. ~17 TWh. The remainder is provided by imports (2%), hydro (1%) and oil (1%). Gas is also the primary fuel used to provide heat. More than two-thirds of the UK's heat comes from gas supplied via a national gas grid.

UK's efforts to move towards a cleaner energy system

The UK government has four long term goals for energy policy. These were published in a White Paper in 2003:

- To reduce CO_2 emissions by around 60% in 2050
- To maintain security of energy supplies
- To sustain industrial and business competitiveness
- To ensure that every home is adequately and affordably heated

In 2006 the UK government published an Energy Review, which assessed progress towards the 2003 White Paper targets. It was also looked at the UK's future energy mix based on two major long-term energy challenges facing the UK: climate change and energy security, especially as the UK becomes increasingly dependent on imports for its

energy needs. Diversity of supply is considered crucial to meeting these challenges. Having a diverse energy mix reduces the UK's dependency on a single fuel type and helps maintain security of supply. It also expands the role of low carbon technologies such as renewables in the overall energy mix. By 2010 the government wants to generate 10% of UK electricity from renewables. The Review proposes greater investment in renewable energy (especially wind), better energy efficiency, and significant investment in new generating capacity, including gas, (cleaner) coal and nuclear plants.

Energy self-sufficiency

Until 2004 the UK was self-sufficient in energy supplies and a net energy exporter. In 2004 the UK became a net energy importer. UK oil and gas production peaked in 1999, and has declined at a rate of about 9% per year. In 2004 the UK became a net gas importer, and is expected to be a net oil importer by the end of the decade.

ENERGY TRANSITION

1. Renewable energies

The UK government wants to achieve 20% of electricity generated from renewable sources by 2020. Currently, renewable energy supplies only ~4% of the UK's electricity. Expansion of renewables in the UK is supported by a mechanism called the Renewables Obligation (RO), where the higher cost of renewable energy is met by electricity consumers.

Bio-energy (including waste and co-firing)

Bio-fuels account for the largest proportion of UK renewable energy sources (83%). The largest contributions come from landfill gas (33%), co-firing (20%) and waste combustion (11%). Biomass generated 9TWh of electricity in 2005, accounting for 2.2% of total UK electricity supply.

Hydro-electricity

In 2005 hydro supplied 4.9TWh of UK electricity (1.2% of total). Most of this is generated in large-scale schemes (>20MW) in Scotland. Opportunities to increase large-scale hydroelectricity in the UK are limited as most commercially attractive and environmentally acceptable sites have been utilised. However, a large 50 to 100 MW scheme in Scotland began construction in 2005. Several other small-scale (<20MW) and micro-scale (<1MW) hydroelectric schemes are currently in planning or development.

Wind

Wind is the third largest contributor of renewable energy in the UK after biofuels and hydroelectricity. In 2005 wind energy provided 2.3TWh of electricity, representing 0.56% of total UK electricity supply. There are 1,700 wind turbines in operation at 134 wind

farm sites in the UK with a total installed capacity of ~1,900MW. The majority are onshore, (1,600MW) with just 5 wind farms located offshore (300MW). However, a further 294 wind projects are in planning or development which will add ~14,000MW capacity.

Distributed energy – Combined Heat and Power (CHP) and microgeneration

The Energy Review proposed that the role of distributed energy, including combined heat and power (CHP) and microgeneration, be expanded. CHP provides 7% of UK electricity. Most CHP is fuelled by gas but a small proportion is fuelled by biomass/waste. Microgeneration, such as solar (photovoltaics), micro-wind and fuel-cells, accounts for <0.5% of UK electricity. But in 2006 the government published a Microgeneration Strategy and allocated £50m worth of grants for microgeneration technologies.

2. Clean fossil fuel

Cleaner coal

Coal will play a role in the UK's future energy mix, because it adds to the diversity of energy sources. Coal fired generation currently meets around a third (34%) of the UK's electricity demand. However, in response to high gas prices during the winter of 2005/6, coal's proportion increased to half the UK demand. The result was that UK carbon emissions rose by 0.3% during 2005. The future of coal depends on dealing with its high carbon emissions. There are three 'cleaner coal' technologies to reduce emissions from coal plants; improving power station efficiency, co-firing with biomass and carbon capture and storage (CCS).

CCS (Carbon Capture and Storage)

CCS is an emerging technology which could reduce the carbon emissions of coal or gas power stations by 80 to 90%. If CCS were economic and technically feasible on a large scale it could deliver substantial reductions in carbon emissions. However, CCS in conjunction with electricity generation has not yet been demonstrated. Despite the technical, environmental and economic uncertainties, in 2006 the UK announced a joint project with Norway to enable CCS development in the North Sea.

3. Nuclear energy

Nuclear power provides a source of low-carbon electricity in the UK. There are currently 23 nuclear power plants operating in the UK, providing almost a fifth (19%) of the UK's electricity. However, all but one of these plants are due to close by 2023. In the 2003 Energy White Paper the government committed to 'Keeping the Nuclear Option Open'. The recent 2006 Energy Review confirms this position, that the government wishes to sustain its existing nuclear power stations to maintain diversity and security of energy supplies and to help meet carbon emission targets. However, before proceeding with

any new nuclear build, the government have pledged that *'there will need to be the fullest public consultation and the publication of a further White Paper*'. This new White Paper is planned to be published by the UK Department of Trade and Industry in early 2007.

End notes

Austria

[1] 32.6% respectively, if only energetic uses are accounted for.
[2] 1TWh= 3.60 PJ, 1 PJ = 0.278 TWh.
[3] http://www.ewea.org/
[4] Source: Gerhard Faninger, "erneuerbare energie" 2006-2; AEA
[5] Source: AEA

European Union

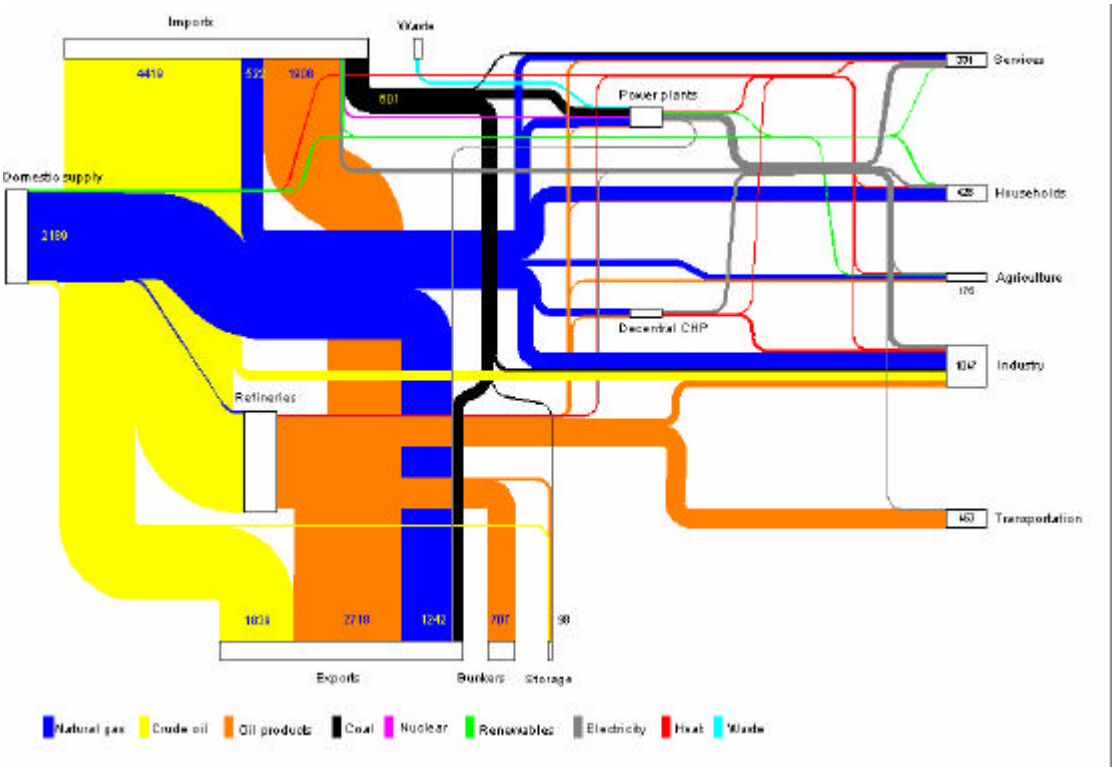
[6] Green Paper - A European strategy for sustainable, competitive and secure energy, COM (2006)0105.
[7] Study on Price setting in the electricity markets within the EU single market, IP/A/ITRE/SC/2005-174, EP 372.957.
[8] EP resolution of 1.6.2006 on Energy efficiency or doing more with less - Green Paper (2005/2210(INI), T6-0243/2006).
[9] Directive 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market, OJ L 283, 27.10.2001, p. 33.
[10] Directive 2003/30/EC on the promotion of the use of biofuels, OJ L 123, 17.05.2003, p. 42.
[11] EP resolution of 29.9.2005 on the share of renewable energy in the EU and proposals for concrete actions (2004/2153(INI), T6-0365/2005).
[12] EP resolution of 14.2.2006 with recommendations to the Commission on heating and cooling from renewable sources of energy (2005/2122(INI), T6-0058/2006)
[13] EP Resolution of 23 March 2006 on Security of energy supply in the European Union, T6-0110/2006.

Italy

[1] The final documents of the abovementioned fact- finding investigations are posted on the Italian Chamber of Deputies' website on the following webpage: ww.camera.it/organiparlamentarism/242/4416/4576/documentotesto.asp?comriun=0&sUrl=10/indag/imprese_energetiche/elenco.htm.
[2] Biomass is the biodegradable part of products, waste and residues (it includes vegetal and animal matter) derived from the agricultural and forestry sectors and related sectors, as well as the biodegradable part of industrial and urban waste.
[3] www.enea.it/com/web/pubblicazioni/rinnovabili/ExecutiveSummaryRinnovabili.pdf.

The Netherlands

[4] This figure provides a schematic overview of the energy system in the Netherlands in 2000. The illustration gives an overview from production at the left side to energy use in the different sectors at the right side. Import is shown at the top of the figure while the export is depicted at the bottom. Natural gas is depicted in blue, oil in yellow and oil products in orange.



Sweden

[1] Primary energy consumption refers to the direct use at the source, or supply to users without transformation, of crude energy, that is, energy that has not been subjected to any conversion or transformation process¨

Switzerland

[2] The below figure shows the connection between energy use and economic development in Switzerland since 1950. The linear connection between these two factors indicates that it will be difficult to be on the track towards sustainability