







Study of the Introduction of Renewable Energy in the EU

Report by INFORSE-Europe to the
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INFORSE-EUROPE
International Network for Sustainable Energy

Study of the Introduction of Renewable Energy in the EU

A report on current status and trends in renewable energy in the 25 EU countries, policies for renewable energy and energy efficiency, and the EU Emission Trading Scheme. Highlights of developments in the UK, Czech Republic and Hungary.

Report by
International Network for Sustainable Energy - Europe (INFORSE-Europe),
www.inforse.org/europe

for

EU-Japan Centre for Industrial Cooperation,
www.eujapan.com

Main authors:
Gunnar Boye Olesen
Judit Szoleczky (Hungary)
Pete West (United Kingdom)
Emil Bedi (Czech Republic)
Niki Fowler (Text Advice)

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1. Introduction

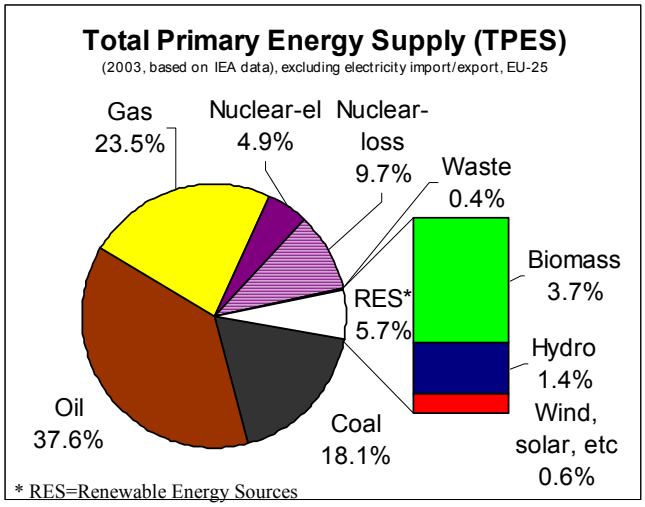
1.1 Overview of EU Energy Sectors

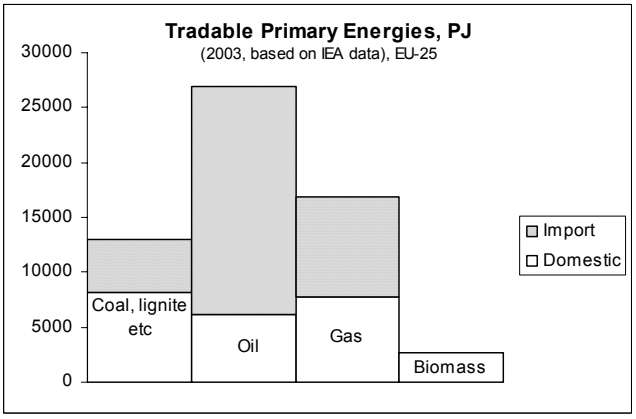
The 25 countries in the European Union differ in many ways, including energy supply and demand. Some, like Denmark, are net exporters of energy, while others meet almost all of their energy demands with imports. Their consumption patterns are very different as well. In Scandinavia, space heating is the largest single use, whereas in the Mediterranean Cyprus and Malta, space heating is not an issue. One feature that all of the countries have in common is a high energy consumption per capita compared with most other world regions, and high emissions of greenhouse gases, in particular of CO_2 from fossil fuels. The EU's average per-capita greenhouse-gas emissions were 10.8 tons CO_2-equivalent in 2003, of which 81% came from fossil-fuel use, mainly as CO_2 emissions.

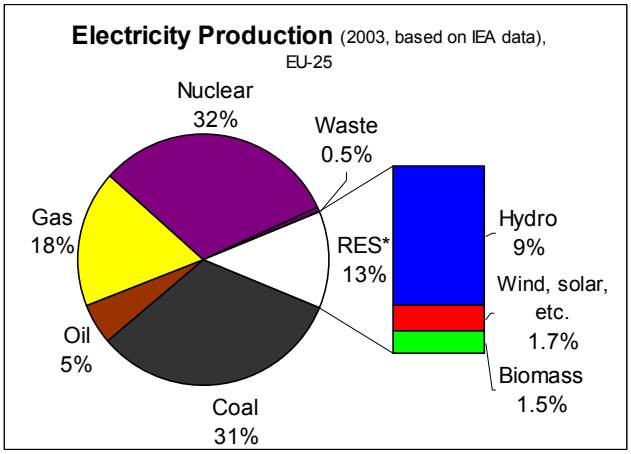
Taken together, the EU countries are large importers of fossil fuels, including oil, gas, and coal. Net imports made up 61% of the fossil-fuel supply in 2003 for the EU-25 countries and 77% of their oil supply alone. Domestic production of all fossil fuels is declining.

Within the last decade, the EU countries have become leaders in the development of renewable energy, while domestic production of fossil fuel has declined. Together with Japan, they are also world leaders in energy efficiency. Some of the fastest growth rates in the use of renewable-energy technologies have taken place in individual EU countries since 1990.

The development of renewable energy has reached a level at which new technologies are making substantial contributions to the energy supply in several of the EU countries.

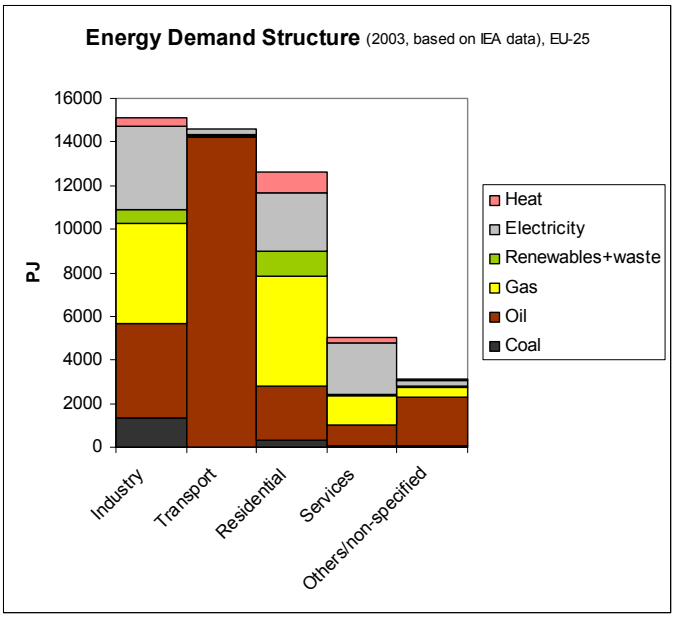


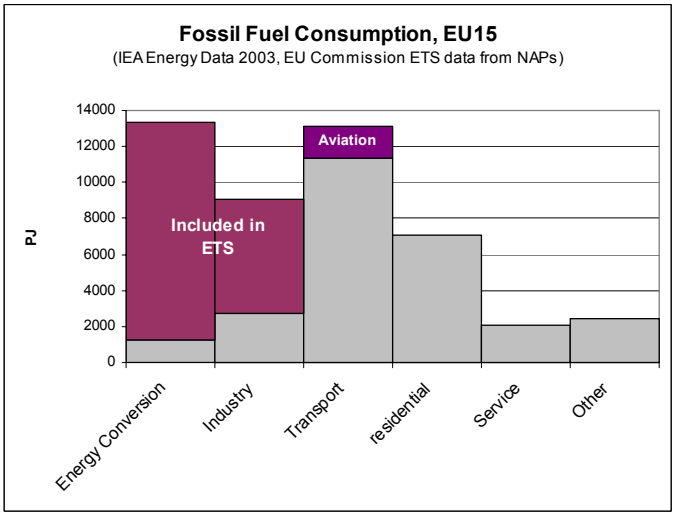




In the future, the EU will consume a decreasing share of the world's energy supply. The role of EU countries as suppliers of better technologies for energy efficiency and renewable energy will be of increasing importance in reducing worldwide consumption of finite energy resources, and thus will make a valuable contribution to the security of supply and to the reduction of global greenhouse-gas emissions.

Emissions Trading Changes Energy Regulation





Since the beginning of 2005, EU energy consumption is divided into one part that is covered by the new Emission Trading Scheme (ETS) and the remainder, which is covered by other regulations. The ETS covers about 11,500 installations in energy and industry. These installations have limits (caps) on their CO_2 emissions, and if they increase emissions above their caps, they will have to buy emission quotas to cover their additional emissions. Failing that, they will have to pay a penalty per ton of CO_2 above their cap, on top of buying emissions quotas the following year. If an installation emits less than the amount of its cap, its owners can sell the excess emission quotas. The cap is set in National Allocation Plans (NAPs), developed by each country and approved by the EU Commission. The first NAPs cover 2005-2007. The coming NAPs, which will cover 2008 – 2012, are still to be decided. The first NAPs typically set quotas at 95-100% of the forecasted emissions. Installations covered by the ETS are usually exempted from some other regulation, such as energy and CO_2 taxation.

The energy-supply sector, with its refineries and producers of power and heat, is almost fully covered by the ETS. Major industrial sectors are covered as well, including steel, non-metallic minerals, pulp and paper. In addition, the ETS covers any combustion installation (furnace) that exceeds 20 MW in thermal capacity. The ETS only covers installations above a certain size, which is specified for each industry. Some major industrial sectors are excluded, such as the chemical industry, but their boilers above a 20-MW thermal capacity are included.

Industry uses about 2/3 of the fossil energy used by the energy sectors, and the same ratio holds for CO_2 emissions. In the ETS, a larger part of the energy sector than the industrial sector is included. This makes the energy sector the largest in the ETS, and thereby the most influential in setting the price of quotas. During 2006, it will be decided whether more of the industrial and other sectors should be included in the ETS starting in 2008. The EU Commission and the EU energy ministers have welcomed the idea that aviation should be included in the ETS beginning in 2008, but no final decision has been made yet.

1.2 Latest Trends in Renewable Energy

Renewable energy has developed fast in several EU countries for more than a decade. Indications are that growth will continue and probably increase, but it is uncertain that the 2010 targets of 12% renewable energy in total primary energy supply, 22% renewable electricity, and 5.75% renewables in transport will be reached.

Windpower has seen the largest growth in installed capacity among the renewable-energy sectors, adding more than 5,000 MW/year to EU capacity in recent years, with a record 6,183 MW in 2005. Compared with 2003 and 2004 there were fewer installations in the leading countries, Germany and Spain, combined with more installations in a number of other EU countries, including the UK and France. If this trend continues, windpower will cover more than 4% of EU electricity demand in 2010.

Photovoltaic (PV) is the fastest growing form of renewable energy, gaining an additional installed capacity of 410,000 m^2 in 2004, primarily in Germany. Indications are that the market has been increasing substantially from 2004 to 2005. In spite of this large growth, PV will cover less than 1% of EU electricity demand by 2010.

Solar Thermal is growing fast, adding 1.69 million m^2 in 2004, equal to 12% of installed solar thermal collector surface. While there are no indications of increased growth in 2005, new building legislation that enters into force in 2006 is expected to increase growth.

Solid biomass grew by only 5.6% in 2004; but it continued to make the largest contribution to total primary energy supply among the renewable energies, almost 4% in EU-25. Indications are that the growth has increased since 2004, with the high oil prices as an important driver. The share of electricity production from solid biomass is increasing fast. The increase was 23% in 2004, and the increase is expected to continue, partly driven by EU targets for renewable electricity.

Liquid biofuels, mainly for transport, are growing fast, and the expectation is that they will grow faster in the years to come, driven by high oil prices as well as by EU targets and policies.

Biogas and geothermal energy have large unused potentials, but their growth rates have been modest in recent years.

Hydropower has large annual variations in production, substantially larger than the small growth experienced in this sector.

These developments are described in more detail in Chapters 2 and 4.

Sources:

Renewable Energy Barometers, from EurObserv'ER, Systemes Solaire and EUFORES:
- Solar PV Barometer 2005
- Solar Thermal Barometer 2005
- Wood Barometer 2005
- Biofuels Barometer 2005
- Biogas Barometer 2005
The barometers are available from www.eufores.org .
European Wind Energy Association Press release, February 1, 2006: European Record for Windpower

IEA Energy Balances for OECD Countries, 2005 Edition (data for2003), International Energy Agency, Paris.

2. EU Policy Trends in Renewable Energy and Energy Efficiency

2.1 Framework for Renewable Energy and Energy Efficiency

Internal Energy Market

The EU Internal Market is an important framework for all economic policies in Europe, as it is for renewable energy and energy efficiency. Thus, a description of the EU's policies for renewable energy and energy efficiency must include trends in the Internal Market.
In 1987, the 12 EU countries agreed on the Internal Market as an enhanced free market, such that the countries are not allowed to favour national products over products from other countries. While oil supply was a natural part of the Internal Market, it was not obvious from the beginning that gas and electricity, distributed via networks, should be part of the internal market. In most EU countries, electric and gas utilities were integrated companies that were state monopolies. The largest exception was Germany, where the power sector consisted of private and municipal monopolies.

Soon after the start of the EU internal market, the UK decided to convert its state gas and electricity monopolies to competitive gas and electricity markets. By the end of 1990, the UK had an electricity market with regional distribution companies and with larger power-production companies, all private except for the nuclear power plants, in which no private investor would invest (in 1996 some nuclear power plants were privatised). The market has an electricity exchange, a private monopolistic transmission company, and an independent regulator to ensure a fair competition, including fair access of trading companies. After the UK electricity sector deregulation, there followed a similar deregulation of the gas sector.

These developments in the UK were followed by Norway's introduction of competition in its power sector, with division of larger production facilities, transmission, and distribution into separate entities. The country also established an electricity exchange and a market regulator. Norway did not privatise its power sector, and the companies remained in the hands of the state and the municipalities.

The EU Commission made a proposal for a EU-wide electricity regulation following the principles of the markets in UK and Norway[1]. This was only welcomed by some of the EU countries, while others preferred to keep their existing monopolies. After years of discussion, the countries agreed on an electricity market directive in 1996, to be implemented fully by 1998. It only required partial competition, starting with the largest consumers, with no changes of ownership. It stated clearly that the countries kept the right to decide which energy sources should be used for electricity production, and it introduced the opportunity for countries to charge a levy on all electricity consumption as a "public service obligation" (PSO). The revenue from this levy can be used to support renewable energy and energy efficiency. This has been used by a number of countries to fund feed-in tariffs for renewable energy as well as for energy-efficiency information campaigns and subsidies. The electricity market directive was soon followed by a similar gas market directive.

When implementing the market directives, a number of countries decided to go beyond the minimum market openings, and to deregulate markets fully, though mostly without changes of ownership; i.e., similar to the Norwegian model. First came Sweden, and followed soon by Germany, Denmark and others. Other countries, particularly France, decided to stick to their state monopolies, introducing only minimum market opening.
In the Central European countries that joined the EU in 2004, a similar dynamic took place. The countries introduced deregulation of the markets, but often they privatised the utilities without dividing them up, unlike the UK. This produced less competition, but brought in more income for the state budgets at the time of privatisation.

Overall, the introduction of the EU Internal Energy Markets has brought competition on the national level, but has led to mergers across borders, resulting in fewer and larger companies in the EU. In the electricity sector, the large companies are the French state-owned Électricité de France (EdF), the German private E.ON and RWE, Swedish state-owned Vattenfall, and Italian ENEL.

The electricity and gas directives were revised in 2003. The new directives required full opening of markets, allowing all consumers to choose their own suppliers by 2007, and commercial companies by 2004.

Recent surveys show that not all countries have given all private companies the ability to choose another supplier of electricity or gas. Other market imperfections include the ease with which large companies can influence the market price[2].

The open electricity market gives consumers the option of choosing a supplier that is fully or partly using renewable sources for the production of electricity. In most countries, some power companies have offered "Green Power" according to various criteria, and at a price slightly above that of non-renewable energy. The most successful initiatives have been in Sweden, Germany, and Netherlands. The Dutch scheme was for a period backed by the state, which charged a lower tax on green power. The schemes have had various criteria, sometimes leading to confusion among customers, and some schemes have had low credibility. A coherent set of criteria is now being introduced EU-wide with the EUGENE criteria system; for more information, see www.eugenestandard.org.

In the Internal Markets, the EU Commission has a special authority to demand that countries reduce state subsidies. There are a few reasons that allow the countries to introduce state aid. One of these is environmental reasons, including support for renewable energy and energy efficiency. To ensure transparency in its administration of the rules, the EU Commission publishes state-aid guidelines, including a guideline on environmental state aid. This guideline allows state aid for renewable energy and for certain forms of energy efficiency, including for CHP. The state aid can be in the form of investment subsidies and in the form of operational support such as a support or tax exemption for energy production. According to a precedent-setting case heard by the European court, feed-in tariffs are not state aid, as the tariffs are paid by the energy consumers and not by the states.
The guidelines are updated regularly, and a new update will be discussed in 2006.

SAVE Program

In the early 1990's the EU introduced the SAVE Programme to increase energy efficiency. The background was a slow-down in the energy-efficiency increase in the EU-countries from around 1985, and concern that the focus on the energy supply with the internal market would leave energy efficiency opportunities unused. Within the overall SAVE programme a framework directive was developed for labelling and for standards of energy-consuming goods (the "SAVE" directive, 1992/75), along with the SAVE program for support of non-technical activities to increase energy efficiency. Both the directive and the programme are still in force; see below.

The SAVE program was followed in 2000 by an EU strategy for energy efficiency.

The SAVE support program was integrated into the Intelligent Energy for Europe Programme, which started in 2003.

In 2005, a Green Paper on energy efficiency was published by the EU Commission with the aim of developing new energy-efficiency policies. This Green Paper is described below under section 2.5.

The White Paper for Renewable Energy 1997

Just before the Climate Convention Conference in Kyoto in December 1997, where agreement was reached on the Kyoto Protocol, the EU Commission presented a White Paper[3] on Renewable Energy[4]. The paper proposed steps toward doubling the use of renewable energy from 5.2% in 1995 to 12% in 2010. The analysis behind the paper proposed increasing all types of renewable energy.

The proposals in the paper will raise renewable-energy use to 12.0 % using the Eurostat Convention/IEA Methodology[5], with a passive-solar increase of 400 PJ (10Mtoe), and on the condition of a rise in energy consumption of 16%. The biomass sectors, with a combined proposed increase of 3,700 PJ, were expected to be the most important. Almost half of the biomass was expected to come from energy crops. Of this amount, 1,110 PJ would be solids. Of the remainder, 750 PJ would be liquid biofuels, although some biofuels could also come from residues. If the solid biomass came from energy forests, it would cover 6.3 million ha (4.5% of the 141 mill. ha of total agricultural area in EU-15). The expected relative growth of the various forms of renewable energy ranges from less than 20% for hydropower, to almost a tripling of biomass use, to increases of solar heating, windpower, and solar electricity (PV) by factors of 15, 19, and almost 90, respectively.

Renewable Energy White Paper 1997: Proposed increases in renewable-energy use, 1995-2010

- Solid biomass for cogeneration of heat and electricity, 1,320 PJ (32 Mtoe)
- Solid biomass for heating, 1,030 PJ (25 Mtoe)
- Liquid biomass, mainly for transport, 750 PJ (18 Mtoe)
- Biogas & landfill gas, 620 PJ (15 Mtoe)
- Windpower, 40,000 MW = 270 PJ (6.5 Mtoe)
- Hydropower, 170 PJ (4.15 Mtoe)
- Solar heating, 100,000 m^2 = 150 PJ (3.74 Mtoe)
- Geothermal 110 PJ (2.7 Mtoe)
- Solar PV, increase of 11 PJ (0.26 Mtoe).
- Passive solar, increase of 400-1000 PJ (10-25 Mtoe)

In 1995 the EU countries welcomed the White Paper and agreed to use the target as an indicative target or guideline for development. The target was later included in the EU's climate policy as one of the major building blocks towards an 8% reduction in greenhouse gases, the EU's commitment in the Kyoto Protocol.
The White Paper is available on-line at http://www.europa.eu.int/comm/energy/res/legislation/index_en.htm.

EU Climate Policies and Climate Change Program (ECCP)

To prepare for ratification of the Kyoto Protocol, the EU Commission established the ECCP with stakeholders including environmental NGO's, industry, energy suppliers, etc. The ECCP is mainly a program for measures within EU countries, but it also deals with joint implementation (JI) and the Clean Development Mechanism (CDM).
The first phase of the ECCP ended with a report in June, 2001, including 43 proposals for reduction of greenhouse-gas emissions, of which many dealt with renewable energy and energy efficiency.
The EU Council of Ministers and the EU Parliament welcomed the work. In October, 2001, the EU Commission followed up with proposals for the EU's ratification of the Kyoto Protocol and with a number of proposals for immediate implementation (2002-2003). The most important of these was a proposed scheme for EU-wide emissions caps and trading (see chapter 3).
The next phase of the ECCP in 2002-2003 focussed on implementation of the proposals from the first phase, and a new phase of the ECCP started in 2005 to review results to date and to improve the basis for EU climate policies after 2012. The results of the review are expected in the summer of 2006.
More information can be found at the ECCP homepage:
http://europa.eu.int/comm/environment/climat/eccp.htm .

Security of Supply

Security of supply is the most important driver of energy policies in the EU countries, together with environmental issues. The issue re-emerged on the agenda in the late 1990's following increases in oil prices and the dwindling of fossil-fuel production in the EU, especially in the UK. The EU Commission was quick to respond with a Green Paper for Security of Supply. The paper highlighted the EU countries' high and rising dependence on imported fuels, leading to an increasingly costly and unsustainable energy supply. The paper discussed opportunities to improve security of supply by increasing energy efficiency and renewable-energy use as well as by improving supply infrastructure (pipelines and LNG[6] terminals), increasing use of nuclear power, and maintaining uneconomic domestic coal production.

In preparing the Green Paper, the EU Commission omitted the EU's own targets for renewable energy and energy efficiency in the analysis of the baseline, even though they were part of the strategy to fulfil the EU commitments to the Kyoto Protocol. Fulfilment of these targets will reduce future problems with security of supply in the EU better than following the baseline scenario presented in the Green Paper.

During the debate, electricity blackouts in Italy, Scandinavia, and other places in 2003 brought the issue of security of electricity supply into the agenda. Partly in response to this, the EU Commission responded with a security-of-supply package of proposed measures, including:

- Proposal for a Directive to Safeguard the Security of Electricity Supply and Electricity Infrastructure (to speed up the construction of new infrastructure; power production as well as transmission lines and interconnectors between different systems).
- Proposed EU Directive on Energy End-use Efficiency and Energy Services (described below).
- A Regulation on conditions of access to gas transmission networks (to promote cross-border trade in gas, to strengthen the gas market).
- Proposal for revision of the guidelines for Trans-European Energy Networks (electricity and gas networks, proposal to promote more interconnectors).

The EU Green Paper of Security of Supply is available on-line at
http://europa.eu.int/comm/energy_transport/en/lpi_lv_en1.html .

The EU Commission never followed up with a White Paper on security of energy supply; but it is preparing a new paper on energy and security of supply, to be published in Spring, 2006, before the high-level discussions on EU energy policies that are scheduled for March 2006.

Intelligent Energy for Europe

The Intelligent Energy for Europe (IEE) programme was introduced in 2003 as an overall program for non-technical support of renewable energy and energy efficiency. It incorporated the existing ALTENER and SAVE programs for, respectively, renewable energy and energy efficiency. It also introduced a new programme for transport efficiency, STEER, and an energy programme for developing countries, "COOPENER", that has been focussing on Africa so far. COOPENER is partly a replacement of the SYNERGY programme, though with a broader agenda of topics, but with a smaller geographical coverage. In addition to these programs, IEE also has a support facility for horizontal projects, usually evaluation projects and those that cover both energy efficiency and renewable energy.

The annual support is about 50 mill € for the general program. There is one call for proposals annually. The latest call was the 2005 call with a deadline of 31/1 2006 and with a total budget of 51 mill €. Typically, the programme supports projects with funding of ½ million € each; and the programme can maximally support a project with 50% of IEE's budget.

In 2005, an executive agency was opened to manage the IEE programme and to reduce the workload of the EU Commission. This follows a recent trend in which more executive functions of the Commission are being placed in special agencies.

The ALTENER and SAVE programs are described in more detail below under renewable energy and energy efficiency, respectively.

The EU Commission proposed in 2005 that the IEE Programme should continue as part of the "Competitiveness and Innovation framework Program" (CIP) for the years 2007 to 2013[7]. The proposed budget for IEE is € 780 million for the seven years, which is a considerable increase. It will continue to address renewable energy and energy efficiency.

Research and Technical Development of New Technologies

EU's R&D activities are organised in 5-year framework programs for research and technical development (RTD). They include subprograms for nuclear energy; sustainable energy, including renewable energy and energy efficiency; energy networks; and, lately, hydrogen technologies, as well as the capture and storage of CO_2. The current framework programme (FP) is the 6th FP, 2002-2006, while the coming, 7th FP is under preparation for 2007-2013. The specific activities of the 6th FP and plans for the 7th FP regarding renewable energy and energy efficiency are covered below (see section 2.2 and 2.4).

The 7th FP has an ambitious energy objective:
"Transforming the current fossil-fuel based energy system into a more sustainable one based on a diverse portfolio of energy sources and carriers combined with enhanced energy efficiency, to address the pressing challenges of security of supply and climate change, whilst increasing the competitiveness of Europe's energy industries."[8]

The non-nuclear energy priorities (as of September, 2005):

- Hydrogen and fuel cells
- Renewable electricity generation
- Renewable fuel production
- Renewables for heating and cooling
- CO_2 capture and storage, zero-emission power plants
- Clean coal technologies
- Smart energy networks
- Energy efficiency and savings
- Knowledge for energy-related policy-making
- International cooperation (cross-cutting priority included in other activities)

Most activities will be in the fields in which Technology Platforms (TPs) are defined. While these are still under discussion, it seems that there will be technology platforms for:

- Hydrogen and fuel cells
- Photovoltaic electricity
- Renewable-fuel production and bio-refineries, mainly for transport fuel production
- CO2 capture and storage for zero-emission power plants
- Electrical energy networks

The proposed budget for the 7th FP for non-nuclear research is 419 million €; but it is likely that it will be cut by 30-40%, in which case the funding will be close to that of non-nuclear energy under the 6th FP.

It is important to note that the EU's research complements national research, and that the EU countries' national research programmes combined are much larger than the EU's research funds in most fields.

EU Summit Agendas

The EU Prime ministers meet four times a year, and at some of these "EU Summits", broad agendas are set. The Gothenburg Agenda on sustainable development (from 2001) and the Cardiff Process on integration of environmental considerations into EU policies and activities (from 1998) both promoted renewable energy and energy efficiency as frameworks. This is also the case for the Lisbon Agenda set in 2000, in which the EU Heads of States agreed to make EU "the most competitive and dynamic knowledge-driven economy by 2010", focussing on technological development, growth, sustainability and employment. These summit agendas are followed up with evaluations and recommendations at later summits. The recommendations are broadly followed by the EU system and the EU countries with specific measures including legislation.

Agricultural Policy

The EU's agricultural policy has the largest budget among EU policies. For over 20 years the policies has resulted in overproduction of food in the EU countries. A main concern is how to reduce agricultural production without destroying the rural economies. One measure has been to leave 15% of the land without agricultural production (set-aside land). That 15% of agricultural land has been suggested as the land potentially available for non-food crops such as biomass for energy.
Change to non-food products, including biomass for energy, is one way to reduce food production while maintaining a rural economy. Recognising this, the EU has introduced support for biomass crops such as short rotation coppice among its policies. It has not led, however, to large-scale conversion to this kind of energy crops. One reason for this is that some EU countries have not provided for such conversions in their national implementations of the EU agricultural policies. In addition, the economic incentives have not been high enough to offset perceived risks in undeveloped markets for the products (wood chips). Recent information from Poland suggests that in some of the new EU countries, where food prices are lower, support could lead to a large conversion to biomass for energy in the future.

Currently, new initiatives for conversions to crops for liquid biomass are under discussion. The EU Commission published a "EU Strategy for Biofuels"[9], Feb. 8, 2006. With the current high oil prices, liquid biofuels constitute a high-value product compared with solid biomass.

Regional Policies

Support for the poorer regions (regions with GDP of less than 75% of EU average), and for regional cooperation, has the second largest budget among EU policies. So far renewable energy and energy efficiency have received only limited support from these structural funds and from other regional programs. Nonetheless, several interesting projects for renewable energy and energy efficiency have been financed. Recent information from the new EU countries shows that structural funds might support substantial conversion to biomass as a local energy source that creates local income. A new framework for regional funds is currently under negotiation, covering the period 2007-2013. It has been suggested, e.g., in communication from the EU Commission[10], that these funds could play an important role in fulfilling the targets for renewable energy and energy efficiency.

Taxation

In the early 1990's, the EU Commission proposed a common CO_2 tax of 10 $/ ton of CO_2 for all EU countries; but as the countries would not agree to that, instead a directive was passed with minimum levels for fossil fuels. Most of these minimum levels were considerably below the equivalent of 10 $/ton of CO_2.

The EU Commission proposed a new directive in 1997 to increase these minimum levels of fossil-fuel taxation, but the countries took until March 2003[11] to agree to it. Like any other tax proposal, it could not be adopted without consensus.
The directive sets the minimum tax levels on fossil fuels for the coming 10 years, starting in 2004; but many countries have specific exemptions for up to 5 years. It broadens the scope of EU energy-tax rates to cover coal, gas, and electricity. Its effect is small because most countries already have higher rates than the minimum rates. The table below gives an overview of the new minimum tax levels.

The rates for fossil-fuel use outside the transport sector are still considerably below the 10 $/ton of CO_2 proposed in the early 1990's. Several NGOs, including European Environmental Bureau (EEB) and Friends of the Earth, have campaigned for this directive, but they criticised the result for being too weak to make a meaningful contribution to sustainable development. Thus, the EEB continues its campaign for fiscal reform.

New EU Minimum Energy Tax Rates, 2004	€-Cent/kWh	Increase from 1992 Directive
Diesel-petrol* for transport	3.0-4.0	25%
Natural gas -LPG for transport	0.94-0.98	25%
Natural gas & coal for heating**	0.11(0.055)	New tax
Fuel oil -heating oil	0.13-0.21	14%
LPG & Kerosene for heating	0	-
Electricity**	0.1(0.05)	New tax

*Unleaded petrol; leaded petrol is 17% higher.
** Rates in brackets are for business purposes; for natural gas, the low business-rate only applies for heating.

Emissions Trading

Following conclusions of the first European Climate-Change Programme in 2001 and as one element of the EU's ratification of the Kyoto Protocol, an emission cap and trading scheme (ETS) was introduced in the EU, starting in 2005. The scheme covers about 12,000 installations that are responsible for 45% of the EU's CO_2 emissions. The first commitment period is an introduction period 2005-2007, followed by the first full commitment period 2008-2012.
The scheme was supported by major environmental organisations, which consider it the second-best alternative to a CO_2 tax, since the EU countries would not accept the latter. It was also supported by the majority of EU industries and power companies, although some industries were against it.

The ETS is described in detail in Chapter 3.

The ETS increases the price of fossil fuels for the companies covered, even though some of those same companies have been released from energy taxes in a number of countries. This would in principle improve the economic incentives to invest in energy efficiency and to change to renewable energy. It is possible to show that for a company using heavy fuel-oil for process heating, the pay-back time could be reduced by 20-50% for an investment in a change to biomass-fuelled process heating[12]. In spite of this, the ETS has not so far resulted in a push for renewable energy or energy efficiency, as far as the authors can judge. The IEA came to the same conclusion in its recent publication "Energy Policies in IEA Countries": "*While marginal CO_2 abatement cost might in the long run direct investments towards abatement projects, fuel switching from coal to gas for power and heat production is probably the single most important measure in the short term*"[13].

While the ETS is not a driver for renewable energy or energy efficiency presently, it could be so, if a number of conditions were met:

- The ETS must lead to a high enough price increase for fossil fuels. This depends on quota price development.
- The ETS market must bring about a stable price increase for fossil fuels, one that is perceived as likely to last beyond the end of the payback periods of the investments, i.e., well beyond 5 years.
- The administrative rules of the ETS must allow an installation to continue to receive credits after it has ended its fossil-fuel consumption. This is not the case in all countries.

If the market stabilises and uncertainties are reduced, such as those related to the allocations for 2008-2012 and to the influx of credits from JI and CDM, the ETS could be a driver for renewable energy and energy efficiency within 1-2 years of today. The chances that this will happen would increase considerably if it were decided that the system should continue beyond 2012, beyond the first commitment period of the Kyoto Protocol.

In promoting long-term investments, the system has the inherent problem that it does not give investors a precise price. Thus, the investor needs an additional profit margin to cover this uncertainty. This is the same problem seen in the "green certificate" systems for renewable energy, as described below.
The ETS is discussed further in Chapter 3, below.

International Policies

The EU has the largest Official Development Assistance (ODA) budget in the world, and it was decided in 2005 that a part of this should be used on energy for poverty reduction in Africa south of the Sahara. This follows EU's Energy Initiative for Poverty Reduction and Sustainable Development, launched in 2002. The first call for proposals is expected in 2006.
Existing EU programs such as ProAsia and the former TACIS (now EuroAid) programme also support projects for renewable energy and energy efficiency, though the funds are not dedicated to this purpose alone.

2.2 Current Renewable Energy Policies

In addition to the frameworks for renewable energy mentioned above in section 2.1, the EU has a number of specific policies for renewable energy and support mechanisms that directly support renewable energy initiatives.

Renewable Energy in Electricity, Directive

After years of negotiations, the *"Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market"* was adopted September 2001. The EU countries were to implement the directive in national legislation before October 2003. The main elements of the directive are:

- Indicative targets for renewable energy for each of the 15 EU countries, leading to a combined target of 22% of electricity production from renewable energy by 2010. This is a considerable increase from 14% in 1995, and is coherent with the Renewable Energy White Paper targets.
- Access of renewable-energy producers to the grid and priority of renewable electricity in dispatch of electricity.
- Objective and transparent rules for connecting renewable-energy producers to the grid for the costs of their grid-connections.
- Reduction of administrative barriers for establishing renewable-energy producing facilities by streamlining procedures and by introducing objective rules
- The countries shall issue certificates of origin for renewable-energy producers interested, e.g., as documentation for "green power" sales.

The directive was a compromise between promoters of market regulations that wanted a so-called "market system" for EU-wide renewable energy support, e.g., with renewable-energy certificates that could be traded EU-wide to fulfil national quotas, and supporters of feed-in tariffs, a support mechanism that had shown its efficiency in practice. The compromise was that the directive leaves it to the countries to choose their own support mechanisms for renewable energy, while giving the EU Commission an opportunity to suggest a harmonised system based on evaluations of the national systems, with the first evaluation scheduled for 2005. The EU Commission evaluated developments in 2004 and 2005, but has decided not to propose a harmonised system. The evaluations are discussed further below under "assessments of targets".

Another important compromise in the directive is that the targets are indicative (i.e., voluntary); but if the general target (22%) is not met, the EU Commission can propose mandatory targets. This proposal has to be approved by the EU countries and Parliament. The Commission has not used this right yet.

The directive can be read on-line at http://www.europa.eu.int/eur-lex/en/lif/reg/en_register_1230.html .

The 10 "new" EU countries have included national renewable-electricity targets as part of their accession agreements. In general, the targets would double their share of electricity from renewable energy in their electricity supply; but some countries with very low shares of renewables in electricity have taken higher targets. These targets have led to some very interesting developments of renewable energy, e.g., in the Czech Republic and in Hungary. Other new EU countries are giving up their targets. Slovakia, for instance, is trying to reduce its target, which is one of the highest.

Leaving the choice of support mechanisms for renewable electricity to the countries has led to a number of different support schemes. The main schemes that the countries have chosen are:

- Feed-in tariffs, which are the most successful support schemes in terms of installation rates and of cost-effectiveness. With these schemes, renewable energy is supported with a fixed tariff for some period, usually for 15-20 years. In the new German scheme, this is divided into different support for different technologies, and even different tariffs for different locations, yielding high tariffs for windpower for sites where there is less wind, such as in Southern Germany. Originally, feed-in tariffs were mostly linked to consumer prices, e.g., 90% of the consumer price; but now they are mostly nominal values. A variation of the feed-in tariff is used in Spain and Denmark, where renewable energy is paid a tariff of the electricity market price plus an environmental premium. While this brings investors less security than the “normal” feed-in tariff, it is successfully driving Spanish development of renewable energy.
- The green certificate system is used in five EU countries, where the renewable-energy producers receive the electricity market price plus a green certificate. Consumers (or, in some countries, suppliers/producers) of electricity have to buy green certificates for a certain share of their consumption (or supply). This is similar to portfolio standard requirements used in some states of the USA. It introduces uncertainty for investors, who do not know how much their income will be from future sales of green certificates.
- Some countries, including France, Ireland, Denmark and, previously, the UK, have used tendering of renewable installations, such as a windpark on a specific site or a landfill gas system on a specific landfill. The investor that offers the lowest power price gets the contract to deliver power for a certain number of years, usually 15-20. While this system is not used widely, a tender was made for two large off-shore windparks, 200 MW, in Denmark in 2005, and France made general tenders for 1000 MW of windpower, half of which is to be offshore.
- Tax incentives are an additional measure that is used in a number of countries. They can be tax deductions of investments or income, or they can be payments of consumer electricity tax (or part of it) to renewable-energy consumers. When electricity taxes are introduced as environmental taxes, it is logical that they are repaid for renewable-energy installation. These electricity-tax refunds have the same effect for investors as a fixed premium on top of electricity prices. Tax incentives are mostly used to provide additional motivation, together with some of the other support mechanisms.
- With net-metering, consumers are allowed to install renewable energy in their own installation and let the electricity meter run backwards if the renewable installation produces more than they consume. The consumer only pays for the net consumption of electricity. This is used in some countries for small renewable-energy installations in households, sometimes confined to one source such as PV, but this system is not useful for larger installations.
- Investment subsidies were previously the most used support mechanism, and they are still used in a number of countries, mostly as an additional measure to support special or new technologies.

While some countries are on track to reach their targets in the directive, the overall assessment based on 2003 and 2004 figures is that the 22% total target will not be met with existing measures, because of lower than expected growth in biomass power and in hydropower. Windpower and solar PV have developed faster than expected. Given that the countries only had to implement the directive until October 2003, it is possible that development will increase after the directive is implemented, which might only be visible in statistics for 2005 and later; see below on assessments of renewable energy and climate targets.

Renewable Energy in Transport, Directives

In May, 2003, the EU countries agreed two directives promoting renewable energy in transport[14]. They set indicative (voluntary) targets for the use of renewable energy in transport (referred to as reference values), and they allow countries to exempt biofuels from vehicle fuel tax, as the EU has set minimum levels for fuel taxes. These indicative national targets, which are referred to as "reference levels" were set to reach 2% in 2005 and 5.75% in 2010, in line with the White Paper on Renewable Energy from 1997. The directives are often referred to collectively as "the biofuels directives", and they mainly support the use of biofuels in transport. This is fuel from agricultural products such as plant oils, plant oil methyl-ester (including rape-seed oil methyl ester, or ROME), methanol, ethanol. The countries were to implement the directives until 2004.

The two main ways for the countries to implement the directives are with tax reductions for the biofuels and with demands for mixture of a certain share of biofuels into vehicle fuels. The most popular have been reduction of fuel taxes for biofuels. This has been implemented in Germany, Spain, UK, and other countries.

In addition to liquid biofuels, there are other possible technologies that can drive cars with renewable energy. Cars can be driven with electricity, hydrogen, or methane gas produced with renewable energy. Vehicles driven on methane gas are increasingly used in the EU. They mainly use compressed natural gas (CNG), often in buses for public transport. Only in a few places is the technology used for biogas. Sweden seems to be the only EU country in which the use of biogas-driven vehicles is growing fast enough to contribute to the national target for renewable energy in transport by 2010. Currently, a few thousand Swedish cars can run on biogas. Electric cars represent a well-known technology, but expectations are that they are not developing fast enough to contribute significantly to the 2010 target. Hydrogen vehicles are under development, but a significant number will not be in use before 2010.

The biofuels markets have grown rapidly in recent years. EU annual production of biodiesel has passed 2 mill. tons, and of ethanol, ½ mill. tons[15]. The growth will continue. At the current rate of growth, the level in 2010 will be 9-10 Mtoe, rather than the target of 18 Mtoe/ 750 PJ; but the market can grow rapidly and there is no doubt that with enough tax exemptions for biofuels, the target can be reached.

There is a growing concern over the environmental effects of biofuel production. Some environmental organisations are generally against biofuels in transport because they fear that it increases agricultural pollution in the EU. Larger concerns are rising against imported biofuels, e.g., from palm oil plantations that are planted on rainforest clearings. The EU Commission mentioned the problem of imported biofuels in its recent biomass action plan (December 2005) and strategy for biofuels (February 2006). During 2006, the EU Commission will discuss with stakeholders ways to ensure that biofuels for transport are produced sustainably. Otherwise, biofuels might not contribute to reductions of global greenhouse gas emissions.

Support for Renewable Energy: Altener Programme

The EU's program for non-technical support of renewable energy is the ALTENER, which is now a part of the Intelligent Energy for Europe framework programme. The programme supports a number of issues such as:

- Renewable Electricity, including non-technological issues for accelerated market introduction of all renewable technologies. This includes grid-system issues, evaluation of support schemes, and promotion of decentralised electricity generation.
- Renewable Heat, e.g., by developing appropriate wood-fuel standards, by improving the supply chains of biomass, by developing enabling heat market structures, by stimulating integration of solar heat applications in buildings, by stimulating geothermal heat use with heat pumps, by providing best practice examples, and by training.
- Small Scale Renewable Applications.
- Renewable-based vehicle propulsion.

A number of the projects are linked with the implementation of EU directives for renewable energy, in particular of the above-mentioned directives.
An overview of the projects supported by ALTENER is available at
http://europa.eu.int/comm/energy/intelligent/index_en.html .
The current budget of ALTENER is 20 million € in average per year (2003-2006)
The ALTENER will continue in its current form through 2006, with one more call for proposals in the second half of 2006. It will continue in a new framework starting in 2007; section 2.1 (IEE).

Renewable Energy in the EU 6th Framework Programme for Research and Development

In the EU research program, a number of renewable-energy projects receive support, ranging from basic research in PV physics to demonstration of renewable energy in integrated systems. The support for non-nuclear energy is divided in two parts: medium- and long-term research; and demonstration and research in the short- and medium terms. There is no subdivision in renewable energy, energy demand, and other fields of non-nuclear energy research. One part of the short- and medium-term activities is a large initiative, "CONCERTO", which supports demonstration projects aiming to optimise energy flows in local communities and cities with renewable energy and with energy-efficiency technologies.

An analysis of recent projects from the Cordis database of the current 6th Framework Program (FP) shows 43 projects for renewable energy, divided as follows:

- 10 biomass projects, including cleaner biomass combustion, gasification, solar-biomass combination, and production of liquid biofuels from different feed-stocks.
- 8 projects on solar PV, including projects on advanced PV cells, cheaper cell production, advanced modules, building integrated PV, and tracking/reflectors for PV.
- 3 projects on solar thermal, also for power production.
- 3 projects in windpower, on offshore /island-based windpower.
- 2 projects in geothermal energy/heat pumps.
- 2 projects wave energy/ocean energy.
- 14 projects on integrating renewable energy into society, including integration of a large share of renewable energy into electricity grids and integration of renewable energy into cities.

The large number of projects on integration of renewable energy is a result of the focus of the 6th FP on this, in the CONCERTO programs.

Each of the projects is usually above 1 million € and has many partners from different EU countries.

The Cordis database is available online at http://www.cordis.lu/fp6/projects.htm. Energy projects are found under the activity area "Sustainable Development, global change and ecosystems".

The 6th FP will continue until the end of 2006 and will then be followed by the 7th FP.

Renewable Energy in the EU 7th Framework Programme for R&D

For the 7th Framework Programme (FP), 2007-2013, the EU Commission has proposed an increase in non-nuclear research; but it has not proposed a division between renewable energy, energy demand, carbon capture and storage, and other areas such as power grids. The research and development (R&D) budgets will probably be cut by 30-40%, and will continue on the same activity level as under the 6th FP. The final decisions about the budget will be taken in 2006. It has not been decided how the current plans will be changed because of the cuts; but the Commission is determined to try to minimise the negative effects of the cuts by coordinating efforts more within Europe to avoid duplication, and to increase international cooperation. The hope is that specific research priorities can be carried out in cooperation with interested countries outside the EU.

The highest priorities in renewable energy seem to be in PV and in biofuels (mainly for transport), where there will be technology platforms; but in the proposal from September, 2005, a much larger renewables agenda is included[16], as described in section 2.1. The priorities are going to be set during 2006, following the budget reductions. In addition, more priorities can be set during programme execution, depending on developments.
In biofuels, emphasis will be on new types of biofuels as well as on the integrated production of energy and other added-value products through bio refineries. There will also be emphasis on standardisation for safe and
reliable biofuel use, on renewable hydrogen production, and on other themes. Detailed priorities are still to be decided.

Regional Funds (Structural Funds)

EU structural funds (SF) are a very promising source of financing of renewable-energy projects in EU countries with regions whose GDPs are below 75% of the EU average. The renewable-energy projects realised on local levels could be one of the best options for effective use of the funds. In particular, in the new member countries, large parts of the countries are eligible for the funds, and there are large potentials for renewable energy, especially for use of biomass. The new EU countries are receiving structural funds of 30 billion EUR for the period 2004-2006. Unfortunately, the process of utilisation of SF for renewable-energy projects is not easy; administrative obstacles and lack of information among potential users could stop the process.
In spite of problems, a number of renewable-energy projects are supported. As an example, 32 renewable-energy projects were supported with about 40 million € in Slovakia alone in 2005. Two-thirds of the projects were biomass projects, while the rest were small hydro and geothermal energy.[17]

Also in the "old" EU countries, structural funds have been used for renewable energy, and a number of successful projects have been reported. These include support for conversion to biomass heating, use of wind-power, and feasibility studies for larger renewable energy plants.

With the new budget period of 2008-2013, larger structural funds will be available for the new EU countries; almost one third of the EU budget, or 336 billion EUR (0,41 % of EU GDP), will be allocated to SF in these years. How much will be used for renewable energy depends on the priorities that will be set during 2006. Renewable energy must be included in the national programming documents if a country wants to use SF for structural funds. Therefore it is crucial that the government officials responsible for the preparation of national SF programming documents include renewable energy (RE) and energy efficiency (EE) in all priorities and aims of the documents. Then RE projects can be eligible for funding through the wide spectrum of operational programmes.

Renewable Energy Support in the Life Programme

EU's support programme for local environmental activities, the Life programme, is also supporting some renewable energy projects. These very different projects range from demonstration of new technologies to environmental improvements of renewable-energy processes. The projects all carried out in cooperation with a local authority. More information is available about the programme and specific projects at http://europa.eu.int/comm/environment/life/project/index.htm.

European Sustainable Energy Campaign

The Sustainable Energy Europe 2005-2008 Campaign is a European Commission initiative in the framework of the Intelligent Energy for Europe (2003-2006) program. Set for a period of 4 years, the Campaign will contribute to the achievement of EU energy policy goals and targets in the fields of renewable energy sources, energy efficiency, clean transport and alternative fuels. It aims to raise public awareness and to promote sustainable energy production as well as use among individuals and all other stakeholders across

Europe. It should stimulate the necessary trends towards an increase in private investment in sustainable energy technologies.

Selected projects and programs will benefit from a range of promotional and communication tools that will increase their visibility at a European level.
This Campaign will also foster the debate between decision-makers and the civil society at regional, national and European levels.

The overall goal of this campaign is to spread regional and national best practices. This transfer of know-how can convince and assist local populations and organizations taking the first steps towards sustainable energy use.

Within the Campaign, achievable benchmarks for 2008 are provided. They arise from EU policy and legislation, and will contribute to EU renewable energy targets for 2010.

In a number of ways, the campaign follows the "*Campaign for Take-Off in Renewable Energy*" that the Commission organized for 1999-2003.

The new Campaign was launched in July, 2005. Thus far, there are no assessments of its effectiveness.

More information on the campaign is available at its official website. http://www.sustenergy.org/obj.htm .

European Sustainable Energy Campaign Benchmarks for 2008	
Wind	15,000 MW of new capacity in windturbines
Solar thermal	35 million m^2 of solar thermal installations
Photovoltaic	1,500 MWp of photovoltaic installations
Geothermal	15 new power plants and 10 new low-mid temperature plants as well as 250,000 new installed geothermal heat pumps
Small hydro	2,000 MW of new capacity in small hydro installations
Biogas	6,000 new biogas plants
Biomass	450 new CHP plants and 13,000 new district/centralized heating unit installations
Bioethanol	Fivefold increase in the production of bioethanol
Biodiesel	Threefold increase in the production of biodiesel
Existing residences	1 million residences with 50% of delivered energy provided by renewables
Existing buildings (> 1000 m^2)	50,000 buildings with 50% of delivered energy provided by renewables

2.3 Assessments of Renewable Energy and Climate Targets

In 2004 and 2005, a number of evaluations were made of the EU's climate- and energy targets. Two evaluations of the renewable-energy targets, concluded that the current trends and policies were not sufficient to reach either the 12% overall renewable-energy target or the 22% renewable-electricity target for the 15 "old" EU countries; but that national targets are in place for renewable electricity and that the targets can be reached if additional measures and policies are introduced. The evaluation of EU's greenhouse-gas emissions from 2005, comparing 2003 figures with previous figures, shows that the reductions in the 15 "old" EU countries are far from being on track to reach the Kyoto target, but because 2003 was a dry year, hydro production was low, and power-sector emissions were above average for that reason alone.

The evaluation of the overall development of renewable energy, published in May, 2004[18], reached these conclusions:

- Targets are in place for renewable electricity; but current polices are only sufficient to reach 18-19% renewable electricity by 2010.
- Windpower has been the largest success, and already in 2003 windpower alone covered 2.4% of EU's electricity demand.
- Biomass electricity has developed less than expected, and the current growth of 7%/year will have to be increased to 18%/year to reach biomass' share of the electricity target.
- In 2004, when the biofuels directive entered into force, 9 countries had fully or partly exempted biofuels from tax, and 0.6% of the EU's vehicle fuel was biofuels.
- If the RES-E and biofuels directives are met, and if renewable energy for heating follows current trends, there will be 10% renewables in the EU-15 in 2010, 2 % less than the target from 1997.
- There are large variations between the countries. Some countries are close to reaching their targets; others are far from it.

The evaluation of renewable electricity was published in December, 2005[19], as part of the evaluation of national support schemes for renewable electricity that is described in the renewable-electricity directive. The main conclusions of the evaluation are:

- For windpower, which has been the most successful renewable-electricity technology, feed-in tariffs are most successful and also the most cost-effective support mechanism.
- Biogas development is supported just as successfully by feed-in tariffs and by green certificates.
- Regarding profit, feed-in tariffs are effective with a relatively low producer profit. Green certificates that are successfully promoting developments have higher profit margins.
- In biomass power, feed-in tariffs in general show the best outcomes, but other factors seem more important than the choice of support mechanism, such as infrastructure, forest management, installation sizes, and secondary support mechanism (loan or investment subsidy).
- In ¼ of the EU countries, support mechanisms are too low to start development of windpower, and in half of the countries, too low to start development of biomass power.
- Support for renewable electricity increases consumer electricity prices by 4-5% in Germany, Spain, UK, and up to 15% in Denmark[20], where new renewables cover over 20% of demand.
- The EU Commission has analysed the different support systems and concluded that "..... *the Commission does not regard it appropriate to present at this stage a harmonised European system*." It will consider the situation again in two years.

In general, the most successful implementation is in Germany, followed by Spain (which lacks local involvement, however), Denmark (which has uncertain legislation, but could reach the target because of previous legislation), Austria, and the Netherlands. Other countries have successful schemes regarding specific technologies, such a biomass CHP in Sweden and landfill gas in the UK. Some countries have good feed-in tariffs but lack good planning regimes to involve local actors. An example of this is France.

The evaluation also concluded that more actions are needed to reach the 2010 targets of 22% renewable electricity in the EU-15 and 21% renewable electricity in the EU-25. A number of proposals are made to improve the development of renewable energy.

The latest evaluation of the climate targets, based on 2003 figures, was published in June, 2005[21]. For the 15 EU countries that share a target of 8% greenhouse-gas reductions from 1990 levels, the reductions were only 1.4%; and energy-related emissions, including those from transport, actually increased by 2.5%, mainly driven by large increases in transport energy consumption. In the energy supply to which most renewable energy contributes, greenhouse-gas emissions only declined by 0.3% in 1990-2003. The drivers behind this small decrease were an increasing efficiency in the power sector, use of gas instead of coal, and new renewable energy. These factors were almost nullified by large increases in electricity consumption, about 2% per year. Proposed policies and measures and use of the Kyoto Mechanisms could bring greenhouse gas reductions of 9.3% compared with 1990 for EU-15; if the measures are implemented timely. Of the 15 countries, ten project that they will meet their targets while the remaining five (Denmark, Ireland, Italy, Portugal, Spain) project that they will not meet their targets.

In conclusion: The climate effects of the renewable-energy production have been nullified by increasing power demand, and the overall emissions have increased because of transport-sector emissions. To this conclusion must be added that 2003 was a dry year and the trend might be downward until 2004. As an example: emissions in Denmark increased by 9.5% in 2002 – 2003, while they decreased by 9.5% in 2003 – 2004 (Danish emissions are especially sensitive to rainfall in Scandinavia).
In the 10 new EU countries, greenhouse-gas emissions were reduced on average by 23.5% in 1990-2003, so they will not have problems fulfilling their Kyoto target of –8% in general. There could be two exceptions: Slovenia has had growing emissions since 1990, and Lithuania could produce higher emissions after the coming closure of its Ignalina nuclear power plant.

Will The Renewable Energy Targets be Reached?

The above evaluations are based on developments until 2003 and 2004. We have data from other sources on developments in 2004 and on indications for 2005. The developments for 2004 are described in "EU Renewable Energy Barometers"[22], while windpower development data for 2005 is available[23].
They show:

- Continued growth in windpower, with a 20% increase in 2003-2004 and 18% increase 2004-2005. This will lead to more than 75,000 MW windpower capacity in 2010, then covering 4-5% of electricity demand. There are decreases in installation rates in the leading countries (Germany and Spain), but more installations in a number of other countries, indicating that the trend can continue for the EU-15. Off-shore installations were slow in 2005, but these projects have long lead times and many large projects are under preparation to be finalised before 2010.
- New, strong growth in biomass power 2003-2004, driven by strong developments in Germany, Denmark, the UK and the Netherlands. This trend seems sustainable except in Denmark, and if it continues, wood power will cover 2-3% of electricity demand in 2010.
- Slow growth but large potentials for biogas, renewable waste and, to some extent, geothermal. If these trends continue, they will cover about 1.5% together of electricity demand in the EU-15.
- Very rapid growth of PV, but at a very low level. If the trends continue, PV will cover 0.1% of electricity demand in 2010; but indications for 2005 are that growth is increasing after 2004, and that the share will be higher in 2010.

If the current trends continue, and if hydro return to its 2001 level, the renewable electricity in 2010 will cover 20-21% of the EU-15's electricity demand at its 2003 level, of which 12.5% will be from hydropower and 8% from other renewables. If electricity demands continue to rise, this could reduce the share to 19-20%.
In conclusion: current projections are close to the target of 22%. With additional measures, it will be possible to reach this target.

The development of renewable electricity in the 10 new countries is somewhat slower than for the 15 "old" countries. Some countries have introduced efficient support schemes and expect to reach their targets, while others are working to reduce their targets. It will require substantial additional measures in a number of new EU countries to reach their electricity targets.

Until 2004, the development of biofuels was not fast enough to reach the target of 5.75% renewable energy in transport. There are as yet no later statistics. The EU regulation only came into force in 2004, and since then, oil prices have increased substantially. This has increased demand substantially for biofuels, and development is gathering speed. It is almost certain that biofuels will cover more than the 3% of vehicle fuels in 2010 (the results of trends until 2004); but how much more is a very open question. Indications are that biofuels covered 1.4% in 2005 in EU-25, compared with a target (reference value) of 2.0%.

The other renewables included in the 12% renewable-energy target for 2010 are biomass, geothermal and solar for heating and industrial use. The trends from the renewable-energy barometers are:

- Solar Thermal is progressing; but trends until 2004 were that only 33% of the (ambitious) target of 100 mill. m^2 by 2010 would be reached. Since then, new building regulations have come into force in a number of countries, and interest is growing, but it is that only 50% - 80% of the full target will be met.
- Wood use for energy only increased by 5.6% in 2003-2004, and if this trend continues, the "White Paper" target will not be reached. On the other hand, development has increased substantially since 2004 in all countries with larger space-heat demands (Northern and Central Europe), driven by the increasing oil prices.
- Development of biogas-based and geothermal heating are not strong enough to change the picture of too-slow development in these sectors to reach the 12% target.

The strong growth that has been seen after 2004, combined with new EU activities following the Biomass Action Plan of December, 2005, indicate that, in spite of earlier trends, it is still possible to reach the 2010 target of 12% renewable energy in primary energy supplies of the in EU-15. It will, however, require more efforts than to reach the 22% electricity target.

One difference worth mentioning between the White Paper forecasts and the trends is that the development of energy plantations for solid biomass has not proceeded as fast as expected. Instead, an international market for solid biomass is developing in which some EU-15 countries import biomass from Central and Eastern Europe, including new EU countries.

For the 10 new EU countries, Central European countries have a strong growth in biomass use, now to a certain extent driven by EU structural funds. Much of this will be replacement of gas with biomass for heating. This will continue, but it is not possible to judge how much this development will contribute to the fulfilment of the targets.

Comparing these assessments by the authors with the above-described evaluation by the EU Commission, the former is more optimistic regarding the ability to reach the renewable energy targets for the EU-15. It agrees, however, with the conclusions of the EU Commission that current trends still are insufficient to reach the targets, and that additional measures are needed.

Relating this to the climate targets, it seems that for the EU-15, renewable energy will give close to its expected contributions to the climate targets.

2.4 Upcoming Initiatives for Renewable Energy, Targets

Following evaluations of renewable energy, in the new Biomass Action Plan[24] of December 2005 and EU Biofuels Strategy of February 2006[25], a number of EU-wide measures have been proposed that could enable the EU countries to reach the renewable-energy targets. These measures will be discussed during 2006, when energy will be high on the EU's agenda[26]. New proposals are expected in 2006 and 2007.

Further, national implementation of EU regulations is very important. Insufficient national implementation is a major factor in failures to reach the targets.

In the following section, the ideas for new measures are grouped according to themes. The sources of the proposals are given in parentheses.

Heating and Cooling with Renewable Energy:

- Introduce legislation supporting the use of biomass for heating, at EU- and national levels (Biomass Action Plan). Many stakeholders have proposed an EU directive with targets, including the EU Parliament. This has prompted the EU Commission's commissioner for energy to promise a draft directive on the issue in 2006.
- Reduce VAT on district heating (Biomass Action Plan). A solution is expected in 2006.

Renewable Electricity:

- Stronger implementation of the renewable-electricity directive. (Biomass Action Plan).
- Improve integration of intermittent renewable-energy sources in electric grids (energy council conclusions, June 29, 2004).
- Reduction of administrative barriers by:
  - One-stop authorisation agencies for renewable-electricity plants.
  - Clear guidelines for authorization procedures, to be established by Member States with a clear attribution of responsibilities.
  - Guidance on the relationship with European environmental legislation for larger installations.
  - For large installations such as windpower, Member States should establish pre-planning mechanisms in which regions and municipalities are required to assign locations for the installations.
  - Lighter procedures should be created for small renewable-electricity projects.

  (The support of electricity from renewable-energy sources, SEC(2005) 1573, December 2005).

Renewable Energy in Transport:

- Regulation and removal of barriers for biofuels in transport, including ensuring the environmental sustainability of biofuel production (Biomass Action Plan).
- An EU Strategy for Biofuels, for transport, communication from the EU Commission Feb. 2006.
- Revision of biofuels directives with targets and sustainability criteria for biofuels production (Strategy for Biofuels)
- Promotion of 2. generation biofuels: liquid biofuels from solid biomass and organic waste. (Strategy for Biofuels)
- Support for biofuels depending on their greenhouse gas reduction potentials (Strategy for Biofuels)

General Support for Biomass:

- A campaign and others for promotion of energy crops in EU's agricultural policy (Biomass Act. Plan)
- Increased use of forest residues (Biomass Action Plan).
- Use of more recovered materials from waste as energy, including waste from slaughterhouses and from meat-processing as well as that from biogas plants. (Biomass Action Plan).
- R&D in biomass for fuels, electricity, heating and cooling (Biomass Action Plan).

Funding for Renewable Energy:

- More use of structural funds for biomass and other renewable energy (Biomass Action Plan).
- Continuation of the ALTENER programme as part of Intelligent Energy for Europe within the "Competitiveness and Innovation Framework Program" (CIP) for the years 2007 to 2013.

New EU Targets

In March, 2005, the EU leaders agreed to aim for a 15-30% cut in greenhouse-gas emissions by 2020 for industrialised countries, subject to future cost-benefit analyses and international negotiations. They also confirmed the commitment of EU countries to work for a limit of global warming to 2°C above pre-industrial levels. In addition, the EU environmental ministers agreed to reduce greenhouse-gas emissions by 60-80% by 2050, although this was not confirmed by the Heads of States.

Researchers have found that the costs of reductions are considerable but affordable, maybe 0,6% of GDP; but the studies usually do not include the costs of energy crises and are based on previous energy prices. These costs must be compared with the costs of 1% of GDP for EU of the increase in oil prices in 2002-2005, a cost that will continue if the high oil prices of 50-60 US$/barrel continue and if the EU does not make a large shift away from oil and gas.

These new climate targets form one basis for development of renewable-energy targets. The targets must also be based on available resources, security of supply concerns, and costs.

There has been discussion of a renewable-energy target of 20-25% of primary energy supply by 2020 for the EU countries. The discussion started in January, 2004, when a number of scientists recommended a 20% target, while NGOs including INFORSE-Europe and WWF proposed a 25% target.
The EU Parliament then, in April, 2004, recommended that a target should be set of at least 20% renewable energy by 2020.

The EU Commission in its communication from May 2004[27] recommended that a process should run until 2007 to develop a target on renewable energy for 2020
In November, 2004, the EU countries' energy ministers discussed the communication from the Commission. They agreed that the target-setting for 2020 should start only by the end of 2005 and that it should conclude in 2007, only 3 years before the existing target year (2010).

Based on this, it is expected that discussions of long-term renewable-energy targets will intensify in 2006.

2.5 Current Energy-Efficiency Policies

In addition to the frameworks for energy efficiency mentioned above in section 2.1 (SAVE Programme, European Climate Change Programme, etc.), the EU Commission published an Action Plan for Energy Efficiency in 2000[28] , which showed the need for additional activities for energy efficiency to meet climate needs, to improve security of supply, and to counteract the prevailing trend of low increases in energy efficiency. It proposed an increase in efficiency of 1% per year, and integration of energy efficiency in many other policies.

Integration of Energy Efficiency in Other Policies

The integration of energy efficiency into other policies has little visibility, but it is important because the EU regulates many parts of economic life, particularly in its internal market policies. The best example of this is probably the revision of the regulation on public procurement. Public procurement (purchases made by public institutions, authorities, public enterprises, etc.) can promote the improvement of energy efficiency and thus stimulate demand for energy-efficient technologies. Thereby, it can set a good example in integrating energy-efficiency measures into public-sector policies/activities. On the other hand, public procurement is regulated in the EU to ensure that national suppliers are not favoured in larger public purchases. This regulation must recognise the need for purchasing products with high energy efficiency, allowing the public buyer to choose energy-efficient products, even when they are more expensive.

Labelling and Standards

As part of the SAVE Programme, the EU adopted a directive on labelling and standards in 1992[29] (The SAVE directive). The purpose of this directive is to allow harmonization of national measures regarding labelling information and minimum efficiency standards on the consumption of energy and of other essential resources. The directive provides a general framework within which must be nested, for each type of appliance, specific implementation directives for labelling as well as for minimum efficiency standards. To update labels and standards, amendments of these directives are needed. Eight labelling and three minimum efficiency standards have been made within this framework:

- Labelling of household electric ovens.
- Labelling of household air-conditioners.
- Labelling of household dishwashers.
- Labelling of household lamps.
- Labelling of household combined washer-dryers.
- Labelling of household electric tumble-dryers.
- Labelling of household washing machines.
- Labelling of personal cars.
- Minimum energy-efficiency requirements for ballasts for fluorescent lighting.
- Minimum energy-efficiency requirements for household electric refrigerators, freezers, and combinations.
- Minimum efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels.[30]

The labelling Directives require that appliances be labelled to show their power consumption in such a manner that it is possible to compare their efficiency with that of other makes and models. The energy-efficiency class of the model is expressed on a scale from A (most efficient) to G (least efficient).
The intention is that consumers will prefer more energy-efficient appliances over those with a higher rate of consumption.
Evaluations have shown that this is indeed the case.

An amendment of the specific directive for freezers and refrigerators in 2003 introduced two extra classes, A+ and A++, for these types of equipment, because the technological improvements had resulted in most of the equipment sold in some countries being class A.

While the system has been very efficient in bringing consumption down for some equipment, it has been slow to regulate new areas, such as computer equipment and equipment with stand-by losses. The system with EU directives to be passed for any improvement in labels and standards is a slow process, and tends to be too slow to match the technological progress of electric and electronic equipment. Because of this, it does not capture its full potential for energy efficiency.

To improve energy efficiency of computer equipment, the EU started to use the US Energy Star label, which was introduced in 2002 in the EU.

To increase the effectiveness of the energy-efficiency standard system, the EU Commission proposed in 2002 a "Directive on the Eco-design of Energy-using Products (EuP)". After three years negotiations, the directive was finally agreed between the countries and the EU Parliament in July, 2005 as directive 2005/32/EC. The countries have until August 2007 to implement the directive. With this directive, energy-efficiency standards can be introduced without special directives. The Commission will establish a work plan with a priority of products to be regulated, in particular those that offer a high potential for the cost-effective reduction of greenhouse gases. When implementing measures, the Commission has to ensure the balanced participation of Member States and involvement of all parties concerned. To this effect, a consultation forum will be established. The directive covers all energy-consuming products except vehicles for transport.

The hope is that the eco-design directive will speed up introduction of minimum energy-efficiency standards that could be in force by 2007. Additional legislation is needed to speed up the development of labelling.

Directive on Energy Performance of Buildings

In 2001, the EU Commission proposed a directive to increase energy-efficiency in buildings with building codes, standards, inspections and labelling. The EU countries and the EU Parliament agreed on the "Directive 2002/91/EC of the European Parliament and of the Council of 16th December 2002 on the Energy Performance of Buildings"[31]. The directive was to have been implemented by the end of 2005, but left some leeway for postponing parts of the implementation until 2008.
The main content of the Directive is:

- Application and regular updating of minimum standards for energy performance of buildings based on a common methodology for all new buildings and for existing buildings of more than 1,000 square meters that are being renovated. The standards will cover energy use for heating, ventilation, and lighting, as well as cost-effective opportunities to use heat recovery and local renewable energy supplies.
- Common methodology for the preparation of minimum integrated energy-performance standards, which Member States will have to adopt separately for each type of building.
- Certification systems for new and existing buildings: energy-performance certificates no more than ten years old, containing advice on how to improve energy performance, will have to be available for all buildings when built, sold or leased. These energy-performance certificates, together with information on recommended and actual indoor temperatures, will also be displayed in public buildings and in other types of buildings frequented by the public.
- Specific checks and assessment of heating and cooling equipment by experts. Member States will have to make arrangements for regular inspection of boilers of a rated output between 20 and 100 kW that must be inspected every two years (gas boilers every four years).

The EU Commission (DG TREN) has formed a committee to oversee the implementation of the directive, with representatives of EU countries and the trade association EuroAce.

Standards in national building codes are one of the most productive and cost-effective ways of raising energy efficiency in most EU countries. Thus, this directive could be very important for future increases in energy efficiency. Its effect, however, is critically dependent on its implementation in national legislation. The directive leaves major decisions to the individual countries, e.g., regarding allowable levels of energy consumption in houses.
The countries have acted quickly to prepare their implementation measures, and the resulting national regulations will lead to improvements in most countries. The deadline, end of 2005, for implementation of the directive has only been met by some of the countries, but many countries will introduce the new rules early in 2006, only a few months late.

Cogeneration of Heat and Electricity

The EU is promoting cogeneration of heat and electricity (CHP) as one way of increasing energy efficiency. This is guided by the EU Commission's co-generation strategy from 1997 that included a target of co-generation use in total EU electricity production of 18% by 2010, an increase from 9% in 1994 (COM(97)514). That strategy paved the way for a directive on cogeneration.

The "*Directive on the promotion of cogeneration based on a useful heat demand in the internal energy market"* was proposed by the EU Commission in July, 2002. It was adopted by the EU countries and by the EU Parliament in February, 2004 as Directive EC/2004/8. The main elements of the directive are:

- The countries shall guarantee that electricity from co-generation should be transmitted and distributed on the basis of objective, transparent and non-discriminatory criteria.
- The countries shall ensure that guarantees of origin of electricity from co-generation could be issued on request by one or more competent bodies.
- The countries shall analyse their respective national potentials for high-efficiency cogeneration, and shall report on their progress.
- The countries can make support schemes for co-generation, if they so choose. The support must be based on the useful heat demand. The support must not be used to subsidize heating.

The proposal does not have any national targets for cogeneration and does not require the countries to support cogeneration. It is a soft measure; its main contributions will be to shift focus to the benefits of cogeneration and to highlight opportunities for national organisations to use the directive as a driver for country-wide support for cogeneration.

CHP is also supported by Guidelines on Environmental State Aid, in which the EU Commission allows the EU countries to give state aid to CHP for environmental reasons.
The development of cogeneration is not on track to reach the 18% target in 2010 as proposed in 1997.

Energy-Service Directive, Energy-Efficiency Targets

In December, 2005, as part of a packet about energy infrastructure to improve security of electricity supply, the EU Commission proposed a directive on energy end-use efficiency and energy services (COM 2003 - 739)[32]. The EU countries and the EU parliament agreed in principle on the directive in that same month, and it is expected to enter into force early in 2006. The countries will then have two years to develop their energy-efficiency action plans.

The main elements of the directive are:

- Targets of 1% increase in efficiency per year. The energy-efficiency targets are defined as energy efficiency resulting from quantified energy-efficiency measures. A list specifies the measures that can be included. The target is specified as a 9% increase in efficiency within 9 years. The targets are indicative (voluntary).

- The directive requires the countries to provide a framework to promote the market both for energy services and for energy-efficiency measures in major energy end-use sectors. These include the retail supply and distribution of net-bound energy carriers, such as electricity and natural gas, together with other important energy types, such as district heating, heating fuel, coal and lignite, forestry and agricultural energy products, and transport fuels.
- The public sector should take the lead, though no special (higher) target is given to the public sector.
- The countries are going to develop Energy Efficiency Action Plans (EEAP) describing the energy-efficiency measures planned to reach the targets set out, as well as to meet the provisions on the exemplary role of the public sector and provision of information and advice to final customers as set out in the legislation.

Support: Intelligent Energy for Europe, SAVE & STEER Programmes

Since 2003, the SAVE support programme of non-technological support for energy efficiency has been a part of the Intelligent Energy for Europe Programme (described above), which also includes the STEER programme for energy efficiency in transport.
Average annual support for SAVE is 18 mill. €, and for STEER, 8 mill. €. The modalities are the same as for the above-described ALTENER programme for renewable energy, with one annual call for proposals, 50% project support, average ½ million €/project in support, etc.

In addition to projects, SAVE supports the start-ups and operations of local and regional agencies for energy efficiency and renewable energy. These agencies are important for local information and promotion of energy efficiency. Each SAVE agency receives 200,000 € from the EU on condition that the same amount should be obtained from local authorities and other local sources. The support for SAVE agencies was 5 mill € in 2005.

The SAVE programme supported 28 projects in 2005, covering the following topics:

- Involvement of small and medium-sized companies in energy efficiency.
- Energy audits and labelling of buildings.
- Energy efficiency in buildings.
- Passive houses (super low-energy houses).
- CHP and trigeneration of heat, cooling and electricity.

Many SAVE-2005 projects focussed on buildings because of the implementation of the Buildings Directive.

The STEER programme supported three projects, all for training and strengthening of local traffic management agencies and energy agencies.

In addition, the IEE supported a number of "horizontal projects", which placed strong emphasis on energy efficiency in 2005. The topics included education, implementation of EU directives, and new energy-efficiency mechanisms such as "white certificates".

Descriptions of the SAVE and STEER programs and projects can be found at:
http://europa.eu.int/comm/energy/intelligent/index_en.html.

Research Programs: 6th and 7th Framework Programs

The EU's R&D framework programs (FP) also support energy efficiency. In the current, 6th, FP (2002-2006), energy efficiency is mainly supported as part of the CONCERTO programme for integration of renewable energy and energy efficiency in local communities.

In the plans for the 7th FP (2007-2013), energy efficiency and energy demand management will have a special priority; but the modalities and the size of the support is still to be decided. It will be supported as part of

the budget for non-nuclear energy; but there are no plans for a special budget line for energy efficiency. In addition, energy efficiency is a smaller priority in a number of research priorities for development of information technology and in other fields.

Structural Funds

Regional Funds (Structural Funds) can also support energy efficiency. Only a few projects have been specifically dedicated to energy efficiency; but, in a number of projects, energy efficiency has been an element in employment generation, improvements of buildings and other projects. With the increased emphasis on energy efficiency and renewable energy in the new budget (2007-2013), it is expected that energy efficiency will play a larger role.

Taxes and Emissions Trading

The mineral-oil taxes of the new emissions-trading scheme add to the increasing costs of fossil fuels, thereby making energy efficiency more cost-effective.
Fossil-fuel taxes gives a long-term price signal that will have an effect on energy efficiency. Except for transport fuels, the EU minimum levels are small compared with mineral-oil prices: 0 – 0.20 €c/kWh. Compared with current oil prices of 3.5 - 6 €c/kWh, the minimum-level tax only increases the price by 0 – 5%, which is not a strong driver for energy efficiency. In a number of countries, fossil-fuel and electricity taxes are substantially higher for certain consumer groups, increasing the current fossil-fuel prices by 25% or more and ensuring that costs will remain higher for fossil fuels. For those consumers, energy taxation is a real price incentive for investments in energy efficiency.

Emission trading was introduced only recently, in 2005, and the future price is still very uncertain. Therefore, the price signal is not certain enough to be a real driver for investments in energy efficiency yet. If the current CO_2 price of 25 €/ton holds, it will increase fossil-fuel prices by 0.5 €c/kWh for natural gas and by 0.9 €c/kWh for coal.[33] This can increase the cost of coal by as much as 50%[34]. If this CO_2 price becomes the future level, it will certainly be an important price signal for energy efficiency in coal use and, to a lesser extent, also for efficient use of other fossil fuels. See also chapter 3.

Voluntary Agreements

Voluntary agreements are used both on national- and EU levels. The most important voluntary agreement in energy efficiency is the agreement between the EU Commission and the car manufacturers on reduction of specific CO_2 emissions for cars. In 1998, it was agreed that emissions should be reduced to 140 g CO_2 by 2008/9 with an interim target of 165-170 g/km by 2003. The interim targets have been reached for European and Japanese cars[35].
Other voluntary agreements cover stand-by losses of televisions and videocassette recorders, domestic refrigerators and washing machines, dishwashers, electric motors, electric storage water heaters (standing losses) and audio equipment (stand-by consumption).

European Sustainable Energy Campaign

This campaign includes energy efficiency as well as the previously described coverage of renewable energy. The campaign's energy-efficiency benchmarks for 2008 are all about energy consumption in buildings, as summarised in the table to the right.

General	5 million inspections and assessments of heating systems. 2 million inspections and assessments of cooling systems. 10,000 new energy services contracts between public authorities and private companies.
Existing residences (small buildings)	2 million new energy performance certifications.
Existing residences (single and multi-family housing)	10 million residences to reduce energy consumption by 30-40% compared to actual consumption.
Existing buildings (> 1000 m^2)	100,000 energy performance certifications .
New residences (single family housing)	50,000 'very low' energy houses built.
All residences in EU	one low-energy appliance and one low-energy light source (CFL) - monitoring at the level of sales.

Figure: European Sustainable Energy Campaign, energy efficiency Benchmarks 2008

Other Promotional Activities

The EU Commission is involved in other promotional activities for energy efficiency:

- The Greenlight Programme, a voluntary initiative encouraging non-residential electricity consumers (public and private, referred to as partners) to commit towards the European Commission to install energy-efficient lighting technologies in their facilities when it is profitable. GreenLight was launched in February, 2000. The core of the programme is a registration form, signed by the Partner and the Commission, in which the Partner commits to profitably upgrading or installing alternative systems to improve lighting quality and to reduce electricity consumption. The Commission provides support to the Partners in the form of information resources and public recognition (plaques on buildings, advertisements, exclusive use of the logo, awards, etc.). Lighting professionals can register as GreenLight Endorsers. In return, the Endorsers get public acknowledgement for their efforts to support the GreenLight Programme.

- The Motor Challenge voluntary programme is a EU-Commission initiative to help industrial companies improve the energy efficiency of their electric-motor-driven systems. The Challenge focuses on compressed air, fan, and pump systems. The core of the programme is an Action Plan drawn up by Challenge Partners to undertake measures to reduce energy consumption. They will receive aid in defining and carrying out the Action Plan and public recognition for their contribution to achieving the EU energy- and environmental objectives.

- Two "Codes of Conduct" have been introduced for external power supplies and for digital TV services. Both Codes of Conduct have in common that participation is voluntary ("indicative") and that their energy-efficiency guidelines are developed in close co-operation with industry. The scope of the Code of Conduct for External Power Supplies includes external power supplies for electronic appliances (e.g., AC adapters, battery chargers, domestic appliances, power tools, and IT equipment) in the input range of 0.3 to 75 W. Though it is a voluntary scheme, the list of participants includes major players in electronics in Europe. This code of conduct is expected to result in savings of 5 TWh per year by 2010.The Code of Conduct for Digital Television aims at consumer equipment for digital broadcasting and related services. Without any such corrective measures, the growing use of this equipment will contribute substantially to the electricity consumption of households in the EU in the near future, thus posing a problem for EU energy- and environmental policies.

- ManagEnergy is EU's information exchange on energy efficiency, in particular concerning local activities for energy efficiency and the successes of local energy agencies. The information exchange is to a large extent internet-based. Its on-line presence is at www.managenergy.net.

2.6 Upcoming Initiatives for Energy Efficiency: Green Paper

On June 22, 2005, the EU Commission launched a Green Paper on energy efficiency[36] to start a discussion on how the EU countries can benefit from cost-effective energy-efficiency measures. The debate continues and includes public consultation until the end of March, 2006. It is expected that the Green Paper and the debate will be followed up with an action plan of energy efficiency. The Green Paper describes energy-efficiency increases of 20% by 2020 as cost-effective, but does not propose specific targets.

Among the Green Paper's many proposals for new actions are:

- Higher priority on energy efficiency in the 7th R&D Framework Programme
- Greater support for energy efficiency in a continued SAVE programme as part of Intelligent Energy for Europe after 2006.
- National Energy Action Plans in all 25 EU countries, reviewed and updated annually.
- More mutually consistent tax regimes that support more energy-efficient goods, including vehicles. In particular, vehicle taxation is proposed to promote energy-efficient cars.
- Increased harmonisation of energy taxation on a high level.
- Better use of state aid to support energy efficiency, including an update of the guidelines for state aid.
- Use public procurement to seek energy-efficient products actively. Procurement of vehicles is mentioned as a specific field of interest.
- Use regional/structural funds more directly for energy efficiency.
- Extend the buildings directive to cover renovation of buildings of less than 1000 m^2.
- Reduce stand-by losses through further work within the framework of the Eco-Design directive and in cooperation with interested international partners.
- Effective national implementation of EU legislation on energy efficiency.
- Initiation of "white certificates" on energy efficiency, as introduced in Italy in 2005. With this scheme, the gas and electricity suppliers have to produce quantified energy savings based on energy-efficiency programmes. The quantified energy savings are then counted with "white certificates".
- Congestion charging and road pricing to improve traffic management.
- Improved local/regional funding mechanisms for energy efficiency.
- Improved international cooperation on energy efficiency.

Some of the proposals are already negotiated, such as the higher support for the SAVE programme in the continuation of Intelligent Energy for Europe (IEE) after 2006 (in the framework of the "Competitiveness and Innovation Framework Program", or CIP, for the years 2007 to 2013[37]).
Other proposals will need new proposals such as new legislation or amendments to legislation.

Sources and Notes

1 Norway is not member of EU; but has close ties. In some cases Norway is a trend-setter, as seen with the electricity deregulation.
2 An overview of the development of the internal electricity and gas markets can be found in the EU Commission's reports of progress in creating the markets, http://www.europa.eu.int/comm/energy/electricity/report_2005/index_en.htm .
3 The EU Commission prepares green papers and white papers as part of discussions of new European policies. Green papers are discussion papers without specific policy proposals, while white papers propose specific policy directions, such as a doubling of renewable-energy use. These documents are not legally binding. If the Commission receives a positive response to its proposals, it will continue with development of proposals for legally binding documents such as directives and support programmes.
4 Energy for the Future: Renewable Sources of Energy, White Paper for a Community Strategy and Action Plan COM(97)599 final, November 1997.
5 Eurostat and the International Energy Agency count primary energy as the first measurable form of energy. This method shows less primary energy compared to useful energy for a number of renewable energy forms (hydro, wind, solar PV), from which the first measurable form of energy produced is electricity, compared with thermal installations

such as nuclear power plants, from which the first measurable form of energy is nuclear steam, which is then converted to electricity with a 66% loss of energy. With the "substitution principle", in which the useful energy is used for comparison, the same amount of renewable energy (12%) will be counted as 15% of total primary energy supply for EU-15.
6 LNG, Liquified Natural Gas, transported by Sea to terminals in UK, and increasingly also to other EU countries. The sources are mainly Nigeria and the Middle East; but now, also Northern Norway (SnöVit field).
7 Proposal by the Commission, 6th of April, 2005, COM(2005) 121.
8 Chapter 5 (energy), p.48 in COM(2005) 440, Proposal for a COUNCIL DECISION concerning the Specific Programme "Cooperation" implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities, September 2005.
9 EU Commission Communication 2006(034)
10 As an example, structural funds are specifically mentioned as a measure in the communication "The share of renewable energy in the EU" (COM 2004-366), May 2004.
11 Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity. See: http://europa.eu.int/scadplus/leg/en/lvb/l27019.htm.
12 With the assumption of 14 Eur/ton CO_2 price, own calculations for different oil prices, assumptions of Danish prices.
13 Page 191, Energy Policies in IEA Countries, International Energy Agency, December 2005.
14 Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels and other renewable fuels for transport and Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, see http://www.europa.eu.int/comm/energy/res/legislation/biofuels_en.htm.
15 Biofuels Barometer June 2005, Eur'Observer, Systèmes Solaire, and EUFORES. Production in 2004 was 1,933,400 tons biodiesel and 497,040 tons ethanol and the trend was a combined growth of around 700,000 tons/year.
16 Chapter 5 (energy), p.48 in COM(2005) 440, op. cit.
17 INFORSE Structural Fund Database, www.inforse.org/europe/Structuralfunds/index.htm .
18 The Share of Renewable Energy in the EU, COM(2004)366, May 2004.
19 Communication from the Commission, The support of electricity from renewable energy sources, SEC(2005) 1573
20 The support from Danish electricity consumers was 1 €c/kWh of a total electricity price of 6.5 €c/kWh for medium commercial consumers. Private persons pay a large electricity tax additionally, reducing the effect of the renewable energy to 5% of their electricity bill.
21 Greenhouse gas emission trends and projections in Europe 2005, EEA Report No 8/2005, European Environmental Agency
22 Renewable Energy Barometers 2005. EurObserv'er, Systemes Solaire, and EUFORES, see www.eufores.org.
23 European Wind Energy Press Release, February 1, 2006: European Record for Windpower.
24 Biomass Action Plan, COM(2005)628, European Commission, December 2005.
25 An EU Strategy for Biofuels COM(2006)034, European Commission, February 8, 2006
26 Energy will be on the agenda for the EU Summit with heads of states in March 2006: not only renewable energy, but the entire energy structure.
27 The Share of Renewable Energy in the EU, COM(2004)366, May 2004.
28 Communication from the Commission: Action Plan to improve Energy Efficiency in the European Community COM (2000) 247.
29 Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.
30 Information on these directives can be found at http://europa.eu.int/scadplus/leg/en/lvb/l32004.htm .
31 The directive can be read at http://www.europa.eu.int/comm/energy/demand/legislation/buildings_en.htm ; see also http://www.euroace.org/bdirective.htm .
32 The proposal is available at http://europa.eu.int/comm/energy/en/fa_2_en.html . The descriptions in this paper are based on the original document and amendments during negotiations. As the final outcome has not been published yet, however, the forthcoming directive might differ from the current on-line version.
33 Based on emissions of, respectively, 57 kg and 95 kg CO_2/GJ for natural gas and coal.
34 Steam coal, based on assumption of price of 115 €/ton (140 $/ton) and energy content of 25 GJ/ton.
35 IP/04/195 Feb. 2004. EU Commission: CO_2 emissions from new cars in the EU down by more than 10% since 1995.
36 The Green Paper on Energy Efficiency, COM(2005) 265, is available at http://europa.eu.int/comm/energy/efficiency/index_en.htm .
37 Proposal by the Commission, 6th of April 2005, COM(2005) 121.

3. Introduction of EU Emission Trading Scheme (ETS)

In January, 2005, the European Union Greenhouse-Gas Emission Trading Scheme (ETS) started as the largest greenhouse-gas ETS in the world. It is a multi-country, multi-sector plan ultimately involving all 25 EU countries. The current trading period, 2005-2007, covers CO_2 only and involves the following installations:

- All installations for combustion of fossil fuels above 20 MW, including power and heat plants
- Mineral-oil refineries and coke ovens
- Metal-ore roasting and sintering
- Production of pig iron and steel
- Cement production
- Glass production
- Ceramic products including bricks, tiles and porcelain
- Pulp, pulp-and-board production

For most of the industrial sectors, small installations are exempted from the EU minimum requirements. Examples include steel production with capacity below 2.5 tons/hour, glass production with capacity below 20 tons/day, ceramic productions with capacities below 75 tons/day, and paper-&-board production with capacities below 20 tons/day. Even so, the countries can decide to include smaller installations in the ETS. In 2006, a decision will be made as to whether more sectors shall be included after 2007.

Each of the 25 EU countries has developed a National Allocation Plan (NAP), defining the installations covered and the CO_2 emission quota (allowance) allocated to each installation for the period of 2005-2007. These NAPs have then been accepted by the EU Commission and turned into national law, with the exception of one NAP that still is under negotiation between the country and the EU Commission. The NAPs cover around 11,500 installations in the 25 countries that collectively are responsible for about 45% of the EU's CO_2 emissions.[1]

New NAPs for the period 2008-2012 are under development and are to be presented to the EU Commission in June, 2006.

The allocations in each NAP for 2005-2007 shall be consistent with a path towards achieving each EU country's target in the EU's burden-sharing to reach the –8% target of the EU-15 in the Kyoto Protocol. In practice, most countries have allocated either historic emissions or a share between 95% and 100% of business-as-usual forecasts for the installations. In addition, a quota is reserved for new entrants in each country, and some countries have chosen to auction up to 5% of their quotas. At least 95% of the quotas must be given for free (grandfathered).
There is a link between the EU's ETS and the Kyoto Protocol mechanisms JI and CDM. Companies can include quotas from CDM projects to cover their emissions and, after 2008, also quotas from JI projects, though with some limits.
The rules after 2007 will be different in a number of ways. NAPs must be consistent with fulfilment of the Kyoto commitments; the countries can decide to auction up to 10% of quotas; and more sectors might be included, such as aviation.

The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003. [2]

3.1 Status of National Allocation Plans (NAPs)

According to the directive 2003/87, the EU countries were to submit NAPs for approval before April, 2004, and they were to be approved by the EU Commission by October, 2004. The process was slow, as only ten of the EU countries had submitted their NAP by May, 2004. Before the end of October, however, the Commission had accepted plans for the following 14 countries:
Denmark;
Ireland;
Netherlands, the plan was amended March 2005 (exclusion of installation, approved by the Commission);
Slovenia, the plan was amended April 2005 (inclusion of more installations, approved by the Commission);
Sweden;
Belgium;
Estonia;
Latvia, the plan was amended May 2005 (inclusion of more installations, approved by the Commission);
Luxembourg;
Slovak Republic;
Portugal;
Germany;
Austria, the plan was amended April 2005 (inclusion of one installation, approved by the Commission);
Finland, the plan was amended April 2005 (inclusion of more installations, approved by the Commission).

These countries' enforcement of the ETS was enough to start it as planned on January 1, 2005.

In December, 2005, the Commission accepted plans for the following three countries and they were able to start their ETS's in the beginning of 2005:
Lithuania;
Malta; and
Cyprus.

In France, the ETS was enforced in February, 2005.
In Spain, the ETS was enforced in March, 2005.

Poland's NAP was conditionally accepted by the Commission in March, 2005, on condition of reductions. The Polish government accepted the reduction and enforced the ETS in December 2005.

Czech Republic's NAP was accepted by the Commission in April, 2005 and it was then enforced in the second half of 2005.

UK submitted its first NAP on time in 2004 and it was accepted by the Commission in July, 2004 on condition of some technical changes. Then UK sent a new NAP in November, 2004 and in February, 2005 with a quota increase of 18.9 $MtCO_2$ (8 % increase). The second NAP was rejected by the Commission April, 2005. In spite of that, UK enforced its NAP in May, 2005 and took the EU Commission to the EU Court over the issue. The Court annulled the decision (of rejection) of the Commission and supported UK's right to change its allocations of quota until a final decision was made in the UK[3].

Italy's NAP was accepted by the Commission in May, 2005 on condition of smaller amendments and it was then enforced in the country.
Greece's NAP was accepted by the Commission in June, 2005 and was then enforced in the country.

Hungary's NAP was expected to be accepted by the Commission by the end of January, 2005. The ETS is expected to be in force by April, 2006, including final allocation of quotas to installations. A previous NAP was accepted by the Commission in December, 2004, but then Hungary proposed a new NAP in 2005 allowing higher emissions.

Table: Overview of EU ETS for 2005-2007. Source: EU Commission, http://europa.eu.int/comm/environment/climat/emission.htm (Q&A and independent transaction log)

Country	CO_2 allowances in mill. Tonnes 2005-2007	CO_2 allowances in mill. Tonnes per year aver.	Share in EU allowances	Installations covered, June'05	Registry functional, start of 2006	Kyoto target
Austria	99.0	33.0	1.50%	205	before June'05	-13%*
Belgium	188.8	62.9	2.90%	363	before Jan.'06	-7.5%*
Czech Rep.	292.8	97.6	4.40%	435	before Jan.'06	-8%
Cyprus	17.0	5.7	0.30%	13	No	-
Denmark	100.5	33.5	1.50%	378	before June'05	-21%*
Estonia	56.9	19.0	0.90%	43	before Jan.'06	-8%
Finland	136.5	45.5	2.10%	535	before June'05	0%*
France	469.5	156.5	7.10%	1,172	before June'05	0%*
Germany	1497.0	499.0	22.80%	1,849	before June'05	-21%*
Greece	223.2	74.4	3.40%	141	No	25%
Hungary**	93.8	31.3	1.40%	261	before Jan.'06	-6%
Ireland	67.0	22.3	1.00%	143	before Jan.'06	+13%*
Italy	697.5	232.5	10.60%	1,240	No	-6.50%
Latvia	13.7	4.6	0.20%	95	before Jan.'06	-8%
Lithuania	36.8	12.3	0.60%	93	before Jan.'06	-8%
Luxembourg	10.1	3.4	0.20%	19	No	-28%*
Malta	8.8	2.9	0.10%	2	No	-
Netherlands	285.9	95.3	4.30%	333	before June'05	-6%*
Poland	717.3	239.1	10.90%	1,166	No	-6%
Portugal	114.5	38.2	1.70%	239	before Jan.'06	+27%*
Slovakia	91.5	30.5	1.40%	209	before Jan.'06	-8%
Slovenia	26.3	8.8	0.40%	98	before Jan.'06	-8%
Spain	523.3	174.4	8.00%	819	before June'05	15%
Sweden	68.7	22.9	1.10%	499	before June'05	+4%*
UK	756.0	252.0	11.47%	1,078	before June'05	-12.5%*
Total	**6,592**	**2197**	**100.00%**	**11,428**		

* Part of EU-15 burden sharing of -8%, ** Allocation under revision

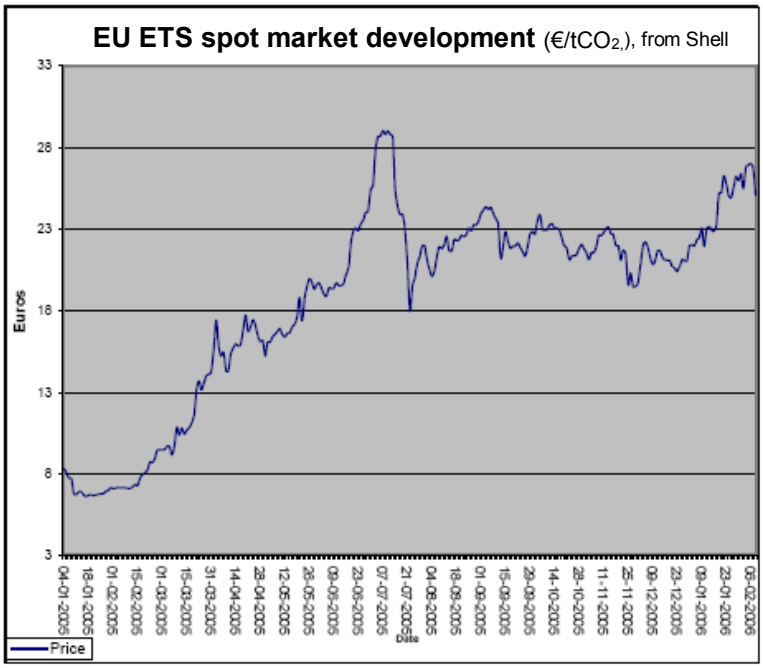
While the ETS's were in force legally for most countries during most of 2005, there were problems with the functioning of some of the registries. According to the EU Commission website, nine national registries were operational by June 17, 2005, and by the beginning of 2006, 19 were operational, leaving six pending (Poland, Hungary, Greece, Luxembourg, Malta, and Cyprus).

A few countries have included auctioning in their NAPs, but no auctioning had started in 2005. Ireland has announced that it will start auctioning in the beginning of 2006.

3.2 First Assessments of the Functions of the EU ETS during 2005

The year 2005 was the first of a 3-year introduction period for the ETS, and several of the countries only entered the scheme after the year had started. Difficulties reported by participants include those with registries, mentioned above, as well as problems of clearance with counter-parties. Nonetheless, trade is proceeding, although, in the first part of the year, mainly with forward transactions. Several exchanges have opened CO_2 quota exchanges such as the European Energy Exchange (EEX) in Leipzig, Germany and Nordpool, the Nordic Power Pool.

Quota prices started in 2005 around 8 €/ton of CO_2. After two months, the prices started to increase steadily until a peak over 28 €/ton around 01.07.2005. This was followed by a stabilisation of prices around 21 €/ton of CO_2. January, 2006 has seen an increase in the spot market price towards 25 €/ton of CO_2 while forward trading for the next period (2008) is a bit lower, 22 €/ton of CO_2.[4] The graph below shows the development of quota spot-market prices in Eur/ton of CO_2[5].



The electricity prices have been higher in 2005 in general than in previous years for Central Europe / Germany. Several observers have attributed it to the ETS. As an example: if power companies include a carbon price of 20 €/ton of CO_2 and the marginal power production that set the market price is an older coal-fired power plant with emissions of 1 kg CO_2/kWh, it will increase the power price by 2 €c/kWh. Real increases have been up to half of that on European power markets in 2005, in spite of lower prices in Scandinavia that previously were setting price trends because of their hydro-production changes. This benefits the power companies that have got (most of) their emissions for free while it is a burden for large power consumers such as the industry. The European industries, and especially the German industry, have raised concerns over the power price increases and the possible linkages with ETS.

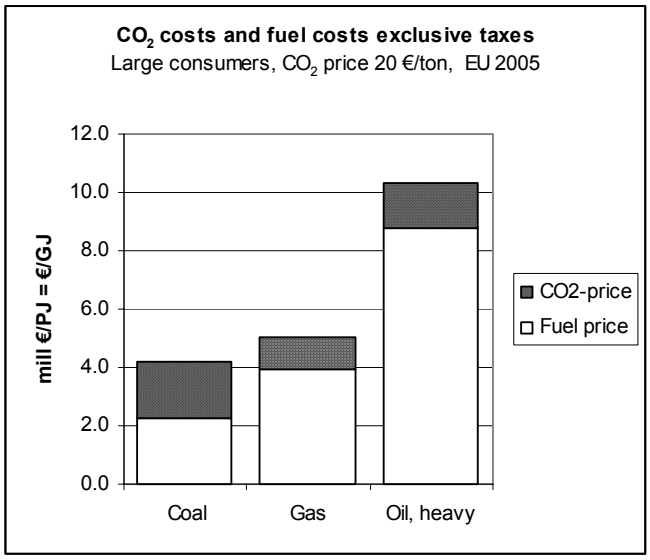
The first reviews of the ETS were published in the beginning of 2006. The EU Commission's DG Environment had commissioned McKinsey & Company and Ecofys to monitor and review the ETS during 2005 and 2006. They collected the views of stakeholders on a range of aspects of the EU emissions trading scheme, June to September 2005. At the end of January it published the first report with highlights from this stakeholder review[6]. Of the companies that responded:

- Half of them factor CO_2 costs into their decision-making and 70% expect to do that in the future, This is dominantly the power companies, where 70% answered that they factor the cost in already while this figure varied from 29% to 43% in other sectors covered by ETS.
- Half the companies regard the ETS as one of the key issues in long-term decisions, while for the other half, it is only one among many issues. There are large variations among sectors. For refineries it is only seen as one among many issues. In the steel, pulp-&-paper, and power sectors, respectively, 86%, 66, and 56% see it as a key issue.
- About half of the companies find that the ETS has a strong or moderate impact on decisions to develop innovative technology. The sector variations ranges from steel, where 68% find that is has a strong impact, to paper-&-pulp, where 66% find that it has little or no impact. Power sector and cement industry are in the middle with, respectively, 55% and 54% finding that it has a strong or moderate impact.

3.3 Impacts on the Sectors included and on Renewable Energy

The McKinsey & Ecofys studies mentioned above clearly show that, in the sectors covered, a large part of decision-makers factor carbon costs from ETS into their decision-making. During 2005, the market has established a carbon price in the range of 20-25 €/ton of CO_2. This means that some decision-makers will see fossil prices increased by the equivalent amount, and that investors in new installations will have to include their ability and costs to get the necessary quotas.

Observers have been focussing on the effects of the ETS on the choice between gas and coal, where the ETS will create a price incentive for gas.[7]
The graph to the right shows the EU-average price effect of a CO_2 price of 20 €/ton for large consumers[8].



For energy efficiency, pay-back periods are more important for industries than the price addition of ETS, as many industrial consumers require very short pay-back periods for energy-efficiency investments, typically two years. Longer pay-back periods, achieved, e.g., via third-party financing and energy-service companies, could be a more important driver for energy efficiency.
Power companies typically have longer investment horizons than industries. With the ETS they will probably be more inclined towards efficiency when renovating plants. As credibility grows around the system and the carbon price, it will also increase demand for more efficient power plants.

CHP is an obvious way of increasing efficiency, but change from power-only production to CHP is not supported by the ETS in its basic form, as it moves emissions from small installations that are not covered by ETS to central plants. While it leads to overall emission reductions, it increases emissions at the facilities covered by ETS. The ETS must be set up to support CHP by treating increased CHP use as a new entrant that can receive allocations for this purpose. Not all NAPs dos that.

International competition results in concern over any new cost to industries involved in international trade. Evaluations from IEA are that the most vulnerable products because of ETS are some steel products as well as aluminium[9]. Aluminium and other large power users are not directly subject to ETS, but when the system leads to higher power prices, they are at a disadvantage, as they have to bear the full impact of higher prices. Sectors with large direct emissions covered by ETS will only need to cover costs of eventual extra quotas bought to cover a small part of their emissions.

Renewable energy is favoured by ETS, if the system is stable enough and if those subject to the ETS will invest in renewable energy. Among the industrial sectors covered, only pulp and paper industries have shown substantial interest in renewable energy previously. In general, industry is not inclined to invest in renewable energy unless the pay-back time is very short. For many industries, there is also an issue of security of supply, if the change is to biomass and if the consumption is substantially above local production of biomass. Finally, uncertainties about future allocations of quotas after a change to renewable energy could make decision-makers reluctant to change now, but rather inclined to wait until the system is more mature.
For power companies, the situation is similar, but there are possibilities, such as increased co-firing of biomass in coal-fired power stations. It requires only a small investment and it can bring down emissions by 10%-20%. In some new EU countries, the price difference between coal and biomass might be enough to justify co-firing, when ETS is factored in, although it probably is not cost-effective throughout the EU.
If the high power prices continue, it will also give a boost to renewable energy, in that it will be cheaper for the countries to introduce support schemes for renewable energy. On the other hand, it is questionable whether the high power prices will continue, if they are caused by the ETS. There are strong forces in EU industry working to amend the ETS and/or power markets to reduce the ETS effect on the power market.

3.4 Challenges for the ETS and EU climate policies, 2008-2012

Preparations are well under way for the second round of NAPs for the first Kyoto Commitment Period of 2008-2012. In June, 2006, the EU commission must present a report evaluating the first period of ETS (2005-2007) and proposing amendments for the second ETS period and later. While the Commission can propose new sectors and new gases, so far discussions have been on the inclusion of aviation in the ETS. In 2005, the EU energy ministers welcomed the inclusion of aviation in the ETS beginning in 2008.

The countries have to present their second NAPs 18 months before the period starts, i.e., by June, 2006. Then NAPs should be accepted by the Commission within three months, and should be enforced in national legislation before the end of 2006. After that, companies will know one year in advance how large their quotas will be.

Given the tight schedule to develop NAPs, some question exists as to how many changes can be made in the ETS regarding sectors and gases for the second trading period. It is most likely that, except for inclusion of aviation, there will be no changes in gases and sectors covered.

These second NAPs must comply with the Kyoto Protocol. This will be a challenge for those EU countries that are not on track to reach their emission targets. They have to make tough decisions between allocation of quotas in NAPs, reductions in other sectors not covered by the ETS (residential, service and transport), and buying emissions via the Kyoto flexible mechanisms.
This is particularly the case for Portugal, Denmark, and Ireland, and depending on the efficiency of their new domestic measures, for Spain and Italy. The ETS does not fundamentally change their challenge of reducing their emissions to meet their commitments, but it gives them another dimension.

A new criterion, which was not used in the 2005-2007 trading period, requires that NAPs specify the maximum amount of JI and CDM credits that may be used to cover emissions from installations included in the ETS. The countries have to specify these limits in their proposals.

A challenge to the stability of future prices is the effect of the Kyoto Flexible Mechanisms. If large amounts of emission quotas are coming from these mechanisms, and if they maintain the low prices around 5 €/ton of CO_2 that many projects have, it could push down emission costs. On the other hand, it is very likely that the number of approved CDM and JI costs with these low prices is limited. In any case, it is a good reason to limit the use of JI and CDM in NAPs to a few percentage points, but it is up to the countries to make their proposals.

As a lesson learned from the first ETS period, in which many NAPs were quite complicated, the Commission emphasises the need to make the second-period NAPs simpler and more transparent.

Sources and Notes

1 Information from the EU Commission website at http://www.europa.eu.int/comm/environment/climat/emission.htm: the EU-wide number of installations included in the ETS was 11,428 in NAPs available by June, 2005; but changes have been made since in several NAPs, some adding installations.
2 The directive is available at http://www.europa.eu.int/comm/environment/climat/emission/implementation_en.htm .
3 Judgment of the Court of First Instance in Case T-178/05 of November 23, 2005, available at http://curia.eu.int/en/actu/news/index.htm .
4 Information from: Energy Policies of IEA Countries, December 2005; Nordpool January 2006; Shell, January 2006.
5 From Shell Denmark, www.shell.dk
6 The report "Review of EU Emissions Trading Scheme", November 2005, Survey Highlights is available from http://www.europa.eu.int/comm/environment/climat/emission.htm.
7 Energy Policies of IEA Countries, IEA, December 2005.
8 Graph made by authors based on averages of gas prices 2.4-5.4 €/GJ, oil prices 41-55 US$/barrel, coal price 14 €/barrel oil.
9 Energy Policies of IEA Countries, December 2005.

4. Overview of the Corporate Structure in the Main Renewable-Energy Sectors

The use of renewable energy is increasingly important in European economies and employments. With more than 400,000 people employed in the EU countries, including suppliers[*], it is also contributing to many jobs that could not have been created by the fossil-fuel sectors, which create far fewer jobs per unit of energy and per unit of economic turnover. The sector is divided into a number of subsectors, working with a specific kind of renewable energy. Few companies are active in more than one subsector of renewable energy, while some larger companies not previously active in renewable energy have entered the renewable-energy market lately.

This chapter gives an overview of the following subsectors in new, renewable energy in EU:

- Windpower,
- Solar PV,
- Solar thermal,
- Solid Biomass,
- Liquid Biofuels,
- Biogas.

The chapter does not cover hydropower, geothermal, heat pumps, and ocean energy. In the EU, there is commercial production of equipment for hydropower (small and large) and for geothermal energy for heat and electricity, as well as of heat pumps using ambient heat for space heating. Development of ocean-energy technology in the form of wavepower is advancing in the UK and in other EU countries with coastlines on the Atlantic and the North Sea. Except for hydropower, the sectors not covered have less economic importance and less immediate potential than the sectors covered.

4.1 Windpower

Windpower has been the fastest-growing renewable sector in terms of turnover in recent years, with growth from about 500 MW installed in 1994 to 6183 MW installed in 2005. With installation costs of around 1 million €/MW[†], the installation market is around 6 billion €, and has grown on average by 500 mill €/year in the last decade, though it has not been a steady growth. In addition to the installation costs, maintenance costs are around 1 € cent/kWh, but they vary considerably and are declining. In a future fully developed market, when new windturbines are replacing old turbines every 20-30 years, maintenance turnover will be close to the turnover in manufacturing of new turbines.
This chapter will mainly deal with large three-bladed windturbines; but at the end of the text on windpower, the market for small turbines is mentioned. The size of the large turbines is increasing, and now land-based turbines in the developed markets of Germany, Denmark and UK are mostly in the range of 1.5 - 2.5 MW.

Windpower business can be divided into four different functional groups:

- Manufacturer of windturbines,
- Developers of projects,
- Investors,
- Maintenance.

Sub-suppliers are also important; but will not be addressed separately in this report.

[*] The German Renewable Energy Federation has calculated that renewable energy generates 150,000 jobs in Germany. The Spanish energy agency IDAE has estimated that renewable energy provides almost 100,000 jobs in Spain, and Danish estimates suggest about 50,000 jobs in Denmark. It is a very conservative estimate that the other 22 EU countries have more than 100,000 jobs in renewable energy combined.
[†] Installation costs vary, with land-based turbines in developed markets considerably lower and with new markets plus off-shore developments higher.

Manufacturer of Windturbines

Manufacturers of windturbines are the largest companies and are the most active internationally. There is a tendency towards consolidation and mergers within the large manufacturers. The largest companies are listed below.

Vestas, based in Denmark, is maintaining its leading position after its fusion with the other Danish windpower manufacturer, NEG Micon, in 2004. It has about 1/3 of the world market. In addition to its leading experience in land-based turbines, it is one of the most experienced companies in offshore turbines, being the supplier to the Danish 160 MW offshore windpark in the North Sea. It is active in most European national markets as well as on other continents. It has a strategy of being involved in all important windpower markets and of leading the technical development of large turbines with gears.

Gamesa Eolica, Enercon, and GE Wind are all competing to be second among manufacturers.

Gamesa is the largest Spanish manufacturer and has benefited from the strong Spanish market. In 2005, it was increasingly active in export, including project development, in particular in Latin America and around the Mediterranean Sea. Its expertise is in large windturbines with gears.

Enercon, the largest German manufacturer, is maintaining a strong presence on the home market combined with increasing exports to neighbouring countries as well as to Asia and America. It has specialised in large gearless turbines with specially designed multi-pole generators. It is currently installing a 6 MW test turbine, which is the world's largest windturbine, and which it expects will be useful for offshore developments. In addition, the company has a strategy of developing special local energy systems integrating windpower. The latest example of this is development of a windpowered seawater desalination plant.

US-based **GE Wind** is a subsidiary of General Electric, and has its roots in the former US windpower manufacturer Kennetech. It got a position on the German market with purchase of the German windpower manufacturer Tacke. GE Wind can use the strength of General Electric to enter new markets and fund developments. It aims to be a global player. Its expertise is also large turbines with gears.

The large German company **Siemens** entered the windpower business in 2004 with acquisition of the Danish windpower manufacturer Bonus Energy. This well consolidated manufacturer now has the economic muscle to enter larger projects and more markets. The company has experience with offshore developments, being supplier to several offshore windparks.

A number of smaller German manufacturers such as Nordex and Repower, and smaller manufacturers in other European countries, complete the list of European windpower manufacturers of large windturbines.

Any complete picture of manufacturers must include the largest manufacturer of windturbine blades, the Danish-based **LM Glasfiber**. It supplies major windpower manufacturers around the world.

In addition to the manufacturers of large turbines, there exist a number of small manufacturers of small turbines, mostly below 25 kW. They are mostly used for off-grid applications, where they compete well with PV powered supply in windy areas. In 2005, a UK gas company offered its customers small windturbines for installation directly on houses and grid-connected. They received an unexpectedly large positive consumer response.

Windpower Project Developers

The development of windpower projects has grown into a separate business. The activities involved include feasibility studies, environmental impact assessments, and obtaining necessary permissions, as well as some investor recruitment and other activities necessary for windpower development. Developers bridge the gap between manufacturers and investors.

In Germany, specialised windpower developers have grown strong, and they are now increasingly active in developing projects outside Germany. One important developer is Energiekontor in Bremen, and there are several others.

In some countries, project design offices of power companies have entered the business of windpower development. They are mainly active in large projects such as offshore developments. Examples are Danish power companies, which are now also active as windpower developers in other countries.

Windpower Investors

Different national markets have different types of investors.
Small investors typically are private persons, each of whom invests a small part of the total required investment in a windturbine. They are organised in cooperatives or other legal structures. This type of investor is still very important in German development, and is of key importance for specific projects in other countries, including the UK Baywind cooperative and smaller cooperatives in a number of other countries.
Land owners, typically farmers, investing in a windturbine on their own land, are important in some countries, mainly in Northern Europe, although their role is diminishing.
Power companies investing in windparks are growing in importance as the power companies realise that windpower is part of the future power mix, and is no riskier than other power-sector investments. Many Spanish windpower investors have close links with the Spanish power sector. Power companies are dominant investors in the offshore sector.
Investment companies and institutional investors such as pension funds are also important investors in some countries, though seldom leaders in the development of windpower markets.

Maintenance of Windpower

Maintenance is a growing business and while the turbine manufacturers are responsible for a large part of the maintenance, a growing number of windturbine owners in developed markets like Germany and Denmark choose independent maintenance companies. This is often done because the maintenance companies offer lower prices on the maintenance. It is a slowly but steadily growing business.

In windpower, the leading European trade associations are:

- EWEA, European Wind Energy Association, organising manufacturers and R&D, www.ewea.org .
- EREF, European Renewable Energy Federation, organising owners of windturbines, and other renewable energy users, www.eref-europe.org.

4.2 Solar PV

Solar PV is the fastest growing type of renewable energy. While installation rates increased 32% from 2003 to 2004 in EU, indications are that the increase from 2004 to 2005 was about 60%. In 2004, 88% of the new capacity was installed in Germany. The high growth has made the PV market a sellers' market in 2005 with increasing prices of solar modules and solar grade silicium. Rapid expansion of solar cell and module manufacturing ensures capacity for continued growth; but a slower expansion of silicium production might result in a tight market for this material for the next few years. In spite of this, the European Photovoltaic Industrialists Association (EPIA) in January, 2006 published a vision of continued rapid growth of PV use reaching a global market for over 5,000 MW by 2010, compared with 1200 MW in 2004. The EU is expected to play a leading role in this, together with Japan and the USA.
In the EU, the number of grid-connected installations is now an order of magnitude larger than that of off-grid installations.

The solar PV market can be divided into:

- Manufacturers of Cells.
- Manufacturers of modules.
- Manufacturers of regulatory and feed-in equipment.
- Installers.

The investors are mainly house owners, not specialised investors. In particular in Germany institutions and institutional investors are important investors for large installations.

Manufacturers of PV Cells

Japanese companies continue to be leaders in solar-cell production, with Sharp and Kyocera being the leaders in 2004.
The largest European solar-cell manufacturer is the German firm Q-cells, which continues to expand.
A number of other solar-cell manufacturers are expanding in Germany, including Solar World/Deutsche Solar, Schott Solar, Ersol and Sunways.
Niche markets are maintained by smaller solar-cell producers around Europe such as the Danish firm Gaia Solar.
Deutsche Solar and Schott Solar produce their own wafers, while Q-Cells has entered into cooperation with the Norwegian Renewable Energy Corporation ASA (REC) on purchase of wafers and has entered a joint venture with REC to start producing wafers in Germany.

Manufacturers of Modules

Module manufacturers include manufacturers of PV cells as well as special manufacturers of PV modules.
Among the German cell manufacturers, Schott Solar makes PV modules.
The largest module manufacturers without solar-cell production are Solon, Solarwatt Solar-systeme, Solar-Fabrik, SMD, and Solar Factory.

Manufacturers of Regulatory and Feed-in Equipment

Most solar PV systems are grid-connected and use an inverter with built-in regulation of the grid connection. By the beginning of 2006, 30 companies were marketing inverters on the German market. These include module producers like Solar-Fabrik, large electronic suppliers such as Philips and Kyocera, other large companies such as Würth, and many specialised companies that either produce or import solar inverters, e.g., the popular Sunny Boy inverter.

Installers

The installation of PV modules has developed into a separate business, especially in Germany. The sector consists of many small installers that are active locally or regionally, and of some larger companies, that are marketing their own brand of solar PV system solutions, such as roof-integrated solutions. To supply the installers, a market is developing for montage systems for solar modules. By the beginning of 2006, in Germany alone, more than 50 companies were marketing components and systems for montage of solar modules.

The leading European trade association in solar PV is the European Photovoltaic Industrialists Association, www.epia.org .

4.3 Solar Thermal

Commercial solar thermal equipment production in Europe is for heating, in particular for domestic hot water. Other commercial applications are space heating (as a supplement) and heating swimming pools, as well as drying and low-temperature process heat.
The most used technology is that of glass-covered flat plate collector modules. Specially designed collector modules can be roof-integrated. In addition to the $2m^2$ to $5m^2$ modules for single-family houses, some companies produce larger $10m^2$ to $13m^2$ modules that are most cost-effective for institutions and even for district heating.
Vacuum-tube collectors give higher temperatures and higher production in winter; but they only make up a small part of the market.

For swimming pools, unglazed collectors are often used, which can give the small temperature increase needed. They make up about 5% of the market.
Solar thermal electric plants are not commercial in Europe. Demonstration plants are under preparation, however, and they promise to produce electricity substantially below the electricity price from solar PV if used in large scale.

Almost half of the collectors installed in the EU are installed in its largest national market, Germany, which, together with Greece and Austria, represents 70% of the EU solar thermal market. The solar industry is expanding in the EU, particularly outside of the three main national markets. Major new markets include Spain and France. Effective in 2006, it is mandatory in Spain to install solar heating for domestic hot water on new buildings, unless the house developer can prove that it is not cost-effective in this particular house.
The solar thermal market in the EU grew steadily in the 1990's, peaked in 2001, and slowed in 2002-2003. Sales were back to the 2001 level in 2004 and growth is expected to continue.

Whereas the German solar industry produces mainly for the national market, Austrian and Greek producers are export-oriented, serving Germany as well as other markets. Greece and Austria have been leaders in solar thermal production for a decade, and now they benefit from their early initiatives with the ability to develop exports.

The solar thermal market serves two broad functions:
- Manufacturing collectors and equipment;
- Installing systems.

Manufacturing Collectors and Equipment

Most solar thermal manufacturers produce solar collectors and supply equipment for solar thermal installations. There is some specialisation; some companies only make absorbers, while others make modules and systems. The largest manufacturers are:
- Buderus, a large German equipment manufacturer for heating and water installations;
- Viessmann, also a large German equipment manufacturer for heating and water installations;
- Wagner Solar, a specialised German solar thermal manufacturer;
- Sonnenkraft, the leading Austrian supplier; but without its own production of solar collector modules;
- GREENoneTEC, the largest solar thermal collector manufacturer in EU, supplying collector modules to Sonnenkraft and others;
- FOCO, the largest Greek solar manufacturer;
- Thermomax, the leading European manufacturer of vacuum-tube collectors, based in Northern Ireland (UK).

Together, these companies supply almost half of the EU solar thermal market, with the rest supplied by a large number of national manufacturers and imports. In recent years, imports from China have been increasing, in particular of vacuum-tube solar collectors, in which China is the world leader.

Sunstrip in Sweden specialises in making sunstrips that are assembled into absorbers.

Installing Systems

Installation of systems is mainly done by plumbers that specialise in solar thermal installations. Some plumbers specialise in only solar thermal installations, while others combine solar installations with other installation work.
Some solar manufacturers have specialised installers.

Alongside the professional installation market is a do-it-yourself (DIY) market that enables homeowners to install their solar equipment themselves. This practice was important to solar thermal success in Austria around 1990, but plays a smaller part now. It is often organised with courses in which the homeowners can learn about installation, maybe make collector modules together, design systems, and get necessary assistance.

The leading European solar thermal trade association is ESTIF, European Solar Thermal Industries Federation, www.estif.org.

4.4 Solid Biomass

Solid biomass is the main form of biomass used. After hydropower, it is the most important category of renewable energy in the EU. In addition to its widespread traditional uses for heating and in certain industries, it is increasingly used in modern, efficient equipment that also minimises local environmental effects. The main source is wood and residues from forests and wood-based industries. In some countries, agricultural residues also play an important role, such as straw use in Denmark. A third source is energy plantations that play a smaller role currently, but that could be very important in the near future with the increasing biomass demand combined with changes in the EU agricultural policy.

While the use of biomass was only increasing slowly until 2004, indications are that installation rates for new equipment have increased since 2004, though there is no statistical evidence yet. This is driven by high oil and gas prices and by support schemes, e.g., in France and Germany. For several years there has been a continued change from traditional to modern equipment for biomass for heating, to allow cleaner and less cumbersome use of biomass. There has also been a rapid growth in the use of biomass for electricity production.

The main uses are:

- Residential use, mainly for heating;
- Industrial use for process heat, mainly in certain industries that have biomass residues from their production;
- District heating;
- CHP, industrial as well as in district-heating networks. The technology used is mainly steam turbines, although gasification to fuel gas motors or gas turbines is entering the commercial market;
- Co-firing together with coal/lignite, typically replacing 10-20% of the fuel, in larger boilers such as in power plants.

The main solid biomass fuels:

- Firewood, traditionally used in small boilers and ovens.
- Industrial wood residues, such as sawdust, that can be fed directly into boiler systems. The residues are used on the production sites as well as distributed locally to medium-sized boilers.
- Wood chips made from residues of forests and from wood industries, sometimes including smaller trees and branches that have low value as timber. These are used in boiler systems ranging from large residential boilers to power plants up to 100 MWelectric. For smaller systems, there is a clear distinction between dry wood-chips (less than 30% humidity), which are more readily combustible in small boilers, and wet wood chips (30-60% humidity). Wood chips are mostly produced and traded regionally, while the raw materials are traded internationally, mainly from Central and Eastern Europe to Western Europe. Large markets are in Finland, Sweden, Austria, Germany.
- Wood pellets produced from industrial residues. This dry and easy-to-handle fuel is increasingly popular for small boilers, mostly for residential use. It is also used for very small ovens, as well for institutional boilers. In spite of a higher price than for other solid biomass products, wood pellets are increas-

ingly popular because of their clean combustion, high energy density, homogeneity, and ease of use in boilers. Wood pellets are the most internationally traded solid biofuel. Pellets and raw material are produced in Central and Eastern Europe and exported to Western Europe. Large markets are in Sweden, Germany, Austria, and Denmark.

- Straw is traded as straw bales. It is used in boilers either as entire bales in special boilers or cut into straw pieces. The largest use of straw is in Denmark.
- "Black liquor" is a residue from the pulp industry that is used for industrial heating and CHP in the paper and pulp industry. It is mainly used in Finland and Sweden.

Equipment Manufacturers

Equipment manufacturers are a very diverse group of companies. Different manufacturers specialise in different types of applications:

- Large boilers (above 5 MW) and CHP plants come mostly from power-sector suppliers; from, e.g., German Siemens or Swedish/Norwegian Kvaerner, or ABB. The Finnish Wärtsila Biopower is an example of a company producing boilers and solutions for industries and smaller district heating, including smaller CHP plants.
- Smaller and medium-sized boilers are mostly manufactured by smaller companies, which are often active internationally. TPS (Termiske Processer - Sweden) and KWB (Austria) are larger manufacturers of boilers for residential and institutional use. The Baxi Group (UK-based) is one of the leading manufacturers for heating installations in EU; it is active in five EU countries and has a large line of boilers for wood-chips, wood pellets, and firewood.

Solid Biomass Fuel

Fuel supply is important to the success of solid biomass markets. Suppliers include smaller entities, smaller departments of traditional energy companies, and forest companies. Oil companies such as Shell and Statoil (Norway) as well as power companies have biomass departments selling wood pellets and sometimes wood chips. While production of wood chips is very decentralised, production of wood pellets is increasingly centralised, with a few large pellet producers supplying each country.

Trade Associations

European trade associations for biomass are weak compared with the large volumes of the sectors. Two European trade associations that cover solid, liquid and gaseous biomass products are:
The European Biomass Association (AEBIOM), www.aebiom.org;
European Biomass Industry Association (EUBIA), www.eubia.org.

4.5 Liquid Biofuels

Liquid biofuels are a rapidly developing market. Their main use is for transportation, but they are also used to replace mineral oil for heating and CHP, usually on a small scale. The market is divided as follows:

- Vegetable oils and derivatives in the form of biodiesel, a methyl ester of the oil that has properties very similar to those of diesel oil;
- Alcohols and derivatives such as ETBE (ethyl-tertio-butyl-ether) that can be used in petrol.

Uses are divided in fuels that are directly used in normal diesel or petrol engines, and fuels that require special engines. The main uses of liquid biofuels are:

- Biodiesel as a replacement for diesel oil, or mixed with diesel oil;
- Ethanol mixed in smaller quantities (often 5%) in petrol;
- ETBE, used as replacement for petrol;
- Pure vegetable oil in diesel engines converted to vegetable oil;
- Fuel with above 90% ethanol used in special ethanol-burning motors.

Biodiesel was by far the most popular biofuel in the EU in 2004, followed by ETBE. Germany is the leading country in EU regarding biofuels, especially in its use of biodiesel. It is followed by France (both biodiesel and ethanol), Spain (ethanol), and Italy (mainly biodiesel). In 2004, Sweden was the only country in which there was large-scale mixing of ethanol in petrol.
The biofuel industries consist of producers of vegetable oil, of alcohol, and of the vehicle fuels. The producers of vehicle fuel tend to be large companies. Producers of vegetable oils can be very small, local companies. Another line of business is conversion of motors to run on vegetable oils.
The raw materials for the EU's vegetable oil and biodiesel are European crops of oil-bearing plants, primarily rapeseed, the next most used being sunflowers. The oil is produced as it would be for human consumption.
The raw materials for ethanol and ETBE are agricultural products that are also used for production of alcohol for human consumption (grain, wine grapes, etc.).
In recent years, imports of liquid biofuels into the EU are increasing. They mainly come from developing countries with large sugar-cane-based production of ethanol, such as Brazil, also including tropical plant oil such as palm oil. Increasing concern over the sustainability and the environmental problems of these imports is driving a push for regulation of the imports, and initiatives are expected in 2006.
Research is advancing in the production of liquid biofuels, mainly alcohols, from cheaper feed-stocks such as agricultural residues, forest residues and other solid biomass at “bio-refineries”. Demonstration of these “bio-refineries” is under preparation.

The main EU producers of biodiesel in 2004 were:

- Diester Industrie, Germany;
- ADM, German subsidiary of an American company;
- Novaol, France;
- Natur Energie West, Germany;
- Fox Petroli, Italy;
- MUW, Germany;
- Campa biodiesel, Germany.

The main producers of ethanol and its derivatives for transport in 2004 were:

- Abengoa, Spain & France;
- Tereos Group, France;
- Agroetanol, Sweden;
- Total, France (conversion from ethanol to ETBE).

The conversion of cars from diesel to vegetable oils is mainly done with equipment from the German Elsbett company.

4.6 Biogas

The biogas sector is subdivided into very different subsectors:

- Landfill gas plants;
- Biogas plants at wastewater treatment plants;
- Agricultural biogas plants and treatment of solid waste.

Biogas plants at wastewater treatment plants constitute about half of the EU's biogas production. Growth potential is limited, but there is some room for expansion in the new EU countries, when they improve their wastewater treatment facilities. The biogas process removes carbon from the sludge and stabilises it, so it is easier to handle, less smelly and easier to dehydrate. The biogas is used at the wastewater plant to cover its large electricity and heat demands; but often excess heat can be exported from the site as well.

Landfill gas is the second largest type of biogas in the EU, with some additional growth potential. In countries in which it is most developed, such as the UK, it is the largest source of biogas. The potential for landfill gas will slowly be reduced in the coming years, as the practice of storing organic materials in landfills will be phased out following EU waste regulations. The gas is used for electricity and, where possible, for CHP.

Not all biogas from wastewater plants and landfills is used. A considerable part is only captured for environmental reasons and just flared.

The smallest but fastest-growing biogas application is to treat animal manure and by-products, as well as organic solid waste. In addition to gas production, the process transforms the material into organic fertiliser. This is done in biogas plants at farms and at municipal solid-waste treatment facilities, as well as in villages, where more farmers share biogas plants, and in industries. This subsector has a very large growth potential, and if fully developed could compete with solar and geothermal in energy production in the EU.

The most important biogas business is the construction of plants. The construction sector is divided as follows:

- Construction of biogas plants for wastewater plants. All larger engineering and construction companies involved in construction of wastewater plants are also designing and constructing biogas plants, though many of them involve specialised companies in the tank construction. The tank construction companies make insulated tanks for many purposes.
- Construction of landfill gas facilities is done by companies that are designing environmentally benign landfills, as well as by a few, smaller, specialised landfill-gas companies.
- Construction of biogas plants for agriculture and solid waste is usually done by specialised companies.

In the field of biogas plants for agriculture and solid waste, the French firm Valorga is the leader, and its technology has been used in 11 countries. Its main application is treatment of organic forms of municipal solid waste. Another important player on the European market is the German Linde KCA Dresden. Smaller companies specialise in biogas plants at farms, mostly active on national markets, although increasingly exporting designs as well as parts of plants. As an example, a number of Danish biogas manufacturers are exporting to Poland.

Plants are also constructed by do-it-yourself builders, mainly farmers. This practice is well developed in Germany, where owners of a number of medium-sized farms have built their own biogas plants, based on construction manuals made for the purpose and with assistance from specialists.

Sources

Renewable Energy Barometers, from EurObserv'ER, Systemes Solaire and EUFORES:
- Wind Barometer 2005.
- Solar PV Barometer 2005.
- Solar Thermal Barometer 2005.
- Wood Barometer 2005.
- Biofuels Barometer 2005.
- Biogas Barometer 2005.
The barometers are available from www.eufores.org.

BTM Consult homepage, www.btm.dk.
Danish Test Station for Smaller Biomass Boilers, http://www.biomasse.teknologisk.dk/kedler/index.htm.
James & James Renewable Energy World (REW) Suppliers Database, http://www.jxj.com/suppands/renenerg/ .

Websites of renewable-energy trade associations, including the European Renewable Energy Council, www.erec.renewables.org.

Websites of renewable-energy companies mentioned in the text.

5. United Kingdom

5.1 Current Energy Status, Conditions for Renewable Energy

5.1.1 Supply and Demand Structure

The UK current energy supply and demand structure is summarised in the UK annex to this report. Significant trends are that total consumption of primary fuels is relatively stable, with a small increase in petroleum, but the UK's indigenous reserves of oil and gas are now in a year-on-year decline in spite of increased budgets for exploration.

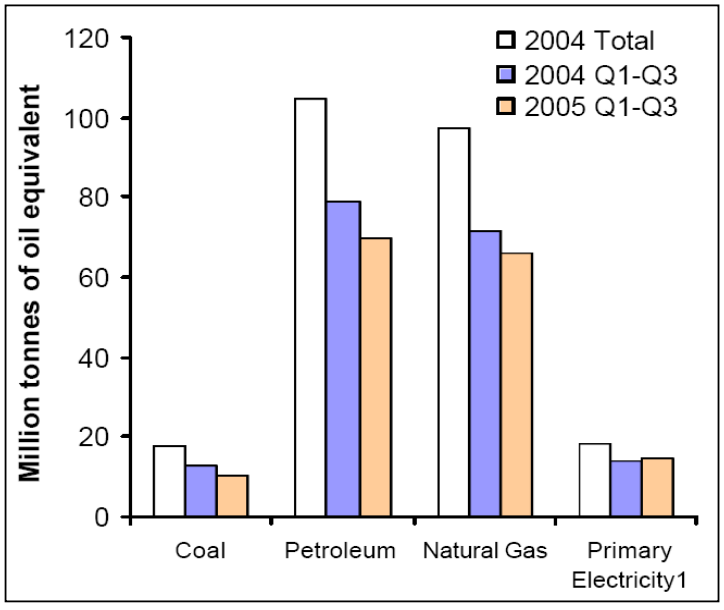
Production

Indigenous production of energy was 8.4 per cent lower in 2004 than in 2003, continuing a year-on-year decline for each year since 1999. Coal and other solid fuel production was lower by 10.0 per cent, nuclear output fell by 8.7 per cent, gas production fell by 6.4 per cent and petroleum production fell by 10.1 per cent. Petroleum accounted for 45.6 per cent of total indigenous production in the third quarter of 2005, while coal and other solid fuels accounted for 7.6 per cent, and natural gas 36.7 per cent. A year earlier, the proportions were petroleum 46.1 per cent, coal and other solid fuels 8.0 per cent, and natural gas 37.5 per cent.

Total Consumption

In 2004, consumption of primary fuels was 1.3 per cent higher than in 2003. The largest contribution to this increase in absolute terms was from petroleum (which increased by 4.1 per cent). On a temperature-corrected basis, consumption in 2004 was 1.4 per cent higher than in 2003.

Figure: UK primary fuel consumption. Comparison Jan-Sept. 2004 with Jan. - Sept. 2005



Source: Energy Trends, December 2005
http://www.dti.gov.uk/energy/inform/energy_trends/index.shtml

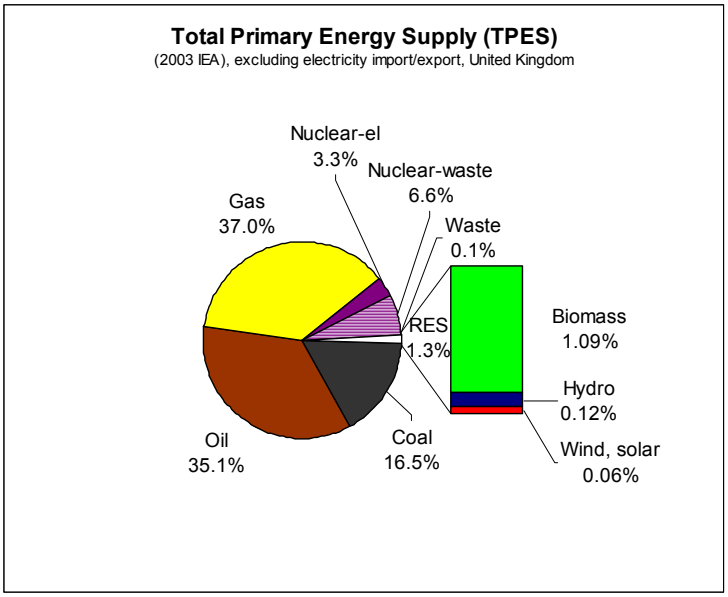
Fuel Prices

Domestic electricity prices, including VAT in September, 2005, were 7.3 per cent higher in real terms than in September, 2004. The price of domestic gas rose by 11.1% in real terms over the same period, with the price of heating oils rising by 32.3%. This has raised the average annual domestic fuel bill to £669, a 10.7% increase in real terms.

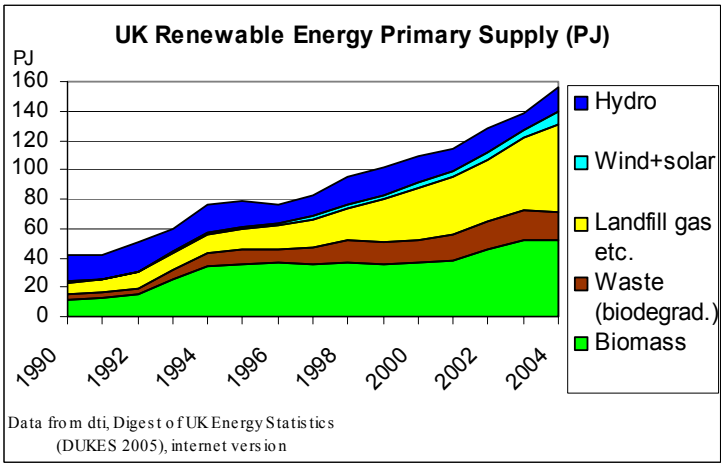
5.1.2 Contribution of Renewable Energy

Renewable energy and wastes (e.g., biogas from landfill sites) contributed 1.4 % of the UK's primary energy supply in 2003. The UK does not have any explicit targets for heat from renewable energy sources, although there are market-based obligations through tradable certificates for electricity suppliers to supply 10% of the UK's electricity from renewable sources. There is a recently introduced obligation to supply 5.75% of the UK's road fuels from biofuels by the same date.

This lack of support for renewable heat and, until recently, for transport fuels has distorted the development of renewable energy in the UK, as renewable energy provided 3.58% of electricity consumed in the UK in 2004, up from 2.67% in 2003.

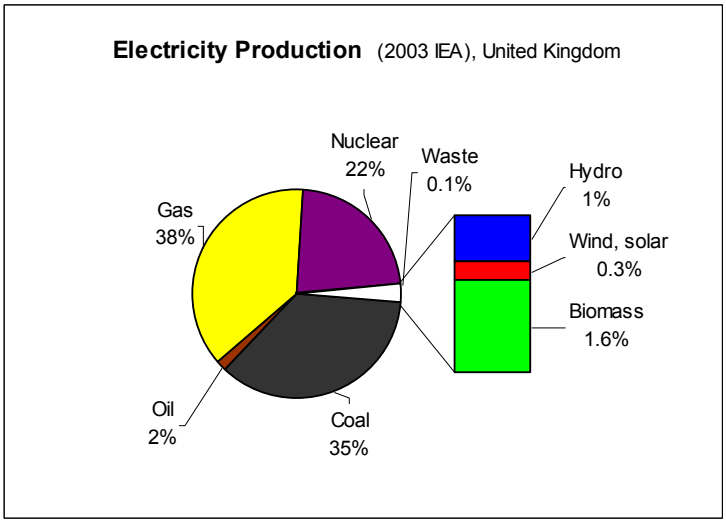


It should be noted that most of the biomass in the UK (energy crops, landfill gas and wood fuel) has been used for electricity generation to maximise returns from sale of Renewable Obligation Certificates (ROC's) in addition to the sale of the electricity itself. Biomass has been mainly co-fired in existing coal-fired power stations, including biomass such as nut shells imported from other regions as far away as SE Asia. There is very little development of biomass district heating in the UK.



Biomass

Largest use of renewable energy is solid biomass (wood fuel and, to a lesser extent, energy crops), the use of which more than tripled during the period 1990-2003, but still only represents 1% of TPES. This includes wood fuel for domestic heating (wood-burning stoves, etc., which are popular in rural areas) and, since 2002, price support for electricity generated from co-firing biomass in existing coal-fired power stations. There are increasing numbers of biomass district heating schemes supported by UK Government funding, mainly based on wood chips from sawmills and forestry operations. There is a very small market for wood pellets in the UK, with 3 manufacturers supplying the market, plus some pellets imported from France, Austria and Northern Ireland.



Biogas and Landfill Gas

The UK is the European leader in biogas (methane) from landfill gas. There is some production of biogas from sewerage works and one centralised biogas plant at Holdsworthy in Devon, which is supplied with animal slurry from local farms. In most cases, the gas is used to generate electricity, which qualifies for financial support of currently £50 /MWh through Renewables Obligation Certificates (ROCs), plus the traded market value of electricity, approximately £30/MWh base load price. The electricity base-load price has doubled since 2002 [£1 Sterling = €1.5 euro].

Landfill gas production increased almost 6 times 1990-2003. There is still room for further developments as well as for increases in efficiency. Most new UK landfill sites are constructed to enable the methane generated to be collected and used for electricity generation after the site has been capped. However, there is a growing shortage of landfill sites, which are very unpopular with local people as they can have a damaging effect on the local environment, e.g., through contamination of groundwater, and can reduce the value of properties in the vicinity.

Wind Energy

In 2004, onshore and offshore wind energy together accounted for 0.49% of electricity generated in the United Kingdom, up from 0.32% in 2003. During 2004, renewable energy sources accounted for 3.58% of the electricity generated in the UK, up from 2.67% in 2003. The UK target is to produce 10% of electricity from renewable energy sources by 2010, backed by the Renewables Obligation, a market-based penalty and reward system described in more detail in section 5.3 below.

Although the renewable-energy sector has been slow to gain momentum in the UK, especially considering the large potential (e.g., the UK has 40% of Europe's wind energy resource plus very good wave and tidal energy resources, including some of the highest tidal ranges in the world), there are signs of increasing confidence in the sector and of substantial growth on the horizon. For example, during the 10 years of 1993 – 2004, a total of 900 MW of wind energy was installed in the UK, representing more than 1100 wind turbines. By the end of end of 2005, a total of 1337 MW windpower was in operation and another 1500 MW approved for installation (BWEA). In addition, a number of large offshore wind energy developments have submitted planning applications, which have not yet been determined, such as the London Array, 12 miles off the Kent coast. This is a major £1.5 billion 270 turbine development with a rated power output of 1 GW, capable of supplying 25% of London's domestic electricity needs.

The current assessment is that 4% of UK electricity could be generated by onshore wind farms by 2010, plus a further 3% from offshore wind farms. There are regional differences due to variations in the wind energy resource, for example, wind energy provided 2.4 % of Scotland's electricity generation in 2004, compared to 0.49% for the UK as a whole. Scotland benefits from 25% of Europe's wind energy resource and has a target to produce 20% of electricity consumed in Scotland from renewable energy by 2010.

Solar Energy

There has been a low uptake of solar thermal in the UK, approximately 20,000 m2 per year in 2003 and 2004. The total installed area in December, 2005 was approximately 250,000m2, partly due to lack of a good solar resource, especially in winter months, and lack of significant government funding to help kick-start the industry.

Solar photovoltaic installations totalled 1.9MWp in the UK in 2004. The total area of PV installed in the UK at the end of 2004 was 7.8 MWp. Solar PV has been supported since 2002 by 50% capital grants for installations on houses and public buildings with an initial budget of £20m over 3 years. There is no premium price for solar PV exported to the grid other than the Renewable Obligation Certificate price offered to all renewables generators at the same rate. The administration work involved for smaller generators in making a claim for ROCs may be more than the £0.05/ kWh value of the ROC. There is a small benefit in that ROCs can be claimed for all electricity generated from eligible renewables sources, even if the electricity is subsequently used on-site. A number of electricity trading companies are offering to pay £0.04 per kWh for all metered generation. They amalgamate the output from many small generators and reclaim the ROC's value at a higher market rate to recover their administrative costs. However, after grant and sale of ROCs, a PV system in the UK will have a 40-year simple payback time at 2005 electricity prices, hence the relatively low uptake.

5.2 Effect of Progressive Targets for Renewable Energy

The targets for renewable energy production in the UK are clear, but the policies supporting those targets have been widely criticised by many working in the renewable energy sector and by a number of leading academics. The current interest in new nuclear power developments in the UK should be viewed in this context.

The main sustainable energy policy document is the energy white paper, "*Our energy future: creating a low carbon economy*", approved by the UK parliament in February 2003, available on-line as http://www.dti.gov.uk/energy/whitepaper/ourenergyfuture.pdf. Key points from the energy white paper:

> *"This white paper sets out a strategy for the long term, to give industry the confidence to invest to help us deliver our goals - a truly sustainable energy policy.*
> *Our country needs a new energy policy. Despite the improvements we have made over the last five years, today's policy will not meet tomorrow's challenges. We need to address the threat of climate change. We must deal with the implications of reduced UK oil, gas and coal production, which will make us a net energy importer instead of energy exporter. And over the next twenty years or so we will need to replace or update much of our energy infrastructure.*
> *With these challenges, however, come new opportunities. The opportunity to shift the UK decisively towards becoming a low carbon economy where higher resource productivity -producing more with fewer natural resources and less pollution - will contribute to higher living standards and a better quality of life.*
>
> *Our ambition is for the world's developed economies to cut emissions of greenhouse gases by 60% by around 2050. We therefore accept the Royal Commission on Environmental Pollution's (RCEP's) recommendation that the UK should put itself on a path towards a reduction in carbon dioxide emissions of some 60% from current levels by about 2050.*
>
> *We recognise, specific measures are needed to stimulate the growth in renewable energy that will allow it to achieve the economies of scale and maturity that will significantly reduce its costs. In January 2000 we announced our aim for renewables to supply 10% of UK electricity in 2010, subject to the costs being acceptable to the consumer. We introduced the Renewables Obligation (which requires suppliers in England and Wales to obtain an increasing proportion of electricity from renewables year on year) in April last year. We also exempted renewable generation from the climate change levy. By 2010, these measures will provide the renewables industry with support worth around £1 billion a year. This is designed to deliver the required expansion in renewables by then. In this white paper we set the ambition of doubling renewables' share of electricity generation in the decade after that. In reducing carbon dioxide emissions, our priority is to strengthen the contribution of energy efficiency and renewable energy sources.*
> *Nuclear power is currently an important source of carbon-free electricity. However its current economics make it an unattractive option for new, carbon-free generating capacity and there are also important issues of nuclear waste to be resolved. This white paper does not contain specific proposals for building new nuclear power stations. However we do not rule out the possibility that at some point in the future new nuclear build might be necessary if we are to meet our carbon targets."*

A failure to deliver effective policies as needed to reach the target for renewables to supply 10 % of UK electricity by 2010 may be attributed to deep splits within the UK cabinet over renewable energy or nuclear power as the best means of delivering the UK's carbon-reduction targets. The Independent on Sunday newspaper reported on 16th February 2003:

> "*Tony Blair has blocked plans for a target of a fifth of Britain's electricity from renewable sources by 2020 in revenge for his failure to push through a programme of new nuclear power stations. Last month he lost a battle to include plans to build six nuclear power stations in the Government's forthcoming energy white paper. In cabinet discussions the Treasury opposed the new renewables targets, but was overruled by an alliance of ministers including John Prescott, the Deputy Prime Minister, Margaret Beckett, Secretary of State for the Environment, and Patricia Hewitt, Secretary of State for Trade and Industry*."

Welsh Secretary Peter Hain is also against new nuclear developments. He was recently (Dec., 2005) quoted in the Western Mail newspaper as saying, "*I do not want to see new nuclear plant in Wales and urge everyone to adopt renewable energy technology such as tidal, wind and solar*".

The result has been a lack of confidence in the UK Government's support for renewable energy which has been reinforced by well publicised rhetoric on renewable energy targets but a lack of funding and infrastructure to support new renewables developments compared to a number of other EU countries.

Renewable Energy Support Measures in the UK

There are a number of financial support measures that operate throughout most of the UK, such as the market-based Renewables Obligation Certificates for electricity, 30% grants towards the capital cost of biomass heating and CHP equipment, grants for farmers for 50% of the establishment costs of energy crops such as willow and miscanthus (elephant grass), tapering financial support to set up biomass energy supply networks and businesses (£3m total budget for the UK over 3 years), capital grants towards the cost of offshore wind energy projects (£60m initial budget, half of which was provided by revenue from the National Lottery), support for other marine renewables, and a reduction in road fuel duty of £0.20/litre for eligible biofuels.

There is some financial support for householders, schools, environmental and community organisations to install renewable energy systems (except PV), with a total budget for England and Wales of £10m over 3 years, likely to be extended for a further period after April, 2006.

Photovoltaic installations qualify for separate 50% capital grants with a budget of £20m over 3 years. It could be questioned why PV received twice the budget allocation of all the other small-scale renewable energy technologies added together, but others have argued that the overall promotional budget for small-scale renewable energy technologies was too little to develop a strong market, representing less than £1 per year per UK taxpayer. This has been compared, for example, with the £2000m per year cost of dealing with the UK's nuclear waste legacy, paid for from public funding, equivalent to £100 per year per UK taxpayer.

In addition to the Renewables Obligation there is a small tax on fossil fuel and nuclear energy supplies for businesses, the Climate Change Levy, currently 0.43 pence / kWh for electricity. This levy raises £1000 m per year but is not all ring-fenced for sustainable energy measures. £800m p.a. is returned to employers as reduced contributions for national insurance payments, i.e., reducing costs of employing staff. The remaining £200m pa is used to fund the Carbon Trust, which works with the business sector to provide free or subsidised energy audits for larger energy users; zero-interest loans for energy-saving measures; tax incentives on new eligible equipment, which can include renewable energy systems; and a small budget for grants for business to invest in renewable energy, but only for demonstration of new innovative technologies.

5.3 Renewable Energy Policies and Measures

Table: Overview of Renewable Energy Policies

Policy name	Measures	Technologies covered
Renewables Obligation (RO) Order (see below)	•Obligations •Tradable Certificates	•All electricity producing technologies
Climate Change Levy	•Fossil Fuel Taxes •Tax Credits •Negotiated Agreements	•Hydropower •Offshore wind •Onshore wind •Biofuel
The Green Fuels Challenge	•RD&D •Biofuels support	•Hydrogen (from renewables) •Biofuel
Reduced Value-Added Tax	•Sales Tax Rebates	•Biofuel •Solar PV
UK Climate Change Programme	•Overall Strategy	•All technologies
Marine Renewables Deployment Fund	•RD&D	•Ocean energy
New and Renewable Energy Research and Development Programme	•RD&D	•Biofuel •Hydrogen (from renewables) •Solar PV •Wind •Hydropower •Ocean energy
Bio-energy Capital Grants Scheme (closed)	•Capital Grants	•Biofuel •Bioenergy
Offshore Wind Capital Grants Scheme (closed)	•Capital Grants	•Offshore wind
Clear Skies Initiative (closing 2006)	•Capital Grants	•Solar heat •Biomass heat •Windpower •Small hydro •Heat pumps
Major PV Demonstration Programme	•Capital Grants •Consumer Grants / Rebates •RD&D	•Solar PV
Renewable Energy Guarantee of Origin	•Tradable Certificates	•Bioenergy •Hydropower •Geothermal •Windpower •Ocean energy •Solar PV •Waste (organic)
The Renewable Trade Promotion Service	•Information	•All technologies

Renewables Obligations

The Renewables Obligation (RO) on electricity supply is the primary policy in support of the UK government's commitment to achieving the 10% target for electricity to be supplied from renewable sources by 2010. It is an obligation on all licensed electricity suppliers in England and Wales to supply a specified and growing proportion of their electricity sales from a choice of eligible renewable sources – with the ultimate aim of achieving 10.4% by 2010. It has been announced that the RO will be extended from 2010 rising to 15.4% by 2015, and it will then remain at this level until 2027. This is intended to help long-term investment decisions in renewables

As an alternative to supplying renewable energy, electricity suppliers may fulfil all or part of their obligation by paying the buyout price to Ofgem, which was set at £ 30/MWh to 31 March 2003 and is thereafter adjusted in line with the retail price index. Proceeds from the buyout fund are recycled and returned to the suppliers by Ofgem in proportion to the number of RO Credits (ROCs) that each supplier presents to discharge its obligation.

In practice there is a shortage of renewable electricity generation in the UK, therefore some generators need to pay the buy-out price. This funding is distributed as a bonus each year to suppliers who have met their obligation; hence the value of ROCs rises above the buy-out price, and is currently approximately £45 MWh, plus additional benefits for green electricity of avoiding the £4.30 MWh Climate Change Levy. The generator sells into the Grid at the "pool" market price and the renewables premiums are additional, hence the renewable electricity generator currently receives a minimum of approx £0.08 kWh (£80 MWh) . The Renewables Obligation is technology blind, e.g., onshore wind energy, offshore wind energy, photovoltaic electricity, power from biomass, and new hydro all receive the same payment.

Major disadvantages with the market-based obligation certificate approach are that prices are high when there is a shortage of generation capacity but ROCs have zero tradable value if generation capacity meets the percentage obligation on suppliers in any year. It may not be until the end of a trading year that the value of ROCs is known. This creates a major disincentive to investors in renewables technologies with a 20-year-plus working life requiring high front-end capital investment.

Generating companies will scale back the introduction of new renewable plants as capacity approaches the level of the Renewables Obligation. The Renewables Obligation, in reality, thus will act as a cap or upper limit on the renewables capacity. Given the uncertainty in annual output from renewables, this cap might be expected to take effect at around 75% of the RO.

This seems to be happening in practice. The UK electricity supply from renewable sources is expected to meet 8% of consumption by 2010, not 10%. The shortfall in meeting the UK's renewable electricity targets has fuelled the call for new investment in nuclear power stations.

The technology-blind approach also means that pre-commercially-viable technologies such as offshore wind, PV and biomass power also need capital grants to enable the projects to be viable at the RO market price for electricity output. On the other hand, the Environmental Audit Committee has advised the UK Government that onshore wind energy is receiving a premium through the RO 30% higher than is needed to maintain a commercially viable wind energy market. These capital grants are also uncertain as to medium-term availability, further undermining renewable energy investment.

This fundamental issue is illustrated in the following transcript of a BBC Radio 4 programme, "File on 4", broadcast in November, 2005. The reporter is Julian O'Halloran who interviews:

- Paul Molyneux, managing director of photovoltaics manufacturer Sharp U.K.
- Seb Berry, a spokesperson for the Renewable Energy Association
- Elliott Morley, UK Environment Minister

O'HALLORAN: Sharp UK and other solar power firms, rely on public funding, because the market is still in its infancy. They need government backing to maintain investor confidence. Up till now, they say, Whitehall has led them to believe this support would continue at a steady, predictable level over many years. But Sharp UK's managing director, Paul Molyneux, says the funds have now been sharply cut back.

MOLYNEUX: *In the Energy White Paper that was delivered in 2003, there was a clear message, there was a strategic aim that the UK would be competitive amongst other nations in developing solar electric in particular. So we had a ring-fenced commitment, which was at least to a ten year period of sustained financial support to allow this fledgling industry to really grow. The problem is that they have just ceased this ring-fenced investment.*

O'HALLORAN: So by how much a year do you expect the funding for solar power to go down?

MOLYNEUX: *Our annual funding is around the £14 million level, purely for solar electric, will fall to between £7 and £9 million on an annual basis over the next three years. The government are professing to be a leader in the fight against climate change and they take the opportunity to say that publicly, but we think there is a big difference between the rhetoric and the reality.*

O'HALLORAN: Back in Labour's first few years in office, solar power companies had high hopes for the way policy was shaping. An earlier government White Paper raised the prospect of Britain becoming a world leader in solar power, next to Japan and Germany. The plan was to install the equivalent of 100,000 solar roofs by 2011. But Seb Berry of the Renewable Energy Association, says today Britain has moved hardly any way towards that target.

BERRY: *We have got not that far down that road. We'll have about four thousand roofs.*

O'HALLORAN: Four thousand roofs by when?

BERRY: *By the end of 2006 –towards the end of the current programme. To put that into perspective, the German solar programme this year alone will install the equivalent of something like 200,000 solar roofs.*

O'HALLORAN: And what was the Japanese target at that time?

BERRY: *The 2001 White Paper referred specifically to the Japanese example, which at that point was a 70,000 solar roof programme, which of course the Japanese delivered several years ago.*

O'HALLORAN: If Germany and Japan are doing so much better than Britain, why is that, do you think?

BERRY: *The one common strand is long term public policy commitment and long term support on the part of Government.*

O'HALLORAN: Environment Minister, Elliott Morley, denies that these changes betray indecision or loss of confidence by the Government.

MORLEY: *We think solar is important, we think there's a role for solar, there is money for solar. But the exact amount of money for solar in relation to the whole range of technologies, I think solar has to negotiate in relation to the benefits it can offer.*

A major difference between the UK and the majority of other European countries is that Renewable Energy Feed in Tariffs, REFITs, have been successfully used in countries such as Germany, Spain and Denmark, who have all developed renewable energy at a faster rate than the UK. In addition, research has shown that REFIT tariffs can be more cost-effective than obligations backed by tradable certificates.

5.4 Emission Trading Scheme

The UK emissions trading scheme was the world's first economy-wide greenhouse-gas emissions trading scheme, which began in March, 2002.

The scheme was initially open to the 6000 companies with Climate Change Agreements. These negotiated agreements between business and Government set energy-related targets. Companies meeting their targets receive an 80% discount from the Climate Change Levy, a tax on the business use of energy. These companies can use the scheme either to buy allowances to meet their targets, or to sell any over-achievement of these targets. Anyone can open an account on the registry to buy and sell allowances.
In the first year (2002), the Participants achieved emission reductions of 4.64 million tonnes CO_2equivalent against their baselines. Over the first two years (2002 and 2003), the Scheme delivered emissions reductions of almost 5.2 million tCO_2equivalent, and over the first three years (2002, 2003 and 2004), the Scheme delivered emissions reductions totalling 5.9 million tCO_2equivalent.

The UK National Allocation Plan (NAP) set out how carbon dioxide emission allowances will be allocated to the UK industrial sectors and installations covered by the EU Emissiions Trading Scheme, (EU ETS) and what the total number of allowances to be issued in the UK would be (allowances of 736 million tCO_2).
The UK NAP was notified to the Commission in April, 2004, and was approved on 7 July, 2004, with conditions. These express conditions were that further information on the new entrant reserve should be provided, and that installations in Gibraltar should be accounted for.

In November, 2004, the UK Government resubmitted the NAP with a request for allowances for 756 million tCO_2 and claimed that the UK made it clear to the Commission in April, 2004, when submitting its NAP, that the total quantity of 736 million allowances was provisional and based on interim projections of emissions. Following the finalisation of emission projections for installations covered by the EU ETS in the first phase of the Scheme, carbon dioxide emissions were estimated to be 50 million tonnes CO_2 higher than previously estimated.

An announcement on 14 February, 2005 specified how these 756 million allowances would be distributed at installation level. It also stated that any allocation below this total figure would be achieved by reducing the number of allowances given to the electricity generation sector.

The Commission decided that the proposed amendment to the national allocation plan notified by the United Kingdom to the Commission on 10 November, 2004 and up-dated on 18 February, 2005, implying an increase of the emission allowance allocations by 19.8 Mt. CO_2eq, was inadmissible.

The UK Government decided to take legal proceedings against the European Commission in the form of an application to the Court of First Instance (CFI).

In March, 2005, the UK Government decided to issue allowances at the lower level of 736 million allowances whilst pursuing the matter through legal proceedings. A statement said:

> "*The Government is today announcing that it intends to issue 736 million allowances as soon as possible to allow operators of UK installations to participate in the EU Emissions Trading Scheme (EU ETS), while initiating legal proceedings against the European Commission.*
> *The Government will also be launching legal proceedings against the Commission. The legal proceedings will seek to require the Commission to consider the substance of the amendment, which proposed to set the total quantity of allowances to be allocated to installations in the UK at 756 million.*"

The Court of First Instance heard the UK case on 10th October, 2005 and delivered a judgement on 23rd November, which was claimed in a press release to be a victory for the UK:

"The UK Government has won its legal case in the Court of First Instance which challenged the European Commission's refusal to consider the amendment to the UK's National Allocation Plan. The ruling does not comment on the UK's amended total cap on carbon dioxide emissions. It does however require the Commission to consider the amended plan and to make a fresh decision on its compatibility with the EU Emissions Trading Directive's requirements."

Overall, the UK Government claims it is committed to making a success of the EU Emissions Trading Scheme, and the first phase of the trading period will bring substantial CO_2 reductions:

"*This is a key element of the UK's strategy to tackle climate change as set out in the Energy White Paper and the UK's climate change programme. Phase I of the scheme is set to reduce carbon dioxide emissions in participating EU countries by a total of around 65 million tonnes over the next three years. The scheme is a vital part of the drive to reduce carbon dioxide emissions throughout Europe. EU Ministers agreed at the October Environment Council that market mechanisms must be at the core of a successful long-term response to climate change.*"

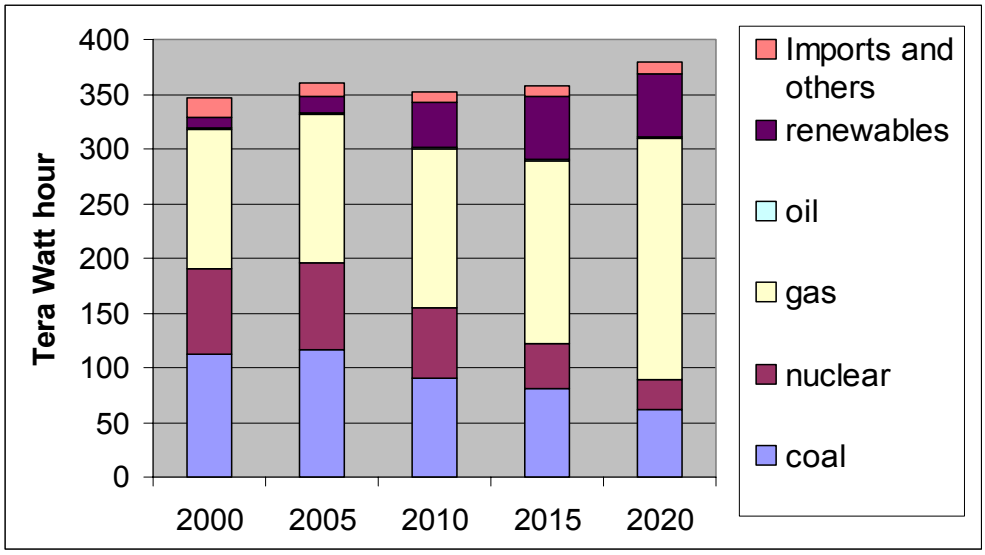
5.5 Outlook for Sustainable Energy until 2020

The UK Government's 2003 Energy White Paper is subject a review announced in November 2005: http://www.dti.gov.uk/energy/review/energy_review_consultation.pdf .

The terms of reference are to 'review the UK's progress against the medium and long-term Energy White Paper goals and the options for further steps to achieve them. The aim will be to bring forward proposals on energy policy next year.' The review will look at 'all options including the role of current generating technologies (e.g. renewables, coal, gas and nuclear power) and new and emerging technologies (e.g. Carbon Capture and Storage). The Review will also consider transport and the role of energy efficiency.' Overall, it will 'focus on policy measures to help us deliver our objectives beyond 2010. The Review will aim to ensure the UK is on track to meet the goals of the 2003 Energy White Paper in the medium and long term.'
Energy Minister Malcolm Wicks said,:

'*The Energy Review is taking place against a background of strengthening evidence on the nature and extent of climate change and increasing concerns about the future security of UK energy supplies. This is the right moment to assess where we are in relation to achieving the goals set out in the 2003 Energy White Paper. The Review will explore all the options open to us taking into account the important international context. There will inevitably be some difficult decisions and trade offs to be made in arriving at the right package of policy proposals. It is crucial that we stimulate a wide-ranging and informed debate and engage the public, business and industry throughout the process as well as academic, private sector, scientific, NGO and other experts.*'

Figure: UK electricity generation by fuel type – data and projections (Dti)



The UK has a good track record on delivery of energy efficiency improvements and effective policies backed by adequate levels of funding. This includes a levy on all domestic fuel bills, which is ring-fenced by utility companies to provide discounts on energy-saving measures for householders, insulation, etc. In addition, public funds are available to install free insulation and other energy-saving measures for low-income households. Such initiatives are managed on a local level by the UK's network of energy advice centres mentioned in the UK annex. These energy-saving initiatives are very cost-effective and are likely to continue beyond 2010 regardless of the energy supply mix.

Energy Efficiency - The Government's Plan for Action sets out how the government aims to cut carbon emissions by an extra 12 million tonnes through energy efficiency within the next six years.

Key measures in the energy efficiency plan include:

- A new aim to save 4.2 million tonnes of carbon from households by 2010;
- Double the level of Energy Efficiency Commitment (EEC) activity from 2005 to 2011, subject to a review in 2007. This is expected to lead to investment of more than £2billion, saving customers £4billion from their bills to 2020;
- New fiscal measures announced in Budget 2004, including a tax allowance to encourage domestic landlords to invest in their properties;
- New energy services pilots, through which energy suppliers can offer innovative energy efficiency packages to customers;
- Committed leadership by government, including a new commitment by central government to use only the best energy performance buildings;
- More emphasis on communicating with people about climate change.

(2004; see http://www.defra.gov.uk/environment/energy/review/ for text on-line)

5.6 The Nuclear Sector, including Recent Political Developments

The construction of new nuclear power stations is currently being considered in the UK as part of the Energy Review recently announced by Prime Minister Tony Blair. A decision is expected before the end of 2006. There is a currently a heated debate on the issue in the UK media. A consultation document on the review was published on 23rd January, 2006, but there has been criticism from the renewable energy industry over the short time frame (3 months) available to respond to the consultation. See http://www.dti.gov.uk/energy/review/energy_review_consultation.pdf.

Commenting on the launch of the Energy Review Consultation Document, Philip Wolfe, Chief Executive of the Renewable Energy Association, said:

"*We welcome the promise of a serious analysis of the issues in energy policy. Ministers rightly remind us how complex the issues are, yet are consulting for just three months and promise new policy proposals by the summer. I hope that we will not end up with a quick and dirty energy policy that ditches the good work of the last Energy White Paper and has to be revisited yet again in a couple of years' time.*

The renewables industry will be pushing for a clean energy policy that takes the long view. We must close the so-called 'energy gap' before trying to fill it. The Government should start by doing more to promote energy saving. They should also firm up 2020 targets for new renewables production across all sectors. And they should stop thinking that energy policy is only about electricity supply and look to heat, transport fuels and demand reduction as well. Without this, they will leave a credibility gap even larger than the alleged 'energy gap'."

A public opinion poll published on 17th January 2006 by the Tyndall Centre for Climate Change, University of East Anglia, showed about a third of people surveyed thought that existing nuclear power stations should be replaced at the end of the stations' lives, with a similar number opposing their replacement. More than three quarters of people thought that renewable energy and energy efficiency were better solutions. However, the research found a degree of cynicism about the government's willingness to listen to public opinion: 6 out of 10 people surveyed said it did not matter what the public thought of nuclear power because the plants would be built anyway. Kevin Andersen, research manager at the Tyndall Centre said, "*Nuclear power is not an answer to climate change. Instead the government should look at ways of countering the UK's rising energy demand, such as enforcing higher efficiency standards on buildings, electrical goods and vehicles*"

The pro- new nuclear position is represented by the views of Sir Bernard Ingham, ex-Prime-Minister Margaret Thatcher's Press Secretary and Secretary of SONE, Supporters of Nuclear Energy:

"After nearly 50 years' experience in Britain of safe nuclear generation of electricity, we know that nuclear power can provide long term security for the nation.

We also know that expectations of the energy to be derived from renewable sources - wind, waves, tides, solar, hydropower etc - look ever more optimistic. So, too, do the savings to be secured from energy conservation, given the steady but relentless increase in electricity demand.

Nuclear is crucial to meeting Kyoto commitments to reduce greenhouse gas emissions. Currently, nuclear generates more than a fifth of our electricity and so avoids the annual emission of some 50m tonnes of carbon dioxide, the main greenhouse gas.

Greenhouse gas emissions in Britain have been rising over recent years - just as nuclear power stations are beginning to close on grounds of age. On present plans, nuclear's contribution to British electricity supplies will have dwindled by the early 2020s from over 20% to a mere 3%.

An increasing number of distinguished organisations have highlighted the dangers of a decline in nuclear output - The Royal Society, The Royal Academy of Engineering and The Institution of Civil Engineers. Others are becoming concerned about the security of energy supplies if we are ever more reliant of imported natural gas.

For all these reasons SONE believes that the steady development of nuclear energy is the only way forward."

Sir Bernard Ingham is very active in lobbying and promoting the pro-nuclear case. In a recent press release (5th Jan 2006) he wrote:

"At present coal (33%) and nuclear (20%) generate just over half of our electricity. But both coal and nuclear power stations are ageing and will be progressively closed. The demise of coal, the dirtiest British method of generation, will be hastened by EU environmental regulations and nuclear's by prejudice. Government projections forecast nuclear's output will fall to seven per cent by 2020. Another 13% of coal generation could also go in the same period. Yet, as things stand, there are no plans to replace the quarter of our electricity supplies so lost.

Not even starry-eyed optimists expect renewables – effectively only subsidised wind power – to come anywhere near to filling a gap of 15-20% opening up between supply and demand. After 15 years' development wind still produces only 0.5% of our power. Energy conservation is doing nothing to stem the relentless increase in demand for electricity by 1-1.5% a year

So how are we going to get the electricity we need to maintain our civilisation? The obvious answer is by importing more and more gas at unknown but almost certainly escalating prices from unstable parts of the world such as Russia, the Middle East, Algeria and Nigeria. In fact, current energy policy, such as it is, contemplates importing at least 80% of our energy in the form of gas.

In spite of Kyoto, carbon dioxide (CO_2) emissions have been rising for at least three years. So, scientists came up with the idea of burning more coal by pumping CO_2 from power stations into strata under the North Sea. They forget to tell you this "sequestration" would do nothing about CO_2 emissions from industry, homes and transport, which represent 70% of the total.

In short, British energy policy, such as it is, is failing heroically on all counts. No wonder the government is reviewing it. It knows longer term security of supply is to be had from nuclear power. Nuclear has proved itself safe – not a single death from a radiation accident – reliable, competitive and clean over 50 years. It has no problems over uranium supplies or in disposing of its waste. All it needs is for the government to designate a site for its waste's long-term storage."

The case against new nuclear power stations is expressed by the environmental NGO Friends of the Earth:

"*There is a very basic error that considerably overstates the ability of nuclear power to play a meaningful role in achieving energy security and in reducing carbon dioxide emissions. Nuclear power, for instance, would not replace gas for heating nor petrol and diesel for transport purposes. Even a doubling of the UK's nuclear power programme, at a huge financial cost, would only reduce greenhouse gas emissions by around 8%.*

Any so-called 'electricity gap' in the UK could not be filled for another 10 years because of the long lead in and construction time required for new nuclear build. It could, however, be filled by energy efficiency, renewable and non-nuclear low carbon sources of energy."

<u>Gas-Fired Power Stations</u>

Other options are also available for cost-effectively filling this 'electricity gap', while reducing carbon dioxide emissions. New gas-fired power stations, which could be constructed within 30 months, are likely to make an increasing contribution while displacing dirtier coal-fired generation elsewhere on the grid. It is an exaggeration to state that the sources for this gas will be some of the most politically and economically unstable countries in the world. The UK's chief supplier of imported piped gas for the foreseeable future will be Norway.

<u>Cleaner Coal</u>

Coal-fired power stations could be retrofitted with super-critical boilers and other efficiency-improving equipment, which can reduce carbon dioxide emissions per unit of electricity generated by almost forty per cent, while further emission reductions could be achieved by co-firing with biomass.

<u>Combined Heat and Power (CHP)</u>

The huge potential of the very efficient combined heat and power (CHP) systems, which use the heat that is normally wasted in electricity generation, is largely untapped in the UK. By comparison, the bulk of electricity in Denmark comes from CHP units. Whereas conventional power stations only convert an average of

35% of the energy in the fuel to electricity, CHP systems can achieve 90% efficiency with significant reductions in carbon dioxide emissions.

Costs

It is mystifying to see the CBI, (note Confederation of British Industry) an organisation that champions free enterprise, lobby for an energy source that has always been costlier than promised, has failed to attract private investment and has always had to rely on state subsidies. The billions of pounds in subsidies that nuclear power has gobbled up in Britain is a far cry from the original promise that it would be an electricity source that would be "too cheap to meter". On the 27th November 2005 the Sunday Times reported that the Government's pro-nuclear chief scientific advisor, Sir David King, has suggested putting a levy on consumer's power bills to help pay for the extra costs of nuclear power. In an interview with the Financial Times (26th October 2005) Energy Minister Malcolm Wicks indicated that the government would not rule out extending the Renewables Obligation to nuclear power. Unless the RO targets were expanded dramatically, the large existing nuclear capacity would squeeze out the support needed to develop the renewable energy sector.

Nuclear Waste

One of the financial barriers to nuclear power is the problem of waste. No solution has been found to safely dispose of this hazardous material, and the Nuclear Decommissioning Authority has estimated that dealing with the existing waste from civil nuclear power is likely to cost the UK taxpayer almost £60bn. This material will remain hazardous and have to be safeguarded for tens of thousands of years. Although less waste is likely to be produced by the proposed new nuclear reactors, it will pose a similar problem, as it will contain a higher proportion of high-level radioactive waste.

Security of Supply

Nuclear power is also unlikely to meet the CBI's requirement of providing a secure and competitive energy supply. The security of supply of electricity from nuclear power has always been undermined by technical problems resulting often in lengthy and costly shutdowns. The Wylfa power station, for instance, has only operated at around 56% of its full capacity since it opened.

Terrorism

To this must be added a further threat to security in the form of terrorism attacks against nuclear facilities and transports. It is worth noting that the 9/11 Commission in the United States found that the masterminds of the terrorist attacks of Sept 11th, 2001, had considered flying planes into nuclear power stations. UK has experienced a number of terrorist attacks, fortunately not on nuclear installations yet.

Proliferation

Should the UK embark on a new build-nuclear programme, supposedly to reduce the emission of greenhouse gases, it would prompt other countries to follow suit. Already, the Iranian ambassador to London has claimed that his country's nuclear power programme will aid the implementation of the Kyoto Protocol. Iran and North Korea demonstrate the dangers posed by the short and tempting step that exists between civil and military nuclear programmes.

Radioactive Discharges

The possibility of nuclear proliferation also increases both the problems of routine radioactive discharges to the atmosphere and seas and the likelihood of nuclear accidents. Radioactive contamination from Sellafield can be found throughout the Irish Sea and restrictions resulting from the radioactive fallout from Chernobyl in 1986 still affect 359 farms covering 53,000 hectares of land in North Wales. In May of 2005, it was revealed that 83,000 litres of a nuclear liquor, reportedly containing enough plutonium to make 20 nuclear weapons, had been leaking undetected for at least nine months from a badly designed pipe at the Thorp reprocessing plant in Cumbria, which is likely to be closed for 12 months or more for decontamination and repairs with a financial loss of £300m from repossessing contracts. It is difficult to comprehend how organisations like the TUC (Trades Union Congress) can refer to nuclear power as a "safe, reliable and clean" source of energy."

UK Nuclear Industry Structure

Major UK-based Nuclear Companies

British Energy Group plc
Through its subsidiary companies British Energy Generation Ltd and British Energy Generation (UK) Ltd, British Energy owns and operates the UK's 7 Advance Gas-cooled Reactors (AGR) and single Pressurised Water-cooled Reactor (PWR) nuclear power stations. It has been wholly in the private sector since 1996. British Energy has also diversified into non-nuclear energy activities in the UK (www.british-energy.co.uk).

British Nuclear Fuels plc (BNFL)
British Nuclear Fuels plc (BNFL) is a public limited company managed on a fully commercial basis and wholly owned by the Government. It provides a full range of nuclear fuel cycle and products and services to UK and overseas customers and owns and operates the countries 20 older, still operating, gas-cooled Magnox nuclear power stations: (www.bnfl.com).

UKAEA
The pioneer of nuclear energy in the UK, the company is today responsible for managing the decommissioning of its nuclear reactors and other radioactive facilities on its sites "in a way, which is safe and secure, environmentally responsible, provides value for money and is publicly acceptable" (www.ukaea.org.uk).

UK Nirex Ltd
UK Nirex Ltd was formed to provide and manage facilities for the safe disposal of radioactive waste in the UK It is owned by BNFL, British Energy and UKAEA (www.nirex.co.uk).

Urenco Ltd
The Urenco Group is a collaboration of companies overseen by the UK/Dutch/German governments. The Group's main activities are the enrichment of uranium for use in nuclear fuel and the development of centrifuge technology. Urenco Ltd is the UK registered holding company for the Group, in which the UK shareholder is BNFL. Urenco (Capenhurst) Ltd is Urenco Ltd's UK operating subsidiary. (www.urenco.com/index.htm/).

Nuclear Decommissioning Authority
The Nuclear Decommissioning Authority was established in April, 2005 to be responsible for civil nuclear waste clean up. Chairman Sir Anthony Cleaver said in a recent radio interview (File on 4, 14th June 2005) that the Authority's annual national clean–up budget is £2.2 billion.
He went on to say:

"*The Nuclear Decommissioning Authority is a non-departmental public body, set up in April, 2005 under the Energy Act 2004 to take strategic responsibility for the UK's nuclear legacy.*
Our core objective is to ensure that the 20 civil public sector nuclear sites under our ownership are decommissioned and cleaned up safely, securely, cost effectively and in ways that protect the environment for this and future generations.
We will lead the development of a unified and coherent decommissioning strategy, working in partnership with regulators and site licensees to achieve best value, optimum impact on local communities, and the highest environmental standards.
The NDA's main task is the decommissioning and clean-up of civil nuclear sites. If the Government decides it is necessary, however, the Energy Act 2004 allows the NDA to take responsibility for sites currently operated by, or on behalf of, the Ministry of Defence (MoD). Resources will then be transferred from the MoD to meet the costs of clean-up."

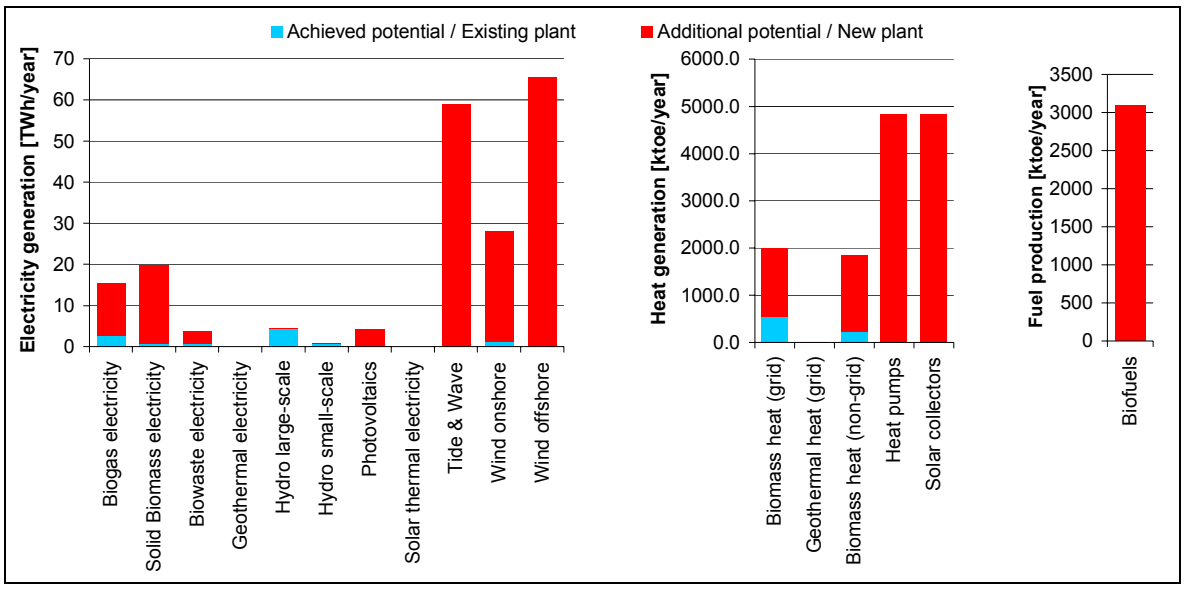
Note on Private Sector Nuclear Sites
Although private sector nuclear sites remain the financial responsibility of the operator concerned, the Energy Act acknowledges that the Government bears ultimate responsibility for the safe and secure decommissioning and clean-up.
If the Government decides that a private sector operator is unable to meet its decommissioning obligations, the NDA can be asked to take responsibility for managing the clean-up of the site concerned. In such circumstances, the operator would meet the full costs, or as large a proportion as possible – ensuring the cost to the taxpayer is kept to an absolute minimum (http://www.nda.gov.uk).

Note - On privatisation of the UK nuclear industry in the early 1990's , the older Magnox reactors were kept in the public sector and the 7 newer AGR's plus one PWR were sold to British Energy.

5.7 Outlook for Energy, for CO_2, and for Energy Imports

The European Commission (Country Profiles- COM 2004 -366 final) provides the following tables for mid-term potential of the UK renewable energy sector. The achievement of this potential will depend on the outcome of current energy and climate change policy reviews and on the development of improved support mechanisms. The additional potential is much higher for all technologies than existing plant, which highlights the challenge ahead for the UK. On the positive side, the UK has large onshore and offshore wind, tidal and wave energy resources.

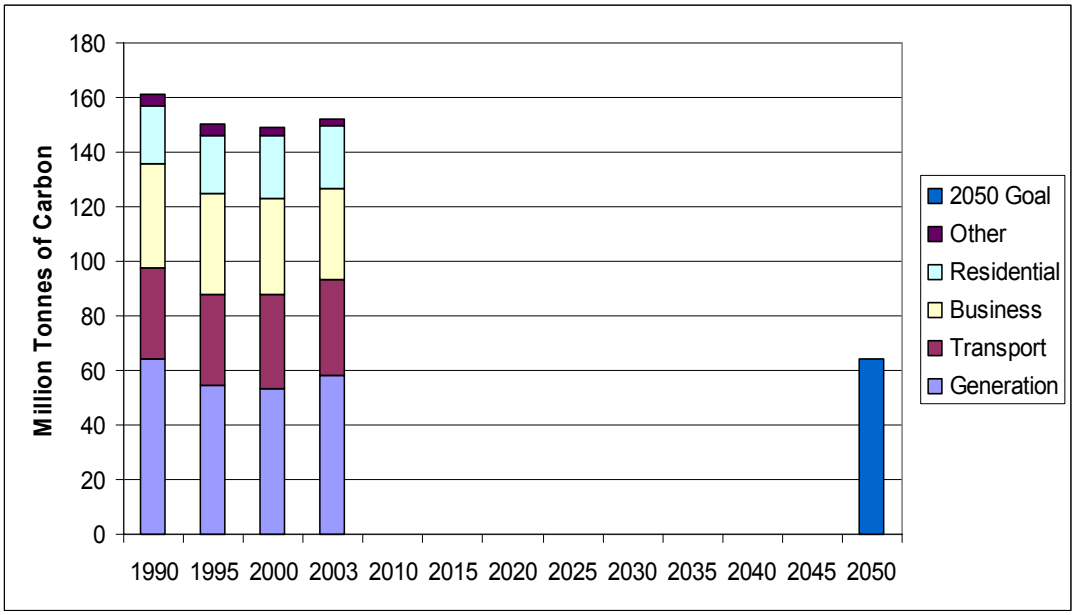
Figure: Mid-term potentials of RES electricity heat and transport in the UK. Source: EU 2004



The UK has improved considerably in energy efficiency. Carbon intensity has improved by 55% since the early 1970s, a rate of almost 2% per annum. Energy intensity has improved by 40% in that period, largely as a result of energy efficiency improvements, the trend away from coal to gas plant for electricity generation, and the shift in our economy from heavy industrial towards commercial and services sectors. There has been a similar trend in other countries.

It is also true that some of the reduction in energy intensity has been due to relocation of manufacturing to developing countries, therefore CO_2 emissions are not reflected in the carbon budget of the country importing the manufactured goods.

Figure: UK historical CO_2 emissions and 2050 target. Source: dti



Professor Michael Grubb is a leading international researcher on the policy responses to climate change and energy policy including renewable energy sources. He is now Associated Director of Policy at the UK Carbon Trust and a Visiting Professor at Imperial College, London. In a recent submission to the UK Stern Review on the economic impacts of climate change, he takes a cautious but optimistic view of prospects for dealing with climate change in the medium term:

"To conclude, our analysis of emission prospects, impacts and mitigation economics has presented evidence that:

- *Global emissions will rise rapidly without responses that change investment incentives in both industrialised and developing countries; the resulting impacts of climate change could seriously affect human welfare, particularly but not exclusively in developing countries.*
- *There remain extensive opportunities for emissions mitigation policies that need not incur significant economic costs, will not threaten industrial competitiveness, and will help to accelerate development and diffusion of low carbon technologies.*
- *Climate change is a century-long policy challenge, and tackling it carries opportunities as well as potential costs. It is important not to let what appears to be politically possible at one point in time limit our horizons only to options that are demonstrably inadequate. The logical structure of solutions must be to take the steps we can, to work with those that are similarly willing to take meaningful and effective action, and on this basis to evolve regimes that can in principle solve the problem. In combination with demonstration, incentive and deterrent effects, it is this that will over time make it possible to expand participation in effective solutions."*

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6 The Czech Republic

6.1 Current Energy Status

The Czech Republic, with its population of 10.2 million, was established in 1993 after the split of Czechoslovakia. The country historically consists of Bohemia and Moravia, which are divided into 13 administrative regions, plus the city of Prague (1.2 million) as its own region. The Czech currency, the krown (CZK), is continually getting stronger (together with the Polish, Hungarian and Slovak currencies) and has an exchange value of 28,4 CZK=1 EUR as of January, 2006. The gross domestic product (GDP) in 2004 was estimated at 2,768 billion CZK and is expected to grow by 4% - 5 % during 2006. The Czech Republic became an EU member in 2004 and was also the first post-communist member of the Organization for Economic Cooperation and Development (OECD) in December, 1995.

6.1.1 Energy Policy and Regulation

The Czech Republic, like all former post-communist states, is undergoing structural changes of its economy. The process of transformation of its energy sector proceeded throughout the 1990s and has been the main priority for all state energy policies so far. The transformation of the sector has advanced considerably. Thanks to the high levels of investment into the energy facilities, the environmental burden has also dropped. At the present time, the Czech Republic has no difficulties in maintaining its limits on emissions of all pollutants.

Basic energy legislation on energy issues is covered by the Act No. 458/2000 Coll. (the Energy Act) and the key governmental document is the State Energy Policy (approved by Government Decision No. 211 of March 10, 2004). This document sets the following priorities:

- independence from foreign energy sources and from risky regions.
- Safety of energy sources, including nuclear safety.
- Reliability of supplies of all kinds of energy.
- Reasonable decentralization of all energy systems.
- Sustainable development, including environmental protection as well as economic and social development.

Legislation related to energy issues is fully in line with the EU directives and regulations, which were also the main driving force behind the latest changes of the national laws. With respect to the renewable energy sources, the accession of the Czech Republic to the European Union has boosted some activities, resulting in, among other developments, the adoption of the EU Directive 2001/77/EC on the promotion of electricity produced from renewable energy which, in the Czech Republic, takes the form of the law on support for use of these sources. This regulation is considered as the most progressive towards development of renewables among the legislative actions of new EU member states and was welcomed also by the environmental NGO community. For many experts, it can serve as the example to be followed by other post-communist countries.

The harmonizing of Czech energy sector standards with those in the EU and restructuring of fuel imports are among the priorities of Czech government. Fuel-base restructuring is oriented toward gradual replacement of coal as a source of heat and electricity and increasing use of co-generation. Nevertheless, the reduction of coal-mining activities is a highly sensitive social issue and all State Energy Policy scenarios still count coal as an important fuel; a few scenarios even include considerable increase of coal production. On January 1st, 2001, a new energy regulatory authority began operating in the Czech Republic. Its responsibilities include determining energy price rates that customers will pay and setting up the framework for third-party access to the electrical grid.

6.1.2 Energy Production and Consumption

It is important to mention that, with respect to its GDP, the country still consumes more primary energy sources and electricity than is objectively necessary; i.e., the consumed energy creates little added value. Despite the improvements during the last decade, in which energy intensity declined by 17% between 1990 and 2004, current energy and electricity intensity of GDP is approximately 60% higher than the EU average. The highest potential for energy savings and increase of efficiency is in the sector of industry and use of heat in the buildings.

End use of energy reached 1,744 PJ in the year 2004. This figure is considerably lower than it was in the early 1990s and is the result of structural changes of Czech economy. Nevertheless, energy consumption started to grow again in recent years by approximately 1% per year. In general, energy consumption per inhabitant is similar to the EU-15 average (see Table, below).

Table: Comparison of energy consumption in Czech Republic and EU.

	EU 15	Czech Republic
Primary energy consumption (GJ/inhabitant)	163.6	171.1
Electricity consumption (kWh/inhabitant)	6,719	5,886

Due to the large coal reserves, the dependence of the Czech Republic on energy imports is relatively low (approx. 32% of energy consumption), but its dependence on imports of oil, natural gas and nuclear fuel is virtually 100%. Energy commodities represent approx. 9% of total Czech imports at the present, with a trade balance deficit in energy commodities of 70-80 billion CZK. Diversification of the structure of consumption of primary energy sources will continue to increase, but the dependence on energy imports, according to the governmental figures, will grow even despite the promotion of indigenous and renewable energy sources. Energy prices (electricity and natural gas) have increased considerably since 1990, with an average annual rise of 13 - 15%. Recently, the typical Czech family spends around 9% of their household income on energy services.

6.1.3 Energy Sources

Oil

The Czech Republic has very low oil resources, with its reserves estimated to be less than 50 million barrels. Oil production in 2004, including natural gas liquids and other liquids, was around 4 000 barrels per day (b/d), while consumption of crude oil and petroleum products was on the level of 187,000 b/d. Future domestic oil production is expected to remain constant, but consumption is steadily growing.
The Czech Republic receives most of its oil through the pipeline Druzba from Russia (capacity of 73 million barrels per year). There are also a new pipeline, Mero, from Germany, and two other pipelines in operation. Two major oil refineries are located in Litvinov and Kralupy, which have a combined capacity of 51 million barrels per year.

Natural Gas

Despite some reserves of natural gas, the Czech Republic recently has been importing around 98% of its consumption. Moreover, this consumption was expected to increase by 5% - 7% per year. This is mainly due to the continual efforts to replace small coal-firing heating plants with cleaner gas-fired ones. Nevertheless, increases in the price of gas will probably reduce expected annual growth of gas consumption and we will see more orientation toward biomass, as in neighboring Austria. Most of the gas that was domestically produced comes from gas deposits near the Austrian border that are extracted by Medusa Oil & Gas, a unit of the British company Ramco. The Czech Republic also serves as an important transit route for Russian gas going to Germany, Austria and France. The company Transgas, responsible for import, purchase, sales, and distribution of natural gas in the Czech Republic, was sold in January, 2002 for 3.64 billion USD to German RWE Gas. RWE Gas also received large stakes in the eight regional gas distribution companies. Czech natural gas demand is met primarily by imports from the Russia, with lesser amounts from Norway and Ger-

many. Despite the 20-year contract for deliveries of Norwegian gas, the main supplier will be Russia with almost a 75 % share of imported gas.

Coal

In the past, coal combustion for power production created huge amounts of environmental damage in several locations, e.g., in the so-called "Black Triangle" between Northern Bohemia, Poland and Germany. All coal power plants have been equipped with flue-gas desulphurisation and even the countryside damaged by the activities (including mining) is now being restored to acceptable levels. Despite strong environmental concerns, coal remains a significant fuel source in the Czech Republic. Recently, it represents almost half of the primary energy consumption. While the Czech Republic has some coal and lignite reserves, most are not suited for mining expansion due to environmental and economic factors. Total recoverable reserves are estimated at around 6 billion tons. Coal is exported primarily to Slovakia, Germany, and Austria. State-owned coal-mining companies have been privatized into six joint-stock companies, but they are not very lucky with the decision of the Czech government to restrict (limit) coal production. The issue is subject to heavy discussion among operators of mines. In the past, inefficient mines have been closed down and environmental regulations have been enforced. All of that resulted in considerable job cuts in mining regions. These events were part of the Czech effort to bring the industry into compliance with EU standards. It is not clear yet how the coal industry will evolve in the future. Despite proclaimed downsizing of the industry, there are ongoing attempts by some politicians and lobbying groups to cancel the limits on coal production.

Nuclear Power

Nuclear power has a strong position in the Czech Republic. There are now 6 reactor units in operation. Four 440 MW units are located at Dukovany (in operation since 1985-1988) and two new 1,000 MW units are in Temelin. Both locations are close to Austrian border, which was the reason for heavy protests of the Austrian public, supported by also by the anti-nuclear Austrian government. In 2004, Czech nuclear power plants produced 26.3 TWh (Temelin 12.69 TWh, and Dukovany 13.63 TWh).

Renewable Energy Sources

Production of energy from the renewables is still very low and covered 2.9 % of total primary energy consumption in 2004. The share of renewable electricity was 4 % and both figures do not show any increase in recent years. Nevertheless, Czech government is trying hard to change this situation by adopting new legislation and introducing financial support mechanisms for the renewable energy sources.

Even despite the governmental support, the very latest figures show that in the first half of the year 2005, the share of renewables on electricity production decreased by 5.8% (total production of 764 million kWh). The main cause was the decline in co-firing of biomass and coal (70% less compared to the figures from year 2004) by the leading power producer, CEZ. By this step, CEZ responded to the reduction of feed-in tariffs set by the state energy regulatory authority. On the other hand, CEZ was able to increase production in its hydro power plants by 2.7 % (735 million kWh). All of that increase was provided by large hydro and was achieved by higher utilization of hydro power plants. Hydro power production was reduced in 2004 mainly due to large flooding in Czech Republic. Quite considerable increase of power production was achieved in wind power plants (42 % rise) and a negligible rise was reached in solar power with total production of 5 000 kWh in first half of the year 2005. The following table shows the development of RE electricity in the Czech Republic (GWh).

Table: Development of electricity produced from the renewables in Czech Republic.

	2000	2001	2002	2003	2004
	GWh				
Hydro power	2,313.0	2,467.0	2,846.0	1,383.0	2,019.0
Other RE (mostly biomass)	0.4	0.2	1.6	495.0	752.0
Total	2,313.4	2,467.2	2,847.6	1,878.0	2,771.0
Share of domestic electricity consumption	3.7%	3.8%	4.4%	2.8%	4.0%

The highest share among renewable energy sources was in hydro power plants (2,019 GWh). Next was biomass, in which an important role in electricity production was played by the pulp and paper industry (296 GWh). Electricity produced in this industrial sector was practically all consumed on-site. An important part of produced power was generated from biogas as well (139 GWh). Wind and solar power did not play any role in energy statistics in 2004. Nevertheless, the development of wind power showed strong growth in 2005, and due to the number of project proposals, it will increase its share in the near future.

Biomass
Around 414,000 tons of biomass were used in 2004 for the production of electricity. It is an increase of 143.5% (over 244,000 more tons than in 2003). The whole increase was generated from wood waste, sawdust and wood chips (increase by 191,000 tons).

Biomass was also used for heat production (16,980 TJ). Out of this, 89 % was used on-site at production facilities and only 11% was sold to third parties. Wood chips, sawdust and wood waste were the most used bio fuels, and their total amount reached 865,000 tons in 2004, an increase of about 60,000 over the previous year. There were 36 towns and villages that used biomass for heating purposes, mainly in municipal district heating systems. The biggest biomass project realized in 2004 was a 1,100 MWth heating plant in Brno-Bystrc municipality.

Biogas
Almost 95,369,000 m^3 of biogas was used for energy purposes in the year 2004, an increase of 23.5 % in comparison to the previous year (77,220,000 m3). The largest share comes from biogas produced at municipal water treatment facilities but there is also growing interest in building biogas facilities using agricultural wastes.

Hydro power
Hydro power seems to be fully developed in the Czech Republic, and there are no plans to build new hydro power plants until 2030. It is mainly due to the geographical conditions, which provide fewer opportunities for utilization of this resource in the Czech Republic than, e.g., in neighboring Slovakia. Most Czech hydro power plants are located on the river Vltava. There are also four pumped storage hydro power plants, of which the facility Dlouhe Strane is the largest (325 MW). This facility also contains the largest reversing water turbines in Europe. The total generated electricity in hydro power plants was 1.8 TWh in 2004. Some unused potential still exists in small hydro power development, of which there is a long tradition in the Czech Republic.

Wind Power
The development of wind power was substantial in the year 2005, with a lot of new projects under preparation. There were 48 wind power plants in operation at the end of the year 2004 with a total installed capacity of 16.4 MW. Total windpower production was 9.9 GWh. Average annual utilization was 12%. In 2005 the capacity increased to 26 MW.

Solar electricity
At the end of 2004, installed capacity in photovoltaic (PV) systems was 126.3 kW with annual electricity production of 77.3 MWh. This figure is practically negligible in domestic energy statistics and despite attractive feed-in tariffs there were no major projects under preparation in 2005. The largest systems were operating at University in Ostrava (20 kWp). One 10 kWp system was also installed by CEZ at their nuclear power plant in Dukovany. In the framework of the program „Sun into Schools“, several 1.2 kWp systems were also installed.

Solar Heat
According to the ministry of Industry and Trade, the total area of solar collectors in the Czech Republic was 50,000 m^2 at the end of 2004. The share of vacuum collectors was 5 %. Since 1990, the total area of domestically produced solar collectors is estimated at 124,000 m^2. In 2004, production reached 8,780 m^2, of which 6,742 m^2 were exported. The total number of solar heating systems is estimated at 5,500.
the following table shows the shares of different RE sources in 2004.

Table: Utilization of renewable energy source in Czech Republic in 2004.

	Heat production	Electricity production	Primary energy	Total energy from RE	Share of RE on PE*	RE share
	PJ				%	
Biomass (excl. households)	18,439.7	4,155.1	-	22,594.8	1.17	40.42
Biomass (households)	19,500	-	-	19,500	1.01	34.88
Hydro power plants	-	-	7 269,8	7,269.8	0.38	13.0
Municipal waste	2,452.3	52.9	-	2,505.3	0.13	4.48
Biogas	1,288.1	814.3	-	2,102.4	0.11	3.76
Liquid biofuels	-	-	1 313,0	1,313.0	0.07	2.35
Heat pumps	-	-	500	500	0.03	0.89
Solar thermal	-	-	82	82	0.00	0.15
Wind power	-	-	35.5	35.5	0,00	0.06
Photovoltaics	-	-	0.28	0.28	0,00	0.00
Total	41,680.2	5,022.2	9,200.6	55,903.1	2.89	100

* PE = Primary energy

Electricity Market

Generation of electricity in the Czech Republic, which is export-oriented, was up by 1.3% from the year 2003 and reached total of 84.3 TWh in 2004. Compared to 2003, demand for electricity in 2004 increased by 2.9% and reached a total of 56.39 TWh. All customer groups contributed to the increased demand. Electricity consumption is projected to rise steadily, much of it from increased demand by small-scale consumers, primarily households.

The Czech electricity market is fully liberalized now, and since January 1st, 2006, all consumers, including households, have the opportunity to choose the provider of power. According to the experts, there will be no big interest in this option, because competition on the electricity market is poor and people are not well informed about this possibility.

It is expected that the Czech power industry will be strongly oriented toward exports until 2010 with its base load capacity of around 17,300 MW (12,100 MW in CEZ utility).

Electricity Prices
Electricity prices are regulated by the state energy regulatory authority. Prices are controlled by the authority on the cost-plus principle. This means that the supplier's price may only reflect economically justifiable costs related to energy production and distribution, along with reasonable profit based on the relevant price regulations.
There was a sharp increase in price for the industry in 2004, and further increases towards the standard European level are expected in the near future. Due to the high share of exported electricity, the German economy plays a key role and is influencing Czech prices. The ministry of industry expects a rise of 2005 electricity

prices of up to 26% by 2010. The price of electricity for the Czech industry and service sector (60.1 EUR/MWh), was lower by 10.7% compared to the EU average in the first half of 2005.

Since January 1st, 2006, Czech households have also the opportunity to choose "green electricity" from CEZ power utility. This power will be more expensive by 0,1 CZK/kWh and will be produced from all energy sources, including fossil and nuclear. The profit from this sale will be used by CEZ to finance future renewable electricity projects.

CEZ Group

The most important player on the market with electricity is the commercial company CEZ Group, in which the Czech government holds all shares. The company is really a pillar of the Czech economy. The CEZ Group is the most profitable power company in Europe (with the highest profitability growth) as well as the least indebted power company. CEZ Group offers and sells electricity on the wholesale market. The majority of electricity is being sold on the domestic market; a significant portion goes to export, which makes CEZ Group the second greatest electricity exporter in Europe, with EdF (the French power company) being the first one. CEZ Group is also the ultimate supplier of ancillary services for the Czech transmission system and is one of the biggest heat suppliers in the Czech Republic. Their power production reached 62.1 TWh in 2004, with the majority coming from nuclear and coal power plants. Financial results for 1st through 3rd quarters of 2005 are also impressive. Net income grew 26.8% to CZK 14.1 billion (up CZK 3.0 billion) and the full-year forecast also improved to CZK 17.2 billion.

The CEZ Group aims to play a significant role on the European electricity market. With its 6.6 million customers, it is the 8th largest power company in Europe and the 10th according to installed power capacity (12,297 MW). The key ambition of the CEZ Group is to become the leader on the electricity markets of Central and South-Eastern Europe. CEZ Group also has become the owner of 51% of the Romanian distribution company Electrica Oltenia. Over the period from January, 2005 to the end of September, 2005, the price of CEZ shares on the Prague Stock Exchange increased by 117.0% (from CZK 341 to CZK 739). In September, Moody's credit rating agency upped the company's rating from A3 to A2, leaving the outlook at stable.

Electricity generation is the primary element of the activities of the CEZ Group. At present, the CEZ Group operates 2 nuclear power plants, 11 coal power plants, 35 hydro power plants, including 4 pumped storage, 2 locations with wind power plants, and 1 photovoltaic (solar) power plant.

Until April, 2003, CEZ, a. s., was the sole owner of CEPS, a. s., the operator of the Czech transmission grid. Under the unbundling process, however, a 66% share was sold to the Czech state and state-owned entities and the 34% remainder was sold at the beginning of September, 2004. The electricity distribution companies incorporated into the CEZ Group during the energy sector integration process do not just distribute electricity to the final consumers, but also trade it, thus playing an essential role in the entire energy distribution chain. CEZ is majority owner of regional electricity distributing companies in Severoceska energetika (SCE – North Bohemia Energetics), Severomoravska energetika (SME – North Moravia Energetics), Stredoceska energetika (STE-Middle Bohemian Energetics), Vychodoceska energetika (VCE- East Bohemian Energetics) and Zapadoceska energetika (ZCE – West Bohemian Energetics). So, except for South Bohemia and South Moravia Energetics companies, which are owned by the German E.On, CEZ controls power distribution and sale practically in the whole Czech Republic.

Four years ago, the Czech government indicated its intent to sell CEZ, including transmission and generation assets (also two nuclear power plants), to one buyer. But the plan was postponed last year and there has been no discussion on this issue since then. Originally, it was supposed that the sale would improve the results of CEZ and that it would bring around 300 billion CZK to the state budget, but looking at the impressive economical performance of CEZ it seems that there is no reason to sell the company now. Moreover, the whole Czech economy is growing, and with a huge inflow of foreign investment, there is no urgent need for sale (in contrary to, e.g., Slovakia, where the government sold Slovak power utility SE a.s. to Italian ENEL just to cover the holes in budgets).

Heat Market

Heat consumption was 374 PJ in 2004, where more than 30% was produced by centralized heating systems, for which coal is still the main fuel source. Despite the fact that natural gas was considered as the replacement fuel for coal, during the last two years we can see huge increase in biomass utilization. In the Czech Republic, as well as in other Central and East European countries, the large district heating plants were originally owned by the former state power utility or by the industrial companies (independent power and heat producers supplying primarily their own industrial facility as well as other customers). The major restructuring of the heating industry started early in the 1990s, when state control of district heating utilities was transferred to other stakeholders, municipal and private. Now the state does not control any interests in municipal district heating utilities anymore (the exception is power utility CEZ Group).

The district heating utilities in the Czech Republic are currently owned and operated by large multinational companies, local private companies, and by local municipalities. In several cases, the infrastructure ownership is controlled by the municipality and the operation is contracted to a private entity, or the infrastructure is leased to a private operator, or the municipality remains in control of the distribution and heat generation is in private hands. In general, there is a good experience with restructured district heating utilities.

Table: The development of the overall energy balance in the Czech Republic.

	1995	**1999**	**2000**	**2001**	**2002**	**2003**
	PJ					
Natural resources	**1,409.8**	**1,156.1**	**1,246.7**	**1,250.7**	**1,258.2**	**1,344.7**
Solid fuel	1,253.6	985.4	1,078.4	1,082.1	1,029.0	1,037.8
Liquid fuel	6.1	7.7	7.4	7.7	11.1	13.3
Gaseous fuel	8.6	7.4	7.1	5.2	4.8	5.3
Primary heat & electricity	141.5	155.6	153.8	155.7	213.3	288.3
Imports	**726.1**	**744.2**	**728.3**	**773.8**	**785.3**	**810.0**
Solid fuel	63.3	40.9	45.0	46.5	46.5	54.0
Liquid fuel	350.7	354.9	333.5	366.1	367.5	390.6
Gaseous fuel	270.0	316.1	318.3	327.5	337.1	329.1
Exports	**397.3**	**361.8**	**338.5**	**342.7**	**345.9**	**357.0**
Solid fuel	341.0	266.4	229.7	223.3	218.5	204.7
Liquid fuel	33.6	49.9	39.9	49.2	50.3	53.9
Gaseous fuel	0.0	1.2	1.5	2.0	1.9	3.8
Inventories balance	5.1	45.8	3.8	14.7	2.2	0.6
Other resources	5.7	36.6	16.4	-3.4	5,0	5.1
Primary resources, total	**1,749.7**	**1,620.9**	**1,656.7**	**1,693.1**	**1,704.8**	**1,803.4**
Solid fuel	1,005.8	824.6	906.4	916.4	887.3	892.5
Liquid fuel	321.6	325.6	314.7	316.6	313.3	349.0
Gaseous fuel	279.3	326.9	317.8	338.7	331.9	332.0
Primary heat & electricity	143.0	143.8	117.8	121.4	172.3	229.9
Total losses	**594.5**	**561.5**	**623.4**	**614.2**	**639.2**	**694.2**
Fuel mining & preparation	22.1	13.2	13.4	13.7	14.0	11.1
Fuel upgrading	68.4	38.9	40.9	41.7	43.1	44.9
Heat production	78.8	53.3	62.4	53.5	45.7	45.0
Electricity production	388.2	420.4	469.3	460.3	487.9	547.3
Energy distribution	37.0	35.7	37.4	45.0	48.5	45.9
Final consumption, total	**1,091.3**	**1,039.4**	**1,002.6**	**1,056.6**	**1,049.8**	**1,083.9**

6.2 Renewable Energy Policy

6.2.1 Promotion of Electricity and Heat Produced from Renewable Energy Sources

The Czech Republic has set the objective of achieving the minimal share of 8 % of renewables in gross electric power consumption and at least 6% share of renewables in consumption of primary energy sources by the year 2010. The target for the electricity was part of the negotiating deal before joining the EU in May, 2004. Basically it means doubling of recent figures, and that was also the purpose of the EU directive on power production from renewables.

This task is a really difficult one and e.g., Slovakia, which similarly accepted doubling its shares of renewables, has subsequently reduced its targets to almost no increase of renewables by 2010 at all. (EU targets are only indicative, i.e., voluntary). Moreover, the Czech Republic is recently a huge exporter of electricity with overcapacity, so there is no real need for new power plants. The questions as to whether it is possible to fulfill these goals and at what costs have been raised quite frequently by Czech officials and energy experts in recent times.

The Ministry of the Environment, in its document entitled „Drawing up the prognosis of renewable energy sources use in the Czech Republic until 2050“, came to the following conclusions: both these goals are technically feasible, their attainment can only be limited by the financial demands of generating energy from renewable sources. If sufficient stimulation mechanisms for potential investors are ensured, both goals can be fulfilled.

Recently the price of heat produced from renewables seems to be more competitive than the price of the electricity from renewables. Especially biomass (waste wood) is in the position to substitute for coal or natural gas, in many places even without any subsidies. On the other hand, substantial support for power production from renewables is necessary.

In order to meet the electric power generation goal in line with the latest version of energy policy, it is necessary in 2010 to generate a total of 6.57 TWh from renewable energy sources. According to the projected outputs, average costs for electricity generation from renewable sources with this production scale are CZK 3.23/kWh. The calculations of the task force have revealed that to achieve the objective it will be necessary to use most of the technologies available at present. Under the presumption that construction of new sources will proceed from the cheapest to more expensive sources, potentials of hydro power (small hydro), energy from landfill gas, biomass, biogas from wastewater purification plants and agricultural products will gradually be utilized. Due to the fact that Czech Republic is an inland country without any sea shores and with higher wind velocities, most of the appropriate places for wind utilization are located in mountain areas and quite frequently are far from the power grid. Nevertheless, in the above-mentioned document, wind power is expected to account for more than half of the electricity generated from renewables in future. All areas with wind velocity exceeding 6 m/s and, partially, some areas below this limit, should be used. The expected power production costs are 4.50 CZK/kWh.

Reaching the goal related to the share of renewables in primary energy consumption by 2010 will in total require the generation of almost 106 PJ of energy from renewables. Costs for energy production have been estimated and the average price of thermal energy from renewables is approximately 210 CZK/GJ. Technically, this potential can be covered by heat production from biomass, generation of heat originating during electricity production and from biogas at wastewater treatment plants or from landfill gas.

6.2.2 Energy Policy towards Renewables

National Energy Policy set an objective with a very high priority focusing on renewable energy sources. All types of renewable sources will be supported – solar, wind and hydro power, geothermal energy and biomass for production of electricity, heat and also used in transportation.

Recently there is a long list of state-supported mechanisms aiming at higher penetration of renewables but the most important of them is the law on support for the use of renewable sources which presents comprehensive legislative measures to ensure conditions for the fulfillment of the indicative (i.e., voluntary) target of producing electricity from renewables.

Law No. 180/2005 on Support for the Use of Renewable Sources
This crucial law was passed by the parliament of the Czech Republic on March 31, 2005, but interestingly was never signed by the president Vaclav Klaus. He also did not veto it, so it came into force anyway on June 1st , 2005. The president is a strong supporter of market mechanisms and opposes any kind of state intervention or state support - which is actually the core of the new renewable-energy-oriented law. His position against the support of renewables was strongly criticized by the NGO movement and lately was not accepted by the governmental social democrats. The new law supports electricity generation from renewable sources including landfill and sewage gases, as well as electricity generation from methane from shutdown mines. This law creates the basic preconditions for investors who consider developing electricity generating plants based on renewables in the Czech Republic. Unfortunately the law does not cover the support of renewable energy sources for heating purposes.

The law anchors support not only for generation of electricity supplied to the grid but also for generation of electricity for one's own consumption. Producers can choose one of the two forms of support: either sale of electric power to a regional distributor for guaranteed feed-in tariffs or sale of electricity on the market for the current market price provided that the regional distributor pays the extra so-called green bonus to the producer. Support but only in the form of green bonuses also applies to biomass co-firing (usually with coal), or cogeneration of electric power from both renewable and fossil fuels.

Electricity producers are provided with the possibility to change the form of support every year. In both instances, the support is financed by the respective operators of regional distribution networks, which project these expenses into their electricity costs.

According to the law, the feed-in tariffs can be reduced by the state regulatory authority annually only by maximally 5%. On the other hand, green bonuses can be set annually according to the market needs and development. In principle, the support by means of green bonuses (after inclusion of the market price obtained) should be somewhat higher than the support by means of feed-in tariffs.

The law does not determine either the actual level of feed-in tariffs or green bonuses; however, in the case of new facilities, it guarantees the support over the period of the next 15 years. Feed-in tariffs for newly installed facilities are announced annually by the Energy Regulatory Authority; nevertheless, from 2007 onward, they must not be lower than the feed-in tariffs in the previous year. The Energy Regulatory Authority will thus have certain scope for independent determination of the level of support, practically only in the case of green bonuses for electricity generated from biomass co-firing.

Table: The current level of electricity feed-in tariffs and green bonus for new plants commissioned after 1. January 2006.

Type of renewable source	Minimum electricity purchase prices	Green bonuses
	CZK/kWh	
Small hydro power stations on new sites (less than 10 MW)	2.34	1.43
Biomass	2.29–2.93	1.32–1.96
Electricity generation from landfill gas	2.23-2.98	1.26-2.01
Biomass co-firing	-	0.54-1.18
Electricity generation using wind energy	2.46	2.02
Electricity generation using geothermal energy	4.50	3.64
Electricity generation using solar radiation	13.20	12.59

Besides this law and price regulation, there is also in place the National Program for Economical Energy Management and Use of Renewable and Secondary Energy Sources for 2006-2009. In comparison to the previous program, there is a threefold increase in funding over that of the recent period.

National support for electricity production from renewable energy sources can be summarized in the following ways:

- Preserving the existing principle of a priority right for connection to the transmission or distribution system and the priority right to transport of electricity via the transmission or distribution system.
- Preserving the right to obligatory purchase of electricity produced from renewable sources (regulated prices).
- A system for issuing guarantees of origin of electricity produced from renewable energy sources.
- A system of tradable green bonuses of electricity produced from renewable energy sources with regulated prices of bonuses and obligatory quotas for their purchasing by those suppliers that are defined in the law.
- Guaranteeing the minimum amount of revenue for a unit of produced electricity to investors in renewable energy sources for the period of at least 15 years from the date of putting the source into operation.

Financial Support for the Renewables from EU Structural Funds

One important fact for investors preparing projects utilizing renewable energy sources is that it is possible to receive financial assistance in Czech Republic through EU structural funds. Especially Operation Program Industry and Enterprise under the measure „Energy Intensity Reduction and Use of Renewable Energy Sources“ offers the unique opportunity to finance renewable energy projects. Support from this program can only be received by business subjects that fall within the category of small and medium-sized enterprise according to the EU definition and do business in the sector of the processing industry and industrial services. Excluded from support are producers and distributors of district heating, electricity and gas and other subjects outside the processing industry. Unfortunately, projects that would serve the public sector (heating of residential houses, schools, health facilities etc) are not entitled to assistance from this program. No support is intended for subjects based in Prague, owing to the fact that the city's economic performance exceeds the limit for gaining support, i.e., the region's GDP is higher than 75 % of the EU average. The maximum level of support can be up to 46.6 % of acknowledgeable project costs, a maximum of 30 million CZK per project.

6.3 Recent Development of Renewable Energy and Outlook 2030

The Czech Republic was not very successful with respect to the development of renewables until now. All of that has to be changed by the adoption of new law on renewables and strong commitments by the government in the energy sector. The only important sources of renewable energy that were used on a relatively larger scale were hydro power, with its development started several decades ago, of which the potential is almost used now; and the traditional biomass (waste wood) used mostly by the industry (heat and electricity production) and households for heat purposes. The utilization of other renewables like wind or photovoltaics was or still is practically an unknown area of energy production.

Biomass

A real boom is now going on in the sale of biomass-firing boilers for households. Most of the producers report that they are not able to meet the demand, which sharply increased after the rise of the price of natural gas. A similar situation appeared also in Slovakia where many families living in single family houses decided to cut off the natural gas pipelines and substituted the gas boiler for biomass boiler. The heating cost can be reduced by more than 50% by this way.

Larger boilers intended for municipal district heating systems are being developed as well. This way, which is very popular in neighboring Austria is influencing the development in the Czech Republic now. Higher investment costs (several million CZK) can be substantially reduced by the grant (up to 75 %) from the Ministry of local development of the Czech Republic.

Due to the higher interest in biomass fuels (waste wood, pellets, chips), their prices increased and, especially for large municipal heating plants, created a new problem. As the result, more and more efforts are being put into research of biomass plantation for energy purposes. Several plants are under investigation and, according to the information from a power plant in Hodonin, energy from amaranth plant (yield of 20 ton/hectare) will be used for co-firing with lignite there.

Some problems were experienced also in larger municipal heating plants utilizing straw. In Novy Bor, e.g., a new biomass heating plant is still using natural gas because the price of straw increased considerably.

Wind Power

Promising development of wind power was slightly slowed down due to licensing problems. New wind power plants have to be approved by the local governments (municipalities), which frequently reject the proposals for various reasons. This situation can be illustrated with the case of two projected wind mills (1 MW each) in Kvetnov (Havlickov Brod). Here the municipality was not satisfied with the financial grant (1 million CZK) from the investor who also promised to provide further grants on the level of 150,000 CZK annually after six years of operation of these wind mills. In case of wind mills, the ministry of environment is also a part of the decision-making process and has to approve all the new wind power plants. Sometimes their recommendation is aimed at reduction of the number of wind turbines in one location, as in the case of a proposed wind park in Chomutov, where 91 proposed wind mills were reduced to 83. The Czech ministry of environment also issued a set of 46 requirements which regulate the preparation, construction and operation of wind power plants. Despite all administrative burdens, there is huge interest on the part of investors in wind power. Attractive feed-in tariffs are the main driving force behind it. According to the study produced for the Ministry of Industry and Trade by EuroEnergy, there are almost 3,000 MW of new wind mills under preparation. Regional distributors of electricity were informed about the intentions of investors to build wind power plants of 2,830 MW in Czech Republic in the near future. Projects where investors compete for the same location include 292 MW. The largest interest is in building wind mills in Northern Bohemia; the least interest is in Southern and Central Bohemia.

According to the estimate from the Ministry of Environment, investment in wind energy will reach 13 billion CZK by 2010 and the annual power production from this source will increase 50-fold. In order to stimulate

further development, this ministry is also providing the wind map to potential investors. The map, which can be downloaded from their web page, shows not only locations with good wind conditions but also the nature-protected regions where construction of wind mills is forbidden.

Solar Energy

The Czech Republic seems to be very attractive to foreign investors. On October 19th, 2005, a Japanese company, Kyocera, opened their new factory in Kadan (North-West Bohemia). The company plans to increase their share of solar photovoltaic panels on the EU internal market from 16% to 21 % and to keep abreast of the growing demand in Europe. Annual production in Kadan is supposed to reach 100 MW with 24 MW in the first year. The new plant is the company's response to the growing global demand for solar energy. In the year 2005, the German company Schott Solar, producer of solar systems (modules), also opened a new factory in Valasske Mezirici.

Kyocera will also have to compete with domestic photovoltaic producer Solartec, which has been quite successful on the Czech market for more than ten years. Solartec is also the organizer of the so-called "Solar League of Czech Republic" – the competition between municipalities oriented toward higher penetration of PV and solar collectors in this country. The project is financially supported by the State fund for environmental protection and by some private companies as well. In the year 2005, there were 386 municipalities involved, with total panel area of 14,000 m^2 (12,000 m^2 of solar collectors and 2,000 m^2 PV modules).

Despite the fact that there is no universal and coordinated national support covering investment costs of solar applications, there are municipalities who are providing the grants for their inhabitants, like the town of Litomerice, which provides grants of 20,000 CZK for one solar system.

Renewables in Transportation

Transportation seems to be the sector where the energy consumption and emissions of CO_2 are growing the fastest. The Czech Republic decided to use biofuels in transportation long before joining EU and before adopting the EU directive on biofuels, which commits the country to reaching a 5.75 % share of biofuels in domestic transport fuel consumption by 2010.

Table: Consumption of fuels in transportation.

	1995	1998	1999	2000	2001	2002
	thousands tons					
Liquid petroleum gas	110	180	245	264	275	241
Unleaded petrol	782	1,173	1,341	1,490	1,913	1,926
Leaded petrol	894	610	583	368	12	0
Diesel	1,983	2,703	2,489	2,271	2,478	2,611
Biofuels	25	180	178	228	235	268
Total	**3,794**	**4,846**	**4,836**	**5,081**	**5,355**	**5,377**

Today, the most used biofuel is biodiesel, or so called MERO or ROME (methylester of rapeseed oil). The main reason for its development was the attempt to solve the problems with agricultural overproduction of food stuffs. In the first half of the 1990s, the government strongly supported production of MERO. In the beginning, it was mostly pure biodiesel, but due to some problems with diesel engines lately, only a mixture of biodiesel (30 %) and diesel (70 %) was used.

Future development of bioethanol is also suggested in the national strategy. According to the EU directive Nr. 2003/30/EC, which set the target of biofuels for transportation, the Czech Republic amended the law on air protection and further developed the idea of stronger biofuels utilization in the governmental decision Nr. 825 from Sept. 1st, 2004, which says that:

- Minimal target for utilization of bioethanol in transportation is 2 million hectoliters by the year 2013.
- Bioethanol will be mixed with petrol.

- Biodiesel will be mixed with diesel.
- Reduction of tax for fuels with bioethanol content from 1.1.2007 until the year 2013 will be introduced.

There is a new support program in force, which was prepared by the ministry of agriculture and is scheduled until the year 2007. According to this program, support will be provided to the producers of methylester of rapeseed oil on the level of 7,850 CZK/ton. Biodiesel will be also taxed at a lower taxation level. Support for bioethanol is proposed only in the form of tax reductions.

Despite promising administrative and financial support, there have been problems with sale of biodiesel in Czech Republic during the year 2005. The key company Setuza does not plan to deliver the biofuel on the domestic market. This company, which was supposed to produce biodiesel according to the new financial support scheme, decided to export the fuel, which is more profitable business for them.

6.3.1 Outlook for the Future – State Energy Policy

In compliance with the general indicative (i.e., voluntary) EU targets of 22% of EU electricity coming from renewable energy sources by 2010, the Czech Republic decided to double its share of renewables by determining the national indicative target of the share of electricity generated from renewable sources in gross national electricity consumption by 8% in 2010.

Furthermore, energy policy claims that the government will create conditions for a gradual increase of the share of all renewable energy sources in the domestic consumption of primary energy sources so that they will reach the level of 15-16% in 2030. Similarly, there is a willingness to increase the share of renewables in the transportation sector, but without any clear target. An important feature is that the government does not plan to develop large hydro power within next 20-30 years, although large hydro historically represented the highest share of renewable electricity.

State Energy Policy outlines several scenarios of future energy development. Interestingly, all six scenarios count with the share of renewables more or less on the same level and they only differ in case of development of coal or nuclear energy. The table below presents the future development according to the "Green scenario" which was prepared by the Ministry of Industry and Trade and made available for public hearing in June, 2003.

Table: Probable amount and structure of primary energy sources consumption until 2030.

	2000	2005	2010	2015	2020	2025	2030
							PJ
Brown coal	612	507	509	480	434	389	374
Black coal + coke	265	229	212	210	227	209	174
Other solid fuels	11	8	9	9	8	7	7
Natural Gas	316	373	359	353	366	366	370
Crude oil	239	222	209	180	152	139	127
Liquid fuel	72	51	67	76	80	82	86
Electricity	-36	-40	-35	1	18	18	1
Nuclear fuel	148	286	286	286	286	330	375
Renewable sources	44	93	159	187	215	269	283
TOTAL	1,672	1,730	1,775	1,782	1,787	1,810	1,797

In general, long-term targets of primary energy consumption structure by 2030 set by the government are presented in Table 8, below.

Table: Expected share of fuels on total energy consumption in Czech Republic until 2030.

Solid fuels	30 - 32 %
Gas fuel	20 - 22 %
Liquid fuel	11 - 12 %
Nuclear fuel	20 - 22%
Renewable sources	15 - 16%

Table: Outlook for the electricity production from renewable energy sources.

	2000	2005	2010	2015	2020	2025	2030
Share of RE (% from electricity consumption)	2.7%	5.8%*	7.7%	7.6%	7.6%	8.9%	10.4%

* Target not reached.

6.4 Emission Trading Scheme, and National Allocation Plan

With respect to the National Allocation Plan (NAP), the Ministry of the Environment was responsible for transposing the EU Directive into national legislation. A general outline of emission trading was proposed by the project "Setting up a CO_2 emissions trading scheme in the Czech Republic", financed by the Dutch Government and managed by a consortium comprising Pricewaterhouse Coopers s.r.o. and Seven o.p.s. At the very beginning of the NAP preparatory process, including first proposal of the Ministry of the Environment, published for a public hearing on June 3, 2004, there was some criticism from the Ministry of Industry and Trade and industrial undertakings. Nevertheless, the plan was adopted and lately also approved by the EU so that emission trading could start in the Czech Republic in 2005.

Despite a green light from the government, the Emission Trading Scheme (ETS) was not realized in full capacity and it is just starting in the Czech Republic. Interestingly, the national register of emission allowances, also responsible for communication with the European and global register of allowance trading, was not functioning in December, 2005.

Basic features of the Czech NAP are the following:

- The maximum total allocated quantity of allowances for the 2005-2007 period of 322.98 million was reduced by the European commission to 292.8 million.
- For each year there is one third (97.6 million) of total allowances allocated.
- Trading is restricted only to emissions of carbon dioxide, as in all EU countries.
- All allowances have been distributed free of charge.
- The amount of emissions included in EU ETS for existing facilities is anticipated at 65% of the Czech Republic's total greenhouse gas emissions in 2010.
- The basic allocation is based on historical emissions in the 1999-2001 period (average for the two years with the highest emissions) and the projected growth to 2007 and individual negotiations.
- With respect to early action and combined heat and power production, 3% and 1.5%, respectively, of the total projection of emissions from all facilities, except for new entrants, will be allocated.
- Operators of district heating systems have the option of correcting allocation for the reasons of standardization of temperatures. Allowances of 1 million ton CO_2 have been reserved for these purposes in NAP.
- The reserve for new entrants equals 3 million allowances; unused allowances from this reserve will be sold in an auction. The auction of allowances will apply only to undistributed reserves for new entrants. If unused allowances remain in this reserve at the end of a calendar year, an auction for sale of unused allowances will be organized within three months (i.e., by March of the subsequent year). Income from the auction will be used to ensure the operation and administration of ETS in Czech Republic and financing of environmental projects.
- Transfer of allowances to the second trading period (banking) is not permitted.
- It will not be possible to distribute the amount of allocated allowances among individual polluters on the basis of their mutual agreement.

Pursuant to the proposed allocation of emission allowances as of May 19, 2005 agreed between the Ministry of Industry and Trade and the Ministry of the Environment, in comparison with the proposal dismissed by the European Commission, the situation will be worse primarily for refineries, the chemical and paper industries, and also manufacturers of construction materials. According to this proposal, the number of allowances for the public energy sector has been lowered by 3.9 %, in the case of in-plant power stations by 12 %. However, between 2005 and 2007 all sectors are allowed more emissions than in 2004. The public energy sector has obtained 5.3 % more allowances than were the actual emissions of power plants and heating stations last year. The limit for in-plant power stations is 17 % higher.

Trading itself must be preceded by registration of every company via the Electricity Market Operator, which concludes with these firms "*contracts on establishing and maintaining an account in the national register for trading of allowances*".

The proportion of emissions represented by allowances for installations included in EU ETS is anticipated at 67 % of the overall amount of emissions of greenhouse gases in the Czech Republic in 2010; thus, a slight increase compared to 2000 is anticipated, reflecting higher production and export of electricity and growth of emissions from other sectors of EU ETS. Stabilization of emissions at the 2001 level is anticipated in sectors outside EU ETS as a consequence of pro-active programs of the Czech Republic. The overall quantity will not exceed the path to the Kyoto objective, as the current reserve is sufficient to cover the anticipated growth in sectors that are both included and not included in EU ETS.

Since the middle of October, 2005, allowances for carbon dioxide emissions have been allocated to individual polluters in the Czech Republic. There are now 436 installations within this trading system. The energy sector is most important among them. Basically the emission trading was open to start in the second half of the year 2005. There was an open criticism of the system and amount of allowances from the side of chemical industry and pulp and paper industry. Pulp and paper industry with its annual growth of 6 % will be forced to buy allowances and they proposed to sue the environmental ministry for unfair division of allowances. Actually the winner seems to be the energy companies (private) who are preparing themselves for selling of allowances. Public energy companies providing mostly heat on a municipal level seems to be less successful and their future position will depend on the weather conditions (tough or mild winters) or the willingness to invest in energy-saving measures in apartment buildings.

It is not clear yet what will be the impact of emission trading on development of renewables. Nevertheless, trends similar to those in the Slovak Republic can be expected, and first of all, old coal heating plants providing heat in municipalities will be continually substituted by natural gas or biomass firing boilers. With recent sharp rise of natural gas prices, the biomass seems to be the future winner of the race. This will result in emission reductions and sale of allowances. In many cases, this substitution has to be done anyway as many coal boilers are now 30 or more years old. In Slovakia, such trading occurred even before the whole system started, and in one case the reduced emissions were traded to a Japanese broker. The same company, that did the deal in Slovakia is starting its activities in the Czech Republic as well.

Despite the fact that the trading with allowances already started in 2005, most of the companies involved in the ETS do not want to present their trading results before presenting annual reports (spring 2006). One exception is large energy company Plzenska teplarenska producing heat and electricity in a major Czech town, Plzen (Pilsen). According to their preliminary results, the net profit in 2005 from sale of their emission allowances was 60 million CZK. This sum is a quite substantial increase of their annual net profit, which was expected to be around 340 million CZK without emission trading. The key measure they introduced in the plant was the start of co-firing of biomass with coal, resulting in lower emissions. It is worth mentioning that this measure had additional financial benefits through the system of feed-in tariffs. Profit from emission trading was not planned and the company is looking to increase the share of biomass fuel in their fuel mix further in 2006.

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7. Hungary

7.1 Current Energy Status

Hungary has a population of 10.1 million. The Hungarian currency (HUF) is relatively strong, and has an exchange rate of 250 HUF to one EUR as of January, 2006. The gross domestic product (GDP) has been growing steadily by 4.6%-6.3 % in the last few years and the unemployment (6%) is lower than the EU average. The GDP per capita is only one-third of the EU average, but it is the third highest among the new EU countries in the continent (after the Czech Republic and Slovenia).
Hungary became a member of the EU in 2004. The country joined the Organisation for Economic Cooperation and Development (OECD) in 1996, and then the International Energy Agency in 1997.

7.1.1 Energy Policy and Regulation

Hungary, like all former post-communistic states, is undergoing structural changes of its economy. The EU accession has had significant implications for energy policies in Hungary, and has been a main driver for changes.
The main renewable-energy-related changes made to conform with the relevant EU directives and commitments to the EU, as well as to the Kyoto Protocol, are the following:
- The National Energy Efficiency Program (NEP) of the Governmental Decree of 1107/1999 (X.8), has a target of increasing the annual renewable energy supply to 50 PJ by 2010, which will be about 5-6% of the total energy supply by 2010. In 2003, the renewable share of the total energy supply was 3.4 % (37 PJ).
- The Electricity Act (VET 2001 CX), which introduced a feed-in tariff system for renewables since January, 2003. The increase of the price given to renewable electricity since September, 2005, gave a considerable boost to renewables. The driving force behind it is that Hungary made a commitment to the EU that the renewable share of the electricity produced in the country should be 3.6 % by 2010. This number was under 1 % in 2003.
- The Biofuel Resolution of September, 2004, which stipulated targets to increase the use of biofuels in transport. The target was 0.4%-0.6% by 2005, and 2% by 2010. The Parliamentarian Resolution of June, 2005 increased the target to 4% by 2010.
- The National Allocation Plan is expected to be approved by the EU at the end of January, 2006, and the emission trading is expected to start in February-April 2006. This happens after a substantial delay.
- Modification of the Electricity Act and the Natural Gas Act in order to bring them into line with the new EU market liberalisation objectives, which means that 100% of both markets will be open starting in mid-2007. The markets are already liberalised for large consumers.

The Hungarian government also decided to prepare a new long-term 2006-2030 energy strategy, which will be submitted to the Parliament in the first quarter of 2006. In addition, the government is preparing a separate renewable-energy strategy in line with commitments to the EU.

7.1.2 Energy Supply and Demand, Trends

In 2003, the total primary energy supply (TPES) was 1,063 PJ, shared by gas (46 %), oil (24%), coal (14%) nuclear (11 %), biomass (3.1 %), geothermal (0.3%), and hydro (0.04%).

If the period of 1990-2003:
- The TPES in 2003 is 9 % below the 1990 figure.
- The share of coal decreased from 21 % to 14%.
- The share of gas increased from 31% to 46 %.
- The share of renewables increased from 1.3 % to 3.4 %.
- The share of nuclear is basically unchanged.

There is domestic production of 19% of gas and of 26 % of oil. Of coal used, 85% is from domestic production of lignite used for generating electricity, and 15% is imported hard coal, which is used in the industry (2003).

Domestic production is declining. In the period of 1990-2003, the production declined by 27 %; gas declined by 40%, and coal declined by 35% (closure of coal mines).

The electricity consumption is increasing since 2000. The total electricity production in 2003 was 31 TWh, shared among gas (36%), nuclear (32%), coal (27%), oil (5%), hydro (0.5%, and biomass (0.5%).

Hungary's total final consumption decreased sharply in the early 1990s because the consumption of the industry decreased to half and because of the closure of some heavy industry. Since 2000, the final consumption is slightly increasing, driven by increases in transport and by the energy use in service and residential sectors.

The Hungarian Government believes that the extension of the 30-year operational licence of the power station Paks to 50 years is the most cost-effective way to keep GHG emissions low, even though the safety upgrading and waste deposition also cost money. This is also a strategic question, while nuclear power also contributes to the security of fossil fuel supply. The expiry dates of the operational licences of the 4 reactors fall between 2012 and 2017. On November 21, 2005, the Parliament adopted the Government's plan to extend the lifetime of the nuclear power plant from 30 to 50 years. 339 parliamentarians voted yes out of 351. Environmental organisations were against this and lobbied accordingly; 80 well-known persons wrote an open letter to the Parliamentarians; but this did not influence the decision. According to opinion polls, the acceptance of the nuclear power plant is considered to be high (around 60%), which is much higher than the EU average (37%). After an accident in April, 2003, the nuclear power plant has not worked fully until recently, but nuclear power is working again 100%. In the meantime, natural gas produced more electricity, and electricity import levels were higher.

District heating is used on a large scale since 1960, when major housing construction programs started. There are 142 district heating companies, which operate 240 systems in 109 towns and cities. These companies supply about 644,000 apartments, which is about 16% of 4 million households. The natural gas accounts for 66% of the fuel used for district heating, coal and oil account for 19% and 11 % respectively, and renewables, waste and other fuels are 4 %.

The Hungarian energy intensity (TPES/GDP) is relatively high among the EU countries; but lower than the energy intensity levels of nearby Slovakia and the Czech Republic. This is partly explained by Hungary's low GDP, which is only 36% of EU-average.
The country's substantial GDP growth has not correlated with increased energy use in the last 11 years. When we look at the period of 1993-2004,
- the GDP increased by 48 %
- the primary energy supply increased by 3 %
- the electricity supply increased by 16%.

Compared with those of other EU countries, the Hungarian primary energy supply (TPES)/capita and electricity supply /capita are low.
Without energy-efficiency measures, it is expected that in the future the increase of GDP (estimated at 3%-4%/year) will have more influence on the increase of the primary energy supply (estimated at 0.7%/year). The Hungarian population is decreasing, a trend that also affects the energy supply. It is estimated that the population will decrease from 10.06 million to 9.54 million from 2010 to 2030. (GKM WG 3)

7.1.3 Energy Companies:

Electricity:
- Transmission network: MVM, Hungarian Power Companies (state owned, former monopoly).
- Distribution: 6 regional companies. Dédász, Démász, Elmü, Èdász, Émász and Titász. The majority are held completely or partly by foreign companies (RWE, E.ON, EDF).
- Generation:
Nuclear: one nuclear power plant in Paks (owned by MVM).
Gas: Several natural gas power plants, where often CHP provides district heating. The power plants are owned by MVM, AES (US based power company), etc.
Coal (Lignite): 80% of the mines were sold to the electricity power plants they supply. Many of the power plants have been changed to be able to burn biomass; see the list under "Biomass", below.
- Biomass: AES Borsod, Tiszapalkomya, Bakony Bioenergia, Pannongreen, Bakony (Bioenergia Ajka), Mátra (II-IV), Kazincbarcika, and Pécs. Most of the power plants, which are using biomass today, are mixed, which means that they used coal (lignite) before or still burn lignite as well.

Oil:
Exploration, production, refining and distribution. MOL is privatised at 75%. The shares are held by international and national investors, Austrian OMV, and Slovak companies. MOL owns 3 refineries, controlling 60% of the wholesale market and 30% of the retail market along with foreign companies (Shell, OMV, Italian Agip, and others).

Gas:
Production, transport, storage, trade: MOL Gas Supply plc. It started its separate business activity from MOL on 1st January, 2004, but still is a 100% owned subsidiary of MOL. E.ON and Gazprom would like to buy part of it, but the EU Commission has not allowed the purchase. Negotiations are continuing in 2006.
Distribution: 6 regional companies, which are privatised since 1995. The companies are: Dégáz, Égáz, Kögáz, Tigáz, Dgáz and Fögáz. The foreign companies involved in privatization are: French GdF, German E.ON, German RWE, Italgáz, and Italian Eni.
These companies are member of the Association of Gas Distribution Companies (www.hungas.hu).

Renewables:
There are 198 companies in the database of Zöldtech (Green Tech), which are involved in solar electricity (75), biogas (32), bio diesel (15), wind (52), solar thermal (105), geothermic (71), hydro (23), cogeneration (38), architecture (40), and biomass (75). Some of them are dealing with more fields. The database is on the following website: www.zoldtech.hu (in Hungarian).

Agencies:

The Hungarian Energy Office (MEH) is administrating the feed-in tariff scheme (www.eh.gov.hu)

Energy Centre Hungary (EK) administers the energy-efficiency program (NEP), and the structural funds (SF) (www.energycentre.hu).

Public Advice:
There is an energy advisory network, the Green Energy Network (ZEH) established by 10 environmental NGOs. These organisations publish brochures, give advice and information, locally and make campaign. Five of them developed a do-it-yourself workshop, where people can make their own solar collectors similarly how it is done in Austria. The organizations are also member of the Hungarian Network of Eco-counselling Offices (Köthálo www.kothalo.hu). The ZEH network got support in 2002-03 from EU with a Phare Macro project for their work giving free information to the public on renewable energy.

7.2 Renewable Energy Policy

Electricity Act

Hungary made a commitment to the EU to cover 3.6 % of Hungarian electricity supply with renewable electricity by 2010. The actual share was less than 1 % in 2003.

The most important tool for increasing the share of renewable electricity is the feed-in tariff system for renewables. The legal basis was laid out by the Electricity Act (VET 2001 CX Law) in January, 2003. Related paragraphs are: #19 on Production, #52 on Permission, #95 on Price. The implementation details and prices are defined by Decrees of the Hungarian Ministry of Economy and Transport. The main Decree fixing the price is Number 56/2002 (XII. 29), which is modified periodically.
Concerning the renewables geothermal, solar, wind, biogas from waste, and gas from wastewater treatment plants, as well as hydro, which is smaller than 5 MW, the price has changed 6 times in the period from February, 2003 to January, 2006.

In September, 2005, two main changes were made that were also reflected in amendments to the Act on Electricity.

- The price structure was changed. Until September, there was a time-of-use price structure, where the different price levels depend on the time of day during which electricity is used: on-peak (28.74HUF), mid-peak (16.51 HUF), or off-peak (9.38 HUF) (Average: 18 HUF).
  This changed to a flat rate of 23 HUF, increased every year by a price index.
- The renewable installation smaller than 100 kW was now no longer excluded from the category from which it is compulsory to buy the electricity.

These changes had a dynamic effect on renewables, but problems remain. Though several sources say that the price is guaranteed until the 2010, the Law actually does not say for exactly how long the price is insured. The Law says that permission to operate should be given for a period that allows a payback period of the investment with a decent profit under efficient operation. There is an internal guideline under development on this. The time period probably will be specified in the permission of new installations, and the old installations need to seek new permissions.
In the expert material for the new Strategy, the following payback times are mentioned: Biomass: 8-9 years, Wind: < 7 years, waste-burning: 10 years, biogas: 11 years, geothermal: 1-10 years, and solar cells: 100 years.

On October 8, 2005, a new change came into force. The VET 2005 LXXIX Law drew a distinction between renewables that are dependent on weather and those that are not.

- The price for those resources that are dependent on the weather remained at 23 HUF (solar, wind).
- The price for those resources that are not dependent on the weather reverted to the previous time-of-use price structure, with 3 different prices. The price is 26.12 HUF on-peak, 23 HUF mid-peak, and 9.38 HUF off-peak.

There is also another new change from the end of year 2005: A quota will be set to limit how much will actually be bought from the electricity producers. The law already contained the mechanism for doing this, but it had not been used in practice. This amount will be decided taking into consideration that the investment should have a decent profit under efficient operation during its payback period. Using this method allows a limit to be set on the support.

The new changes from the last quarter of 2005 reflect the fact that the regulators, seeing the rapid increase of the renewable-electricity supply and of interest in it, would like to slow down its development.

Biofuel Decree

The support of biofuels was decided in the Governmental Decree of 2233/2004 (IX.22). The target was 0.4%-0.6% by 2005, and 2% by 2010. The Parliamentarian Resolution 63/2005 (VI.28) increased the target of biofuels' share of all fuels from 2 % to 4 % by 2010.
To meet the target, a return (repayment) of the fuel excise tax was introduced. The time period for the returned excise tax was originally to end in 2010 (Decree of 2233/2004 (IX.22)). This was changed to the middle of 2007, at which time a stronger incentive, a differential tax system, will be introduced for mixing 4.4% biofuel in the fuel. (2003 CXXVII modification)

National Energy Efficiency Program (NEP) /Structural Funds (SF)

The Governmental Decree of 1107/1999 (X.8) has the goal of decreasing the annual energy demand by 75 PJ and of increasing the annual renewable-energy supply to 50 PJ by 2010. In 2003, the renewable share of the total energy supply was 3.4 % (37 PJ). The amount of 50PJ is expected to be about 5%-6% of the total energy supply by 2010.
Towards this target, a long-term National Energy Efficiency Program (NEP) was introduced to provide funding and loans, and the Energy Center (EK) was established to operate and implement the NEP. (In 2001-02, the NEPs were running under the Széchenyi Plan.) In 2000-2005, the NEP only secured 4.1-PJ decrease in the energy consumption, which is only 11% of the target for the period.

The NEP also provided funding for renewables. During 2000-04, 768 renewable projects got 857 million HUF, which is only 7 % of the 12,071 million HUF total support available through the NEP. The NEP supported 450 roof-mounted solar-thermal collectors, which is far short of the planned total of 10,000 for the period. This means that the Program has to be reinforced and revised. It is expected that the EU will be more stringent in demanding fulfillment of the targets e.g. decreasing energy consumption by 20% by 2020; introducing energy evaluation of all new and sold houses. A new Hungarian Action Plan is needed for the period of 2007-2013. (GKM WG 11)

In the middle of 2004, the NEP's funding was stopped. In 2005 and 2006, the Structural Fund provides funding for renewables and for energy efficiency.

As one of the newer and poorer EU countries, Hungary receives support in the form of EU structural funds. Thus, from April, 2005 forward, there has been a new possibility for funding through EU Structural Funds for renewables and energy efficiency. For renewable electricity, 700 million HUF was available in 2005; and 2,020 million HUF will be available in 2006. The name of the program is Environment and Infrastructure Operative Program (KIOP-2005-1.7.0.f). The application window was from April, 2005 to January 31, 2006. The investment cost needs to be a minimum of 125 million HUF, and the installation needs to be done within 2 years. The support is different for authorities, associations (category 1), and private investors (category 2). Generally, the support is 10% lower for private investors. The support for the 2 categories are, respectively: biomass (50% and 40%), solar thermal (40% and 30%), wind (25% and 20%), wind park (18% and 16%), solar electricity (45% and 30%), geothermal (40% and 30%), small hydro (35% and 20%), energy efficiency including cogeneration (40% and 30%), and biomass production facilities such as oil presses (40% and 30%). For community biomass-based district heating or geothermal energy, it can give up to 60%. Between 10 and 40 projects are expected to be funded in 2006. The applications were to be submitted to the Energy Centre Hungary. About 28 projects were awarded funding in 2005. (GKM WG11 & EK)

Building Directive

Preparations have been started to formulate a regulation to comply with the EU Buildings Directive 2002/91/EU, which states that, for new houses bigger than 1,000 m^2, consideration must be given to how renewable energy can be used economically. When this rule is adopted, increased use is expected in buildings bigger than 1000 m^2. It is also expected that existing building regulations will be more carefully enforced.

7.3 Recent Development of Renewable Energy and Outlook 2030

The feed-in tariff system had an effect on the increase of renewables since 2003. Later, the increase to the flat price of 23 HUF (9 €c) for renewables in September, 2005, resulted in dynamic growth.

We can see an overview of the first half year of 2005 as reported by the Hungarian Energy Office:
Renewable electricity doubled in the first half of 2005, compared to the same period of 2004.
The biomass, wind, and hydro (less than 5MW) increased by 138 %, while the hydro plants bigger than 5MW decreased by 40 % because of the worse weather conditions. Biomass use increased the most, by 150%. In the same period in 2004, there were only 3 plants that were fuelled by biomass, while in 2005 there were 3 other power plants, which changed to be fuelled by biomass. (MEH)

Biomass

Biomass was 3.1 % of the total energy use and 0.5% of the total power production of the country in 2003. It accounts for the largest share (90%) of Hungary's renewable energy consumption and for half of the renewable-electricity production (2003).
In 2004, electricity production from biomass increased 5 times compared to that in 2003, and the increase continued in 2005.
In December, 2005, the representative of the Ministry of Environment and Water mentioned in a conference that the electricity produced from biomass increased so much that it can happen that Hungary reaches the renewable-electricity target of 3.6 % already in 2005. This share was 0.7% in 2003, and was estimated at 2.2% for 2004. The substantial increase has occurred mainly because many previously coal (lignite) power plants are changing to biomass. The conversion of the previous coal-fired power plants to biomass were mostly done in the framework of Joint Implementation using foreign contributions for 20% of the investment costs.

Despite the extensive use of forestry waste for energy production, it is estimated that only 10% of these resources had been utilised in 2003. There are 7 heating plants providing hot water and heating to residential areas utilizing forestry waste and sawmill by-products.

Besides the forestry waste and sawdust, there is potential from energy plantations. In 2005-06, energy forest will be planted on 5-10,000 ha, which could be increased to 60,000 ha by 2010. In 2005, an energy grass plantation was started from a specially developed energy grass called Szarvas-1 on 10,000 ha. This could be increased to 110,000 ha by 2010, and to 300,000 ha by 2025. There is about 3 million t/year potential from straw and sun-flowers.

Hungary is one of the EU countries that has the least use of biogas. Only Portugal and Slovakia use less. The Hungarian energy production from biogas in 2004 (2.3 ktoe) is very low even when we compare it to Austria (17 ktoe) and the Czech Republic (35 ktoe). (Barometer) However, there is potential in biogas, as the agriculture sector is much bigger than the EU average. There are about 5 million pigs, 28 million poultry, and 0.9 million cows in the country, and there are 555 wastewater plants.

Biogas produced from the waste of animal farms is utilized in 5 plants, the largest of which, in Nyírbátor with a capacity of 1.6 MW, started its operation in 2003. There are biogas investments under planning and construction at the waste treatment plant of North Budapest and at an Austrian-Hungarian demonstration project on liquid manure at Pálhalom.

Wind

The feed-in tariff system, and afterwards the increased flat price of 9 €c (23 HUF), raised the interest of private investors in harvesting Hungarian wind potential.
In 2004, there were six 600-kW windmills in 4 places. In 2005, one 800-kW and one 1.8-MW windmill were installed.
In 2005, a total of 350-MW wind power plants got permission and are under planning; and permissions were sought as well at the 1,600-MW level. The private investors are pushing for it, while the electricity grid owners are against it because the electricity net is not flexible enough. Power companies have claimed that the electricity grid, even in 2020, will not be able to handle more than 500MW peak wind electricity at the grid's present rate of development. The future energy policy has to tackle the opposition of the electricity grid owners and find a solution for eventual developments of the electricity grid.
There is also a need for maps to guide the investors as to where wind mills can be set up considering wind speed as well as nature and landscape. Hungary's wind map is under preparation by the Hungarian Meteorological Service and others. It was supposed to be ready by the end of 2005.
For many years, it was thought that Hungary had low wind potential. This turned out not to be true. There is good wind potential in the northwest and southeast portions of Hungary.

Hydro

The hydropower covers 0.5% of the power production of the country (2003), which was half of its renewable electricity in 2003. There are 31 hydro power plant with a total of 55 MW capacity, and 195 GWh/year production (0.6 PJ). Of the 31 plants, 23 are producing electricity and 8 of them are out of use (2005). 90% of Hungary's total power is produced by 4 power plants (Kisköre, Tiszalök, Kesznyéten and Ikervár).
Hungary is a less mountainous country; therefore, the hydro potential is relatively limited. The theoretical potential is 7.5 TWh, on the rivers of Duna (72%), Tisza and Dráva (19%), Hernád and Rába (4.5%), and many (338) smaller streams (4.5%). But after the plan of the hydro power plant of Bös-Nagymaros on the Duna at the Slovak border failed to be implemented, a bigger hydro power plant in Hungary seems unlikely. There is strong resistance against the project at all levels.
It is estimated that there is 10-12 MW new capacity on the smaller rivers, for 50GWh/year production. The nuclear power plant Paks is also considering building a 5-MW hydro power plant on the outflowing cooling water of the plant. Taken all together, the total is around 1.1 PJ.
In the last few years, investors showed interest in building small hydro power plants on the three rivers of Rába, Körös, and Hernád with around 1.5-1.8 MW capacity each. Most of them are asking permissions and afterwards will try to get support, both of which are difficult to get.

Solar Thermal

Hungary lies in the middle of the Carpathian basin on a relatively flat surface surrounded by mountains, and has favourable solar conditions compared to other European countries. Solar thermal collectors can decrease the hot-water demand of a family house by 50%-70%. However, there is no widespread implementation of the technology, opposite to the case in neighbouring Austria. The total installed solar thermal collectors in 2004 were 2.4 million m^2 in Austria but only 45,000 m^2 in Hungary. Just in 2004, 191,000 m^2 were installed in Austria, while only 3,000 m^2 were installed in Hungary. (Barometer)
In 2001-2002, there was a support scheme paying 30% of the investment, which decreased the payback period to 10-15 years. The scheme supported 450 installations. It was part of the National Energy Efficiency Program (NEP), which stopped in 2004. To reach the NEP target of 20,000 roof-mounted systems by 2010, a support scheme would be needed again for family houses along with an information campaign, easy support procedures, and increased support budget. The Structural Funds for the period of 2005-06 only support those installations, that cost 125 million HUF or more. (EK)
Preparations started to make a regulation to comply with the EU Buildings Directive 2002/91/EU stating that, in the case of a new house that is bigger than 1,000m^2, economical use of renewable energy must be given full consideration. When this rule is be adopted, increased use is expected in buildings bigger than 1,000 m^2.

Solar Electricity

The use of solar electricity is almost nothing in Hungary. In 2004, there were 0.14 MWP of installed solar cells, while in neighbouring Austria this number was 19.8 MWP. (Barometer)
There are two big solar-cell power plants in Hungary, both of are valuable facilities for demonstrations of the technology and for education value. In 2005, a 150-m^2 solar cell plant (10 kWp) was built at the Gödöllö University with EU and state support; it, too, serves educational and research purposes. In 2003, the Hungarian Oil and Gas Company (MOL) installed a 200-m^2 solar-cell plant along the M1 motorway to provide electricity to a petrol station.
A Hungarian solar-cell manufacturing company called Dunasolar was active on the market for 6 years until 2004, when it was sold to Bangkok Solar in Thailand. (GreenTech)
A new development is that Sanyo built a solar-cell module factory in Dorog in 2005, which targets mainly the German market, but it also opens up the possibility of quick reaction to the region's increasing market demand. The facility's 50-MW annual production capacity is to be expanded to 100 MW in 2006. (Sanyo)
Solar cells are under consideration to be part of a complex development plan for small farms, which are without electricity in an area between the two rivers of Duna and Tisza. This would be in the framework of a EU-supported program starting in 2007.
When we look at the long term, e.g., at development by 2030, despite the long payback period of today (more than 50 years), the price of the solar cells could fall in the future if there were to be more R&D and mass production on the world PV markets.

Geothermal

The geothermal energy supply was about 0.3% of the total energy supply of the country in 2003. Hungary has one of the largest geothermal reserves in Eastern Europe. Generally, they are low to medium enthalpy, 50 ^{o}C-200 ^{o}C, and more suitable for heat supply than for electricity production. The primary geothermal resource is a reservoir system in the southeastern part of Hungary. There is a technical problem caused by the high salinity of the thermal water.
Geothermal energy is used for heating of greenhouses, district heating, and swimming pools (200 wells supplying baths and spas). The residential and industrial demand led to drilling of several thousands of wells. There is still substantial potential to increase the use of the geothermal energy. The use of heat pumps is increasingly recognised in the residential sector as a way to utilise geothermal heat. There is no electricity production presently (2005), but there are possibilities in about 5-10 places, and there are actual plans for 3 places, where investors are looking for support.

Biofuels

The support of biofuels was decided in the Governmental Decree of 2233/2004 (IX.22) and the target of biofuels is 4 % of fuels by 2010. The incentive system is changing in 2007, when instead of the return of the fuel excise tax, a differential tax system will be introduced to promote the mixing of 4.4% biofuel into the fuel. (2003 CXXVII modification).
There are 2 main areas of interest in biofuels in Hungary:
- Bioethanol (made from corn and wheat) can be used as petrol component in the form of ETBE. The domestic production of ETBE and its mixing into petrol has started, and it looks as though the target for this will be reached by 2008. Bioethanol is made by alcohol companies (Hungrana, Györiszesz), and new production facilities are planned. There is a certain amount of export of bioethanol, which can be increased once use of it increases in Europe.
- Biodiesel (in Hungary made from rapeseed oil) can be used as a component of gas oil. In 2005, 2 production facilities of biodiesel were built (Kunhegyes 4,000t/year, Mátászalka 10,000 t/year). The production is expensive. It can be used in a clear version only in special motors. Rapeseed oil yield is lower in Hungary than in Austria or in Germany; therefore, imports are presently the cheaper option.

It looks realistically possible that Hungary's biofuels share will reach 6-7% by 2025 with increased domestic production, and with R&D to decrease the production costs. It is very likely that it will get an extra push from the increasing oil prices by 2025.

Outlook for the Future - State Energy Policy until 2020 or 2030

The Hungarian government decided to prepare a new Hungarian Energy Strategy for the period of 2006-2030. The Hungarian Ministry of Economy and Transport established 17 working groups to prepare expert background studies. Five of the studies are available from the Ministry's web site and they were open to comments in January, 2006. (GKM WG) One of the 17 working groups is about renewable energy. The expert study is one of those available to the public and can be downloaded and commented on. After the completion of the preparations, the Energy Strategy is expected to be submitted to the Parliament in the first quarter of 2006. It is considered likely that, after the approval of the Parliament, there will be financial resources allocated to the development of renewables, but presently there is no public information about this.

Parallel to the work on a new Hungarian Energy Strategy for 2006-2030, the Hungarian Government is also preparing a separate Hungarian Renewable Energy Strategy in line with the EU commitments in the area. This strategy is not open to the public, but consultation on the draft 60-page material was held with civil organisations and the industry. These stakeholders were invited to a meeting in the framework of the so-called Hungarian Renewable Roundtable on February 23, 2005. At the meeting, many commented that there is a need of further studies and thematic consultations. It was mentioned that renewable energy is also a possible tool to develop poorer rural areas. The opinion on the draft material made by 3 environmental organisations is open to the public and downloadable. (EClub-FOK). This opinion points out that the strategy is not ambitious enough. Hungary's target of 3.6% of renewable share of electricity by 2010 is the lowest among the EU countries, while in some areas the Hungarian renewable resources are above EU average.

The Minister of Environment and Water stated on January 5, 2006 that the Government will adopt the Renewable Strategy in 2006, which will boost the use of renewable energy, and which shows the way of development of environmentally friendly energy production (MTI).

The study material developed for the new energy strategy (GKM WG 12) shows the following development to be possible:
By 2010, Hungary can exceed its commitments to the EU. The economical and technical possibilities and the new incentives make this possible. The commitments were:
- 3.6 % renewable electricity of the electricity supply of 2010. (1 % in 2003)
- 4% bio fuels (bioalcohol and biodiesel) of the transport fuels
- 6.1% renewable energy of all energy supply. (3.5 % in 2003)

By 2010, according the study's conclusions:
- 4 % renewable electricity of the electricity supply of 2010. (1 % in 2003)
  The study's authors expect that this can be reached mainly with increase of biomass, new wind mills, while geothermal energy; hydro has small roles, and PV is not considered to be economic.
- 4.5 % bio fuels (bioalcohol and biodiesel) of the transport fuels

By 2025, the commitments can be
- 7-8 % renewable electricity of the electricity supply (mainly biomass and wind).
- 6.5 % biofuel of the transport fuels. The study sees as a realistic strategy to increase the production of bio fuels, bio-alcohol, rapeseed oil, and an introduction of a bio diesel program, as well as an agricultural program. The study's authors expect that this will be enforced by the increase of the price of oil and gas.
- 9 % renewable energy of all energy supply. The study's authors expect a big increase in solar-thermal collectors and geothermal used for heating, as well as solar architecture. PV is expected to increase, but still is not considered to be economical.

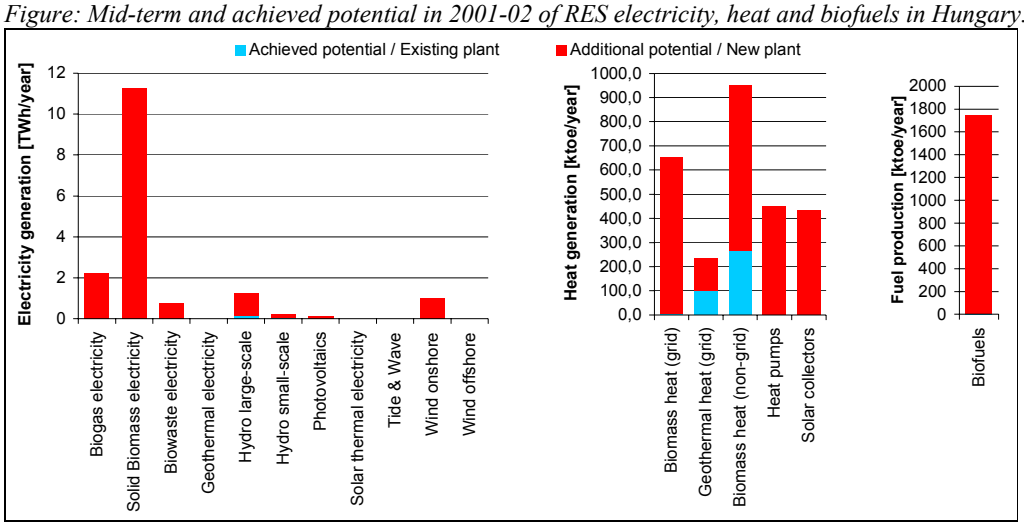
The above renewable percentages are of course depending also on how much the total energy supply will be in 2010 and in 2025, as well as on how much energy efficiency will be gained by that time. That depends on how the country can meet the targets of the Energy Saving & Energy Action Program (1999). This needs earmarked funding of projects, and more stringent building regulations, labelling, information campaigns, etc. There has been progress, but some of the processes have stalled; it is expected that they will get a push from the new National Energy Strategy in the first quarter of 2006.

In the following table and graph you can follow 2 estimations of the Hungarian renewable potential.

Table: A possible renewable energy development in Hungary, from the GKM WG 12 study.

	PJ			Power (TWh)		
	2003	**2010**	**2025**	**2003**	**2010**	**2025**
geothermic	3.60	7.40	14.40		0.10	0.39
solar thermal	0.07	0.18	2.60			
biomass total	32.79	56.49	78.90	0.13	1.56	2.97
hydro	0.62	0.84	1.10	0.17	0.23	0.30
wind	0.01	4.54	7.50	0.00	0.30	1.10
pv	0.00	0.10	0.20	0.00	0.01	0.02
waste burning	1.50	2.00	4.00	0.07	0.11	0.20
Renewables total:	**38.59**	**71.55**	**108.70**	**0.4**	**2.3**	**5.0**
bio fuel		6.6	10.9			
wood waste + energy plantation	18.20	33.20	46.70	0.1	1.5	2.8
forestry waste wood	4.80	5.00	7.00			
other biomass	9.60	11.00	13.00			
Biogas	0.19	0.69	1.30	0.0	0.1	0.1
Biomass total:	**32.79**	**56.49**	**78.90**	**0.1**	**1.6**	**3.0**

Figure: Mid-term and achieved potential in 2001-02 of RES electricity, heat and biofuels in Hungary. (EU COM)



Renewables could play a much bigger role in supply if there were to be a political decision in closing down the nuclear power plant's reactors according to their theoretical lifetimes. In December, 2005, Ernst & Young (E&Y) made a study drawing up different pragmatic scenarios with dramatic effects on CO_2 emissions. The scenarios show +83 % increase in case of nuclear power exit and fossil-fuel replacement, whereas, combining imports and 16% of renewables delivering 8% electricity, the scenario results in -19 % in emissions. However, a nuclear energy renaissance with new power plants (+ 3 %) and the business-as-usual scenario (+ 9 %) only experience a small increase. All of these scenarios need at least EUR 5-10 billion invested to ensure the long-term security of supply. The E&Y study is very interesting but quite theoretical as long as there is no political will from the Hungarian Government to effect a nuclear exit. Presently, the biggest driving forces for renewable energy are the need to meet EU targets and the pressures caused by increasing oil, gas and electricity prices.

7.4 Emission Trading Scheme and National Allocation Plan

Hungary made a commitment under the Kyoto Protocol to reduce its greenhouse gas (GHG) emissions to 6% lower than the average levels of 1985-87 by the period of 2008-2012. These numbers are different from those of the old-EU countries, where the reduction is 8% and the comparison level is that of 1990. The Hungarian emission base level is relatively high, because the Hungarian heavy industry decreased substantially since 1985-87, even though transportation emissions increased to balance this somewhat.
In short, the 1985-87 level was 111.7 $MtCO_2$, in 2001 the level was 79.5 $MtCo_2$, and according to official sources this is expected to rise to 102 $MtCO_2$ by 2012, when the gross GHG emission will be equivalent to 97 $MtCO_2$. These are all less than the Hungarian Kyoto commitment of 105 $MtCO_2$ by 2012. Though these emission estimations by 2012 could be different according to which energy policy Hungary will follow in the period, the fate of the 4 reactors of the nuclear plant is quite crucial.

The principles of the Hungarian National Allocation Plan (NAP) for the period of 2005-07 were accepted by the Hungarian government and the EU Commission in December, 2004. The Hungarian Parliament approved the new Act on Greenhouse Emission trade in April, 2005 to harmonise with the EU-ETS directive. (LAW ETS). The implementation is done by The Hungarian Ministry of Environment and Water (KvVM) and by the Ministry of Economy and Transport (GKM).

The EU Emission Trading Scheme (ETS) is valid since January 1, 2005. The companies can buy or sell (after buying), but in reality is that the companies are mostly active on the option market. According to estimations, Hungarian companies sold quotes on the option market, but in the contract they put in the possibility of the Hungarian system delay. (BusinessQ 24.01.2006)

In Hungary the actual trading did not begin in 2005. The reason for the delay is that the Hungarian NAP was modified several times since November, 2004, and the final version had not been approved yet by Brussels as of this writing (January 26, 2006). The approval was expected at the end of January, and the trading was to start in February according to Ministerial press communications dated January 6 and 25, 2006. (MTI)
However, delays can still occur, as the 2005 authorised emission reports have to be delivered by the companies by the end of March, and afterwards the allocations have to be given to the authorities by April, 2006. The electronic transaction list will be similar to electronic banking. It is controlled by the Emission Trading Department of the Hungarian Environmental and Water Inspectorate (OKTVF).

According to the Law XV on GHGs, the state should allocate at minimum 95% of the quotes to companies free in the first period, and at minimum 90% in the next period. (LAW ETS)
As long as the NAP still has not been approved, only drafts are available (KvVM). The volume of the Hungarian quote is changing according to different drafts. In the draft allocation plan of October, 2004, the volume of the allowances is 89.7 $MtCO_2$. In January, 2006, the Ministerial sources mention the volume of 93.7 million t CO_2. According to Ministerial (KvVM) sources from 2005, 97.5% is planned to be allocated to 170 companies' 263 installations; 2.5% will be sold by the state and used for emission-reduction-related state activities as well as for renewable energy resource support projects. These numbers have changed to 98.5% and 1.5%, according to sources from January, 2006. The majority of the quotes are planned to go to the energy supply companies of oil, biomass, and coal plants that are bigger than 20 MW (60%), then to companies from iron, steel, cement, glass, construction-material and paper industries (30%), and about 2% is reserved for new entrants. (Draft NAP). The number of the installations varies in the period of negotiations. By February, 2005, there were 236 Hungarian installations that got the permission, and by January, 2006, there were 229 installations, which will get the exact quote when the system starts. This number can be compared to the total of 11,500 in the entire EU.

The companies can decide whether they will sell or buy quotes. The trading can be done on a stock exchange as well as outside of a stock exchange. Because of high annual fees and complicated legal procedures, even the bigger Eastern European companies have not registered themselves on the Western European stock ex-

changes. Seeing this barrier, Vertis, an Environmental Financial Advisor Company ltd, will start soon an internet portal for the trade, where there will be no annual registration fee, but only fees after the transactions. The actual accounting will be done by APX, Amsterdam Electric Stock Exchange. It is aimed to meet the needs of the region, where, even though there are restrictions, the companies will sell more. Therefore, Vertis is looking to link its platform with other regions' stock exchanges where the companies are buying more. (BusinessQ 24.01.2006)

On January 5, 2006, the Hungarian Minister of Environment and Water said to the major Hungarian information agency (MTI) that he expects the emission trading system will boost investments in renewables, because they can be accounted as quotes.

In March, 2005, the EU Environmental Ministers stipulated a target to decrease the GHG emissions level by 15%-30% by 2020, and by 50%-60% by 2050. For Hungary these could be translated to a decrease of its GHG emissions by about 22 % by 2020, and by 35% by 2030 compared to the levels of 1985-1987.
To meet these targets a new energy policy is needed, which needs new technical solutions. This could include solar cells, biofuels, energy efficiency in transport, and housing, hydrogen etc.
The ETS will not be a big burden for Hungary until 2012, but beyond that it will be a challenge for the energy industry, since the allocations will be less. (GKM WG 10)

Sources and Information:

GKM: Hungarian Ministry of Economy and Transport (www.gkm.gov.hu).

KvVM: Hungarian Ministry of Environment and Water, (www.kvvm.hu).

MEH: Hungarian Energy Office (MEH) (www.eh.gov.hu).

EK: Energy Centre Hungary (EK) (www.energycentre.hu)

GKM WG: Expert background studies made by Working Groups (WG) for the New Hungarian Energy Strategy 2006-2030, requested by the Hungarian Ministry of Economy and Transport (GKM). Publicly available for comments in January 2006:
- GKM WG 12: The Role of the Renewable Energy Resources in the Energy Supply, 2005 September;
- GKM WG 3: Scenarios of the Hungarian Energy Demand, and Consequences, 2005 December;
- GKM WG 10: Mid-term & Long-term Environmental Demands to the Hungarian Energy Supply, 2005 December;
- GKM WG 11: Energy Efficiency in the Hungarian Energy Policy, 2005 November.

- EClub-FOK: Opinion on the draft material to be prepared to the Government on the Hungarian Renewable Energy Strategy, the situation of using renewable energy, and the commitments towards to the EU. Made by Independent Ecological Centre, Energy Club Hungary and Renewable Energy Section of the Hungarian Association of Building Installation Technicians (MEGSZ), 28.02.2005.

IEA: International Energy Agency, Energy Policy in Hungary, 2003, and Energy Policy in OECD countries, 2005.

EBRD: Hungary Country profile made for European Bank for Restructuring and Development. 2003. (EBRD)

EU COM: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged EU COM(2004)366, Commission Staff Working Document. EC, Brussels, 2004.

Barometer: 2004, Biomass, PV, solar thermal, EUFORES.

LAW ETS: Hungarian Law 2005 XV on Greenhouse Emission Trading (ETS). (KvVM).

Electricity Act, VET 2001 CX Law. (EK)

Draft NAP. Draft National Allocation Plan, June, 2004; October 8, 2004. (GKM)

MTI: Hungarian Information Agency.

BusinesQ: News at the Business Quarter, 24.01.2006.
(www.origo.hu/uzletinegyed/hirek/hazaihirek/20060123azemissziokereskedelem.html)

GreenTech: Zöldtech database and news. (www.zoldtech.hu)

Sanyo: Sanyo Starts Full-Scale Photovoltaic Module Production in Hungary, Expand and accelerate sales in Germany and other European markets, July 20, 2005, (www.sanyo.co.jp/koho/hypertext4-eng/0507/0721-e.html)

E&Y: Ernst & Young study, 2005 December

Acronyms & Abbreviations

AEBIOM: Association Européene pour la Biomasse (European Biomass Association)
AES: US-based global power company, www.aes.com
AGIP: Fuel stations of ENI www.agip.eni.it, www.agip.it
ALTENER: Alternative (Renewable) Energy Programme of the European Community (non-technical)
b/d: barrels per day
BNFL: British Nuclear Fuels plc
CBI: Confederation of British Industry
CDM: Clean Development Mechanism
CEZ: Czech state-owned utility [www.cez.cz/presentation/eng/]
CHP: Combined Heat and Power (cogeneration of heat and electricity)
CIP: Competitiveness and Innovation Framework Programme
CIS: Commonwealth of Independent States
CMR: Carbon Management Response
CNG: Compressed Natural Gas
COOPENER: EC International Energy Cooperation Programme
CORDIS: Community Research and Development Information Service
DG TREN: Directorate General for Energy and Transport of the European Commission
DIY: "Do-It-Yourself" - describes the practice of doing or making something without professional training or help; e.g., DIY installation, in which homeowners install their own solar thermal systems.
DNC: Declared Net Capacity
€: Euro, 100 €c= 1 €
E.ON: German utility company [www.eon.com]
EC: European Commission
ECCP: European Climate Change Programme
ECN: Energy research Centre of the Netherlands [www.ecn.nl]
EdF: Électricité de France [www.edf.fr/259i/Homefr.html]
EE: Energy Efficiency
EEAP: Energy Efficiency Action Plan
EEB: European Environmental Bureau
EEC: European Economic Community
EEX: European Energy Exchange in Leipzig, Germany
EIA: US Energy Information Administration, www.eia.doe.gov
ENEL: Italian utility [www.enel.it/azienda_en/chi_siamo/missione/]
ENI: Italian Energy Company, [www.eni.it]
EPIA: European Photovoltaic Industrialists Association
EREF: European Renewable Energy Federation
ESTIF: European Solar Thermal Industries Federation
ETBE: Ethyl Tertiary Butyl Ether, made from ethanol and petroleum
ETS: Emissions Trading Scheme
EUBIA: European Biomass Industry Association
EUGENE: European Green Electricity Network
EUFORES: European Forum for Renewable Energy Sources
EWEA: European Wind Energy Association
FP: Framework Programme
GJ: Gigajoule
GDF: French natural gas supplier company, [www.gazdefrance.com]
GDP: Gross Domestic Product
GHG: Greenhouse Gas
Gt: Gigatonne

GW: Gigawatt (1,000,000,000 watts)
HUF: The Hungarian currency (forint)
IEA: International Energy Agency
IEE: Intelligent Energy - Europe
IT: Information Technology
JI: Joint Implementation
kWh: Kilowatt hour. 1,000 watts applied for one hour or 1 watt applied for 1,000 hours
LNG: Liquified Natural Gas
LPG: Liquified Petroleum Gas
MoD: UK Ministry of Defence
MOL: Hungarian Oil & Gas Company Plc, www.mol.hu
Mt: Million tonnes
$MtCO_2$: Million tonnes of carbon dioxide
Mtoe: Million tonnes of oil equivalent
MTBE: Methyl Tertiary Butyl Ether, made from natural gas and petroleum
MVM: Hungarian Power Companies, [www.mvm.hu]
MW: Megawatt (10^6 or 1,000,000 watts)
MWp: Megawatt peak
NAP: National Allocation Plan
NGO: Non-Governmental Organisation
Nordpool: Nordic Power Pool
ODA: Official Development Assistance
OECD: Organisation for Economic Cooperation and Development
OMV: Austrian oil and gas company, [www.omv.com]
PJ: Peta Joule (10^{15} or 1,000,000,000,000,000 joules)
PSO: Public Service Obligation
PV: Photovoltaic
R&D: Research and Development
RE: Renewable Energy
REC: Renewable Energy Corporation (based in Norway)
REFIT: Renewable Energy Feed in Tariffs
RES-E: Renewable Energy Sources - Electricity (Directive)
RO: Renewables Obligation
ROC: Renewable Obligation Certificate
ROME: Rapeseed Oil Methyl Ester
RTD: Research and Technical Development
R&D: Research & Development
SAVE: Specific Actions for Vigorous Energy Efficiency, EU Programme for Energy Efficiency
SEC(200x): Communication from the EC: Staff Working Document in Year 200x
SF: Structural Funds
STEER: EU Programme for Energy Efficiency in Transport
t: As used in the present document, always represents a metric tonne (1,000 kilograms).
TACIS: Technical Assistance to the CIS (or Commonwealth of Independent States) (now EuroAid)
tonne: Metric tonne [1,000 kilograms or 1.1023 US short tons]
TP: Technology Platform
TPES: Total Primary Energy Supply
TUC: Trades Union Congress
TWh: Terawatt hour (10^{12} or 1,000,000,000,000 watt-hours).
UK: United Kingdon
US: United States
VET: Hungarian Act on Electricity (VET 2001 CX Law)

Contents of Annexes 25 Fact Sheets for the EU Countries

EU

Population: 456.9 million (2004)

GDP: 10,289 billion € (2004) = 22,521 €/capita

GHG emissions: 4,925.1 million tons CO_2 equivalence (2003) = 10.8 tons/capita

GDP growth rate: 2.4 (2004), 1.2 (2003)

Balance of state finances (%GDP): -2.6 (2004) -3.0 (2003)

Balance of current account (% of GDP): 0.0 (2003)

Unemployment: 9% (stabile in 2003-04)

Increase of TPES: 2.3 % (2004/2003)

Electricity Production: 3,082 TWh

District Heating: 3.3 %

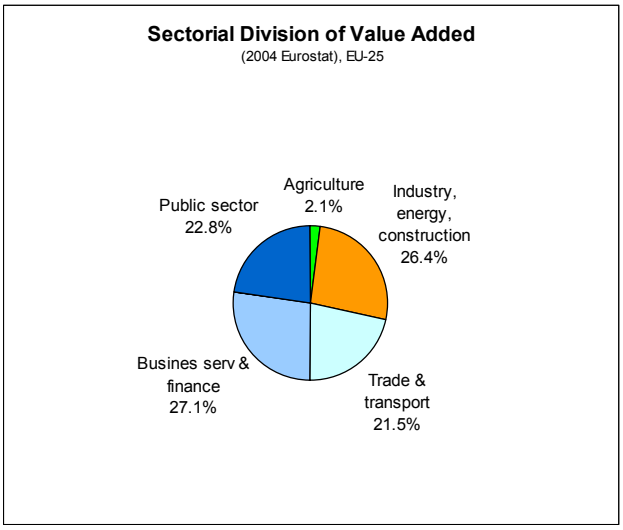
Grid loss of net production: 7.2 %

Aviation share of Transport: 13%

CHP/total power: 18.4%

Loss/production electricity: 1.5

(From Statistics: Eurostat and IEA)



AUSTRIA

Population:
8.1 million (2004)

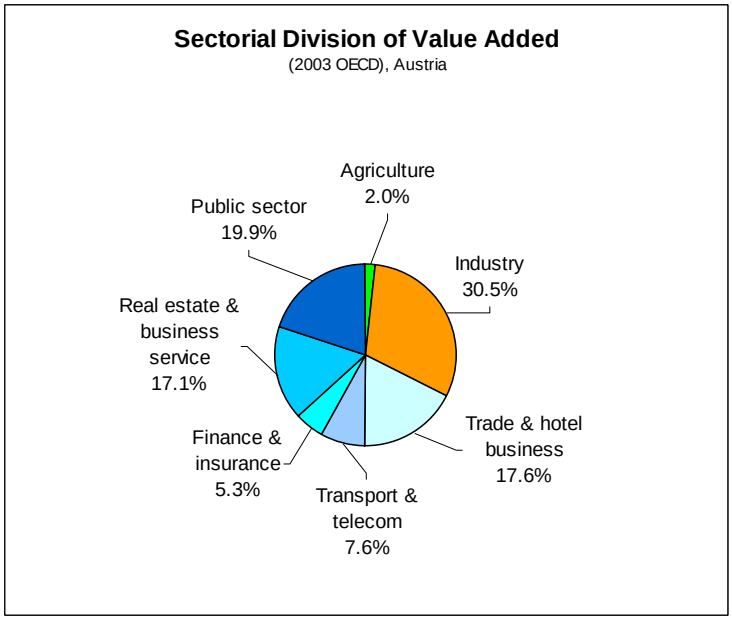
GDP:
237 billion € (2004)
= 29,115 €/capita

Greenhouse-gas emissions:
91.6 million tons CO_2 equivalent (2003) =
11.3 tons/capita

Economic Sectors
Private service sectors contribute 48% of the value added of Austria, which is close to the EU average. Agriculture contributes 2%, which is around the EU average, while industry contributes 30%, which is higher than EU average.

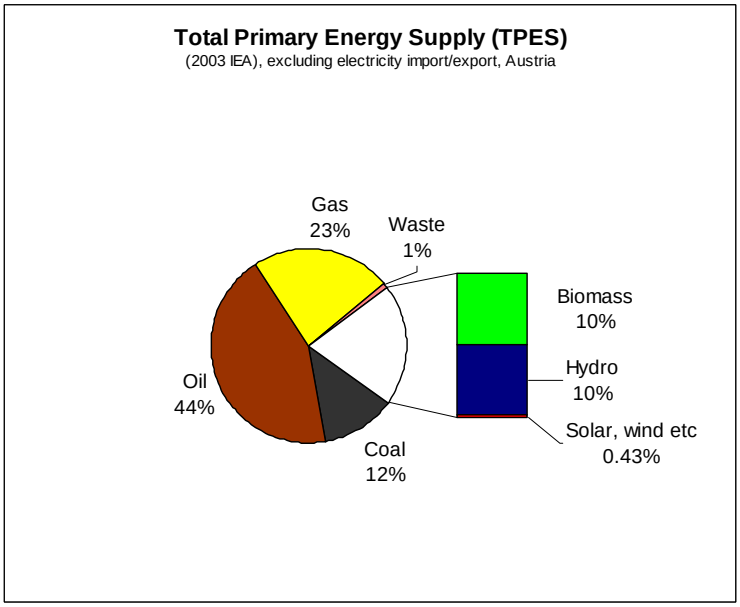
This relatively small and rich republic was the central power of the large Austro-Hungarian Empire before the First World War. The Austrian GDP per capita of 29% is above the average of the EU, while the GDP growth rate was 2.4% in 2004, average for the EU. The unemployment rate of 4.8% is among the EU's lowest. The economy is stable with a small deficit on state finances (-1.0% of GDP in 2004) and a small negative current account balance in its foreign exchange (-0.5% of GDP in 2003) (Eurostat 2005).

Leading industries are iron and steel, textiles, chemicals, and tourism, as well as electric machinery and equipment, pulp and paper, ceramics, and food. The country is taking steps to change its image from steel and heavy engineering towards electronics, biotechnology, and pharmaceutical sectors. Austria is famous for its skilled craftsmen (e.g., glassblowers, jewellers), and classical-music events. The town of Wels became a major annual meeting place of the renewable-energy industry in Central and Eastern Europe.



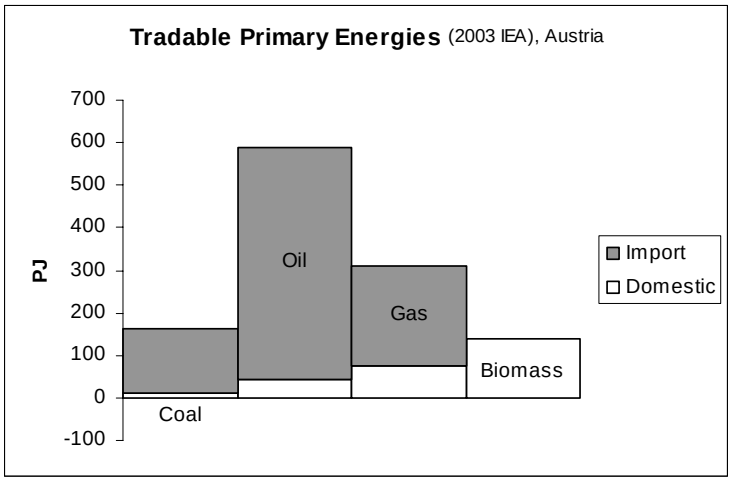
Energy Supply and Demand
The Austrian energy supply is dominated by imported oil that contributes 44% of the total primary energy supply (TPES), followed by gas (23%), coal (12%), biomass (10%) and hydro (10%).
The domestic production of gas is 24% of the gas supply, for oil 7% of the oil supply, and for coal 7% of the coal supply (2003-IEA).
The TPES was 1,351 PJ in 2003, not including electricity import. It increased 7% in 2003, partly weather related.
In the supply structure, oil is dominant, covering 47% of total final consumption (TFC), followed by electricity covering 19% and gas covering 17%. (TFC, 2003-IEA).

Austria has imported some of its electricity in recent years, 10% in 2003 (2003-IEA).
The district heating is above the EU average, supplying 4.6% of TFC.



The demand structure is dominated by industry, transport and residential consumption. Among industrial sectors, paper, pulp and print are the largest energy consumers. They account for 18% of industrial energy consumption, followed by iron and steel (16%), chemical industry (14%) and construction (12%) (2003 IEA).

Transport includes aviation, which accounts for about 7 % of transport energy use.
"Others/non-specified" are primarily non-energy oil use and agriculture.

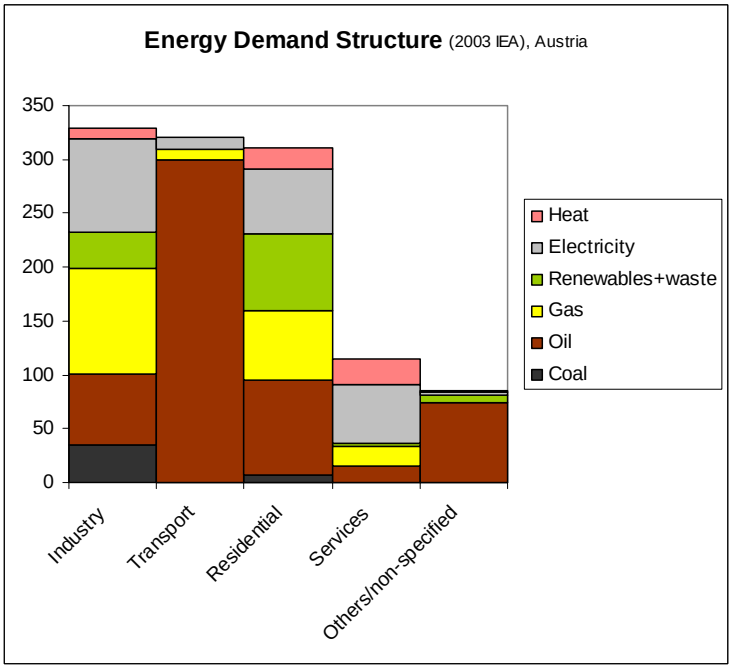


Electric Power Supply

Austria's power supply structure is dominated by hydro power stations, which supply 60% of electricity production, followed by gas (18%), and coal (15%) (2003 IEA).
The total production was 61 TWh in 2003 (IEA).

The efficiency of the power sector is high, as hydropower and cogeneration of heat and electricity are widely used; losses in the electricity and CHP sector are 0.46 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 5% of electricity production.
14% of the power production is from CHP plants.

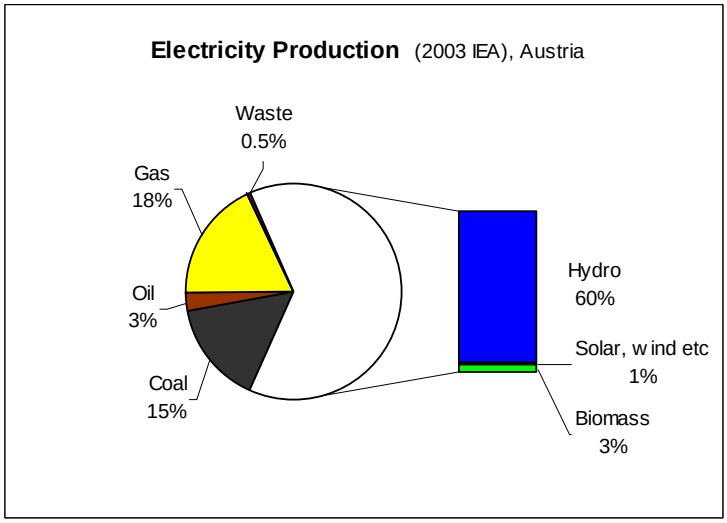
The electricity distribution losses of 5% are below the EU average (2003 IEA).



Renewable Energy

Austrian renewable energy is mainly generated from biomass and hydro, with minor but increasing supplies from solar thermal, geo thermal, wind power, and renewable municipal waste.

The largest component of Austria's renewable energy comes from biomass (2003), of which solid biomass composes the major part (98%), with the remainder from liquid biomass (0.5%) and biogas (1.5%). The production of both solid and liquid biomass has increased since 1990. Significant development of liquid biomass occurred in 2004, with production in Austria increasing by 78%. Production of biogas has been stable since1999.



The other important renewable energy in Austria is hydro. Production has been stable since 1990, with large yearly fluctuations due to variations in rainfall.

Of biomass and wastes, roughly one fourth is used by electricity plants, CHP plants, and heat plants. One half is used for residential purposes. One fourth is used by industry, particularly by the paper and pulp industry and by the wood and wood products industry.

Austria ranks fourth among EU countries, after Latvia, Sweden, and Finland, in consumption of primary energy per capita from wood energy.

The fastest-growing Austrian renewable-energy source over the last decade was solar thermal energy. The country has played a leading role in thermal solar for many years. In 2004 it ranked third in the EU (after Germany and Greece) with respect to installed capacity as well as cumulative capacity of solar thermal collectors. A cumulative capacity of 2.4 million m^2 was installed in Austria by the end of 2004, equivalent to 0.3 m^2/capita. Only the small country of Cyprus has a higher use of solar thermal per capita among the EU countries. The development continues with support for solar heating in a number of Austrian regions.

PV and wind achieved significant growth. Their development started basically from scratch in 2003 as a result of the feed-in tariffs that were introduced. In 2004, the installed capacity of wind grew more than 200% to 606 MW. In 2005, the growth rate was 35%, resulting in an installed capacity of 819 MW by the end of the year. (EWEA)

In 2005, Austria had nine large-scale and three pilot biodiesel plants with a combined biodiesel production capacity of more than 100,000 tonnes per year. In 2003, 55,000 tonnes of biodiesel were produced in Austria and approximately 90% of this quantity was exported to other countries, as the price that could be obtained for biodiesel in Italy and Germany was higher than that in Austria. Austria does not have a bioethanol production plant. (ECN).

Renewable-Energy Promotion and Policies

As a member of the EU, Austrian has a national target of deriving 78% of its electricity from renewable energy (compared with 62.8% in 2003) by 2010. The renewable energy development has been promising in recent year, but if proposed new feed-in tariffs are enforced, it is not likely that Austria will meet the target.
The biofuel target is 5.75% renewable energy in transport, to be reached already by 2008. By 2008, the aim is to use 481,900t of biodiesel and 150,000t of bioethanol.

In January, 2003, the obligations to buy renewable electricity with a high feed-in tariff system was introduced, which was a major modification of the Austrian RES policy. The tariffs included in the Renewable Energy Act stimulated significant growth especially for wind, biomass electricity and small hydro power. The instrument was effective for new installations obtaining permits by December, 2004 and finished before June 2006 (end of 2007 for biomass-fired installations).
The feed-in tariffs were 47-60 €c/kWh for PV, 10-16 €c/kWh for solid biomass and biogas, 10-13 €c/kWh for liquid biomass and 7.8 €c/kWh for windpower, and were set at lower levels for small hydro. For PV, an upper limit of 15MWp was installed for all of Austria. Installations are still constructed based on permits from 2004, e.g. the installations of windpower was 218 MW based in 2004, based on permits from 2004. The government is working on a new feed-in tariff system with substantially lower tariffs and with a fixed price for only 10 years. It is expected that the new system will be approved by the Austrian Parliament and enter into force in 2006, and that they will slow down development compared with 2004-2005 (IGWIND).

Renewable-energy heat production is supported by the environmental support program with a subsidy of around 30% of the investment costs. There is a wide variety of additional policy measures for the support for at the provincial level in specific regions.

Biofuels for transport get more than 95% tax reduction of vehicle fuel tax.

National coordination of renewable-energy development is done by the Austrian Energy Agency. There are at least seven regional energy agencies and four local energy agencies active in information and promotion of renewable

energy. Seven of them receive or have received support from the EU for their operation and start-up. (ManageEnergy)

The main barriers are the short period for the feed-in tariff system (2002-2004) and the limits placed on PV. If the proposed feed-in tariff system is enforced in 2006 as planned, it will be a barrier that tariffs for new renewable electricity installations are too low and paid for too short time.

Geographical Distribution of Renewable Energy

While biomass and solar installations are located throughout the country, wind power is limited to certain sites. In general, the wind conditions are less favourable in landlocked Austria than along the Atlantic, Baltic and Mediterranean coasts.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was notified to the European Commission in March, 2004.
The Commission accepted the plan in July, 2005 after some negotiation. The plan was then enforced for the 205 installations that it covered.
In 2005-2007, the NAP covers emissions of 32.86 $MtCO_2$ annually, equivalent to 35.8 % of total GHG emissions. Credits of 7.31 $MtCO_2$ annually are given to the energy sectors (IEA 2005 and EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition, (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

EWEA: European Wind Energy Association Press release, February 1, 2006: European Record for Windpower

Barometer: 2005, EurObserv'er, Systemes Solaire, and EUFORES.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport, www.managenergy.net

ECN: Overview and Analysis of National Reports on the EU Biofuel Directive, Prospects and barriers for 2005, May 2005, Centre of the Netherlands (ECN).

IGWind: Austrian Wind Energy Association, www.igwindkraft.at

BELGIUM

Population:
10.4 million (2004)

GDP:
284 billion € (2004)
= 27,317 €/capita

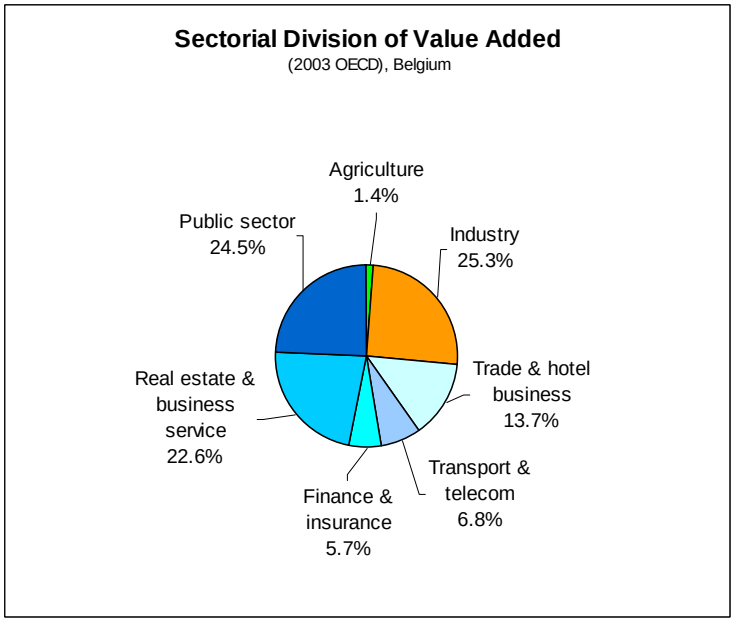
Greenhouse-gas emissions:
147.7 million tons CO_2 equivalent (2003) = 14.2 tons/capita

Economic Sectors

Private service sectors contribute 49% of the value added of Belgium, which includes a relatively large real estate and business service sector (23%). The public sector is relatively big, while agriculture contributes relatively less to the economy.

The Belgian GDP per capita is 21% above the average for the EU. The GDP growth rate was 2.6% in 2004, which was slightly above the EU average. The economy is generally in good shape with an unemployment rate of 7.9%, balanced state finances (0 % of GDP in 2004) and a positive current account balance in its foreign exchange (7.6% of GDP in 2003) (Eurostat 2005).

Belgium has diverse industries, e.g., chemicals, food, and others. Prominent companies include: Agfa-Gevaert (photographic and medical imaging media); Interbrew (beverages); Umicore (primary metals); Solvay (chemicals); Tessenderlo Chemie (chemicals); UCB (pharmaceuticals).

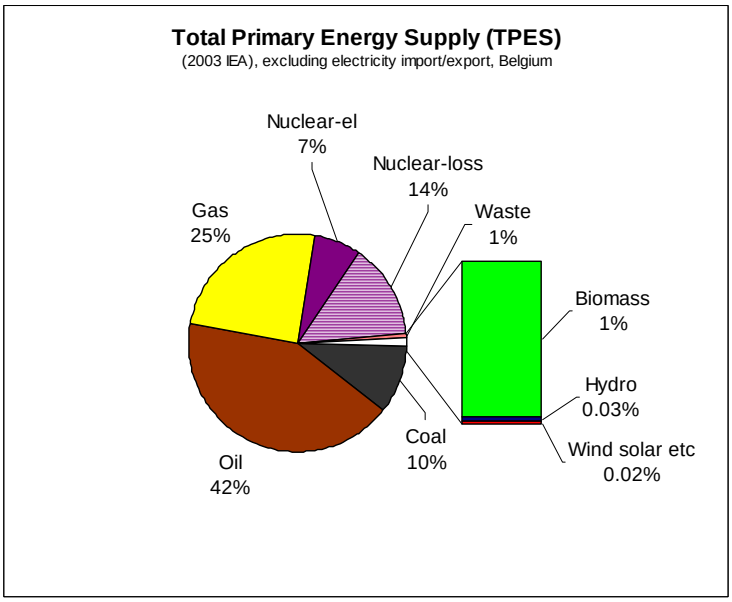


Energy Supply and Demand

The Belgian energy supply is dominated by imported oil and gas that contributes, respectively, 42% and 41% of total primary energy supply (TPES, 2003), followed by nuclear (21%). Domestic production accounted for 1% of the coal used in 2003; there is no domestic production of oil or gas (2003-IEA).

The TPES was 2,421 PJ in 2003, not including electricity imports. It increased by 5% in 2003.
In the supply structure, oil is dominant, covering 53% of total final consumption (TFC), followed by gas at 25% and by electricity, covering 16%. (TFC, 2003-IEA).

Belgium has imported electricity in recent years, 8% of its supply in 2003. (2003-IEA).
Use of district heating is below the EU average, supplying 1% of TFC.



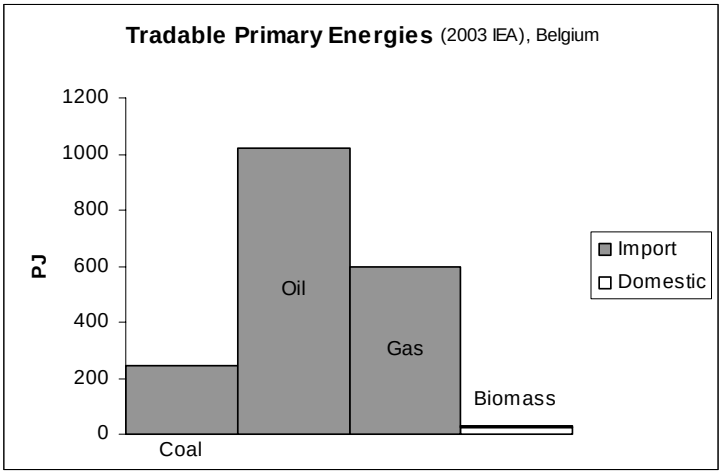
The demand structure is dominated by industry, transport, and residential consumption. Among industrial sectors, chemicals and petrochemicals are the largest energy consumers. They account for46% of industrial energy consumption, followed by iron and steel (18%), non-metallic minerals (8%), and food and tobacco (7%) (2003 IEA).

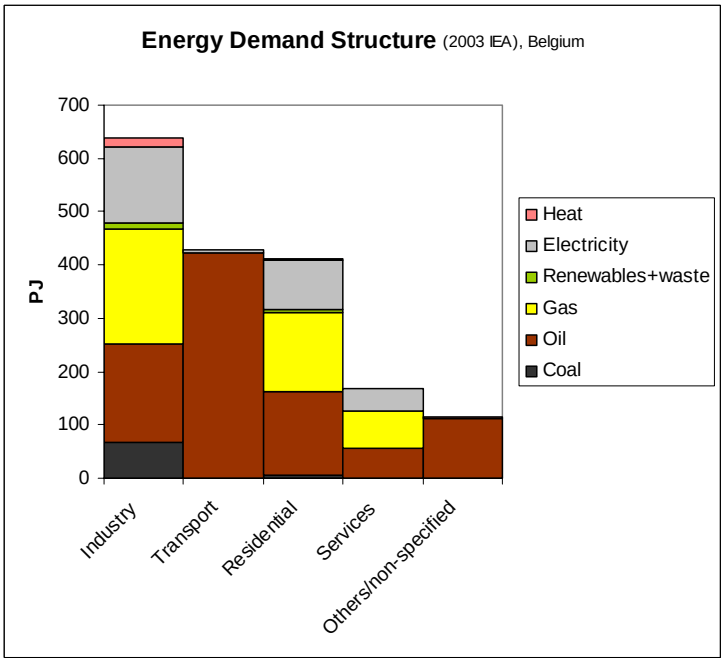
Transport includes aviation, which represents about 2% of transport energy use.
"Others/non-specified" is primarily non-energy oil use and agriculture along with non-specified energy use.

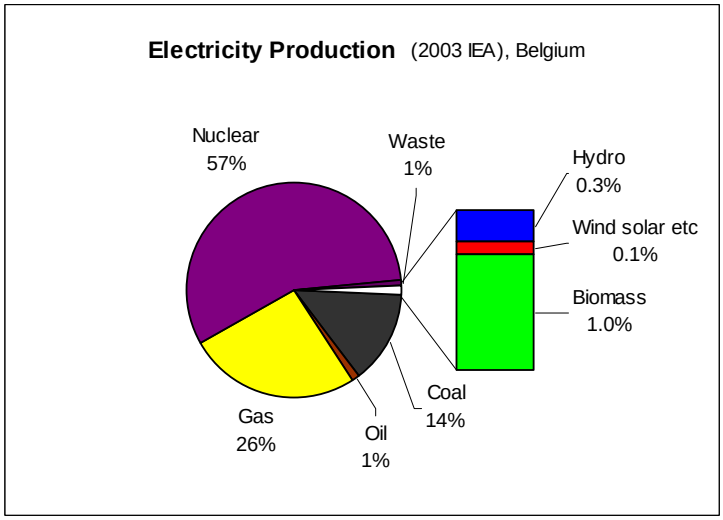
Electric Power Supply

The power supply structure of Belgium is dominated by nuclear power stations that supply 57% of the country's electricity production, followed by gas (26%), and coal (14%) (2003 IEA).
The total production was 84 TWh (2003 IEA).

The efficiency of the power sector is relatively low as cogeneration of heat and electricity is little used; losses in the electricity and CHP sectors are 1.8 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption 8% of electricity production. 9% of the power production is from CHP plants.
The electricity distribution losses of 5% are below the EU average (2003 IEA).







Renewable Energy

The renewable energy in Belgium is mainly generated from biomass, renewable municipal waste and, to a minor degree, hydro.

The largest use of renewable energy is by far biomass, of which solid biomass is most important (91%), supplemented with a smaller amount of biogas (9%). Production has been increasing since 2000.

The second most important renewable energy source is renewable municipal waste.

Together with renewable and non-renewable wastes, biomass is mainly consumed by electricity producers, followed by other industries (paper, pulp and printing products, wood and wood products) and by the residential sector.

The third most important renewable energy is hydro. Production has been stable since 1990 with large yearly fluctuations due to variations in rainfall.

Modest development of windpower and solar is in progress. The windpower capacity reached 167 MW by the end of 2005.

Belgium is endowed with substantial potentials for increased use of renewable energy, for windpower including off-shore windpower, as well as for biogas and solar.

Renewable Energy Promotion and Policies

In Belgium, renewable energy is mainly promoted through public education and through subsidies, along with green certificates with minimum prices and obligations to buy renewable electricity.
Within the EU, Belgium has a national target of 6.0% of its electricity to be covered with renewable energy (compared with 1.4% in 2003) by 2010. The installation rates for renewable energy are not high enough to reach the target.

Coordination of renewable energy is divided among the three regions of Belgium, i.e., Flanders, Wallonia, and Brussels, which complicates development. Promotion of off-shore windpower is managed at the federal level.

There are four Green certificate systems for renewable electricity, for the four regions, offshore being a special region. Given the relatively low penalties for non-compliance of electricity suppliers that do not purchase sufficient renewable electricity, many have chosen to pay penalties. The grid operators have to buy green certificates at a minimum prices:
- 15 €c/kWh for PV, in Flandern this has been increased to 45 €c/kWh from 2006;
- 9-10.7 €c/kWh for off-shore windturbines, the first 216 MW get the high price;
- 5 €c/kWh for onshore windpower and hydro;
- 2 €c/kWh for biomass and other renewables.

Each region's centres and networks of NGOs are in charge of information. Two of these regional energy agencies/networks have receive EU-support for their operation, mostly during their establishment and first years of operation. (ManageEnergy).

Subsidies available for solar thermal are highest in Wallony; but the rates also vary within each region. The subsidies are 1,500-3,000 € per installations in households. For PV there is 10% subsidy in Flanders. In addition, there is a federal tax reduction of 40% for solar investments, with a maximum of 1,280 €. In Wallony there is a subsidy of 15% for companies' renewable-energy investments. Other specific regional and local subsidies exist.

There is a partial tax exemption for biofuels and no tax on pure plant oils for transport. Tenders for biofuels are planned for 2006 and 2007.

The main drivers for the development of renewable energy are national policies. In recent years, increasing prices of imported energies have given an additional impetus to investment in renewables.

A number of barriers have slowed the development of renewable energy. The barriers can be grouped in a number of categories:

- Little knowledge of the new technologies and of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Low prices for renewable electricity, e.g., for biomass and onshore windpower.
- Regulations vary in different parts of Belgium, creating quite small markets for renewables and for Green Certificates.
- Long administrative procedures, in particular for windpower.
- Difficulties with grid connections of renewable-electricity producers.
- Densely populated country with few sites for windpower on land and relatively small biomass production.

Geographical Distribution of Renewable Energy

No specific geographical distribution; though wind conditions are generally best near the sea.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was notified to the European Commission in June, 2004.
The European Commission accepted the plan in October 2004, and it was then enforced for the 363 installations covered.
In 2005-2007, the NAP covers the emissions of 53.91 $MtCO_2$ annually, equivalent to 36% of total GHG emissions.
Credits of 18.39 $MtCO_2$ annually are given to the energy sectors. (IEA 2005 and EU NAP)

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

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EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

European Wind Energy Association, press release Feb. 1, 2006: European Record for windpower.

Belgian Electricity and Gas regulator, CREG, see www.creg.be.

Energy information: www.energiesparen.be.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

Information on biofuels from Premia, December 2005, presented at the conference Clean Vehicles and Fuels, Nov. 2005, Stockholm, www.premia-eu.org.

CYPRUS

Population:
0.7 million (2004)

GDP:
13 billion € (2004) =
17,798 €/capita

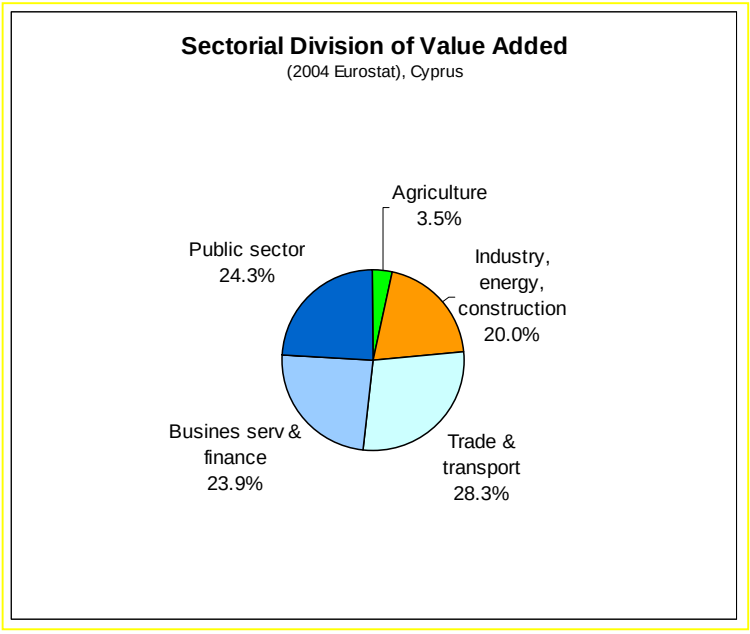
Greenhouse-gas emissions:
9.2 million tons CO_2 equivalent (2003) =
12.6 tons/capita

Economic Sectors

The service sectors contribute 76 % of the value added of Cyprus, which is slightly higher than the EU average. Agriculture (3.5%) contributes much more and industry (20%) contributes less to the economy than the EU average.

The GDP per capita in Cyprus is 79% of the average in EU, while the GDP growth rate is significantly above the average, 3.8% in 2004. The unemployment rate is among the lowest in the EU (5.2 % in 2004). The economy is troubled, with a deficit on state finances (-6.3% of GDP in 2004) and a negative current account balance in its foreign exchange (-3.5% of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer countries, Cyprus receives support from EU structural funds.

Industries include food and beverage processing; cement and gypsum production; ship repair and refurbishment; textiles; light chemicals; metal products; wood, paper, stone and clay products.

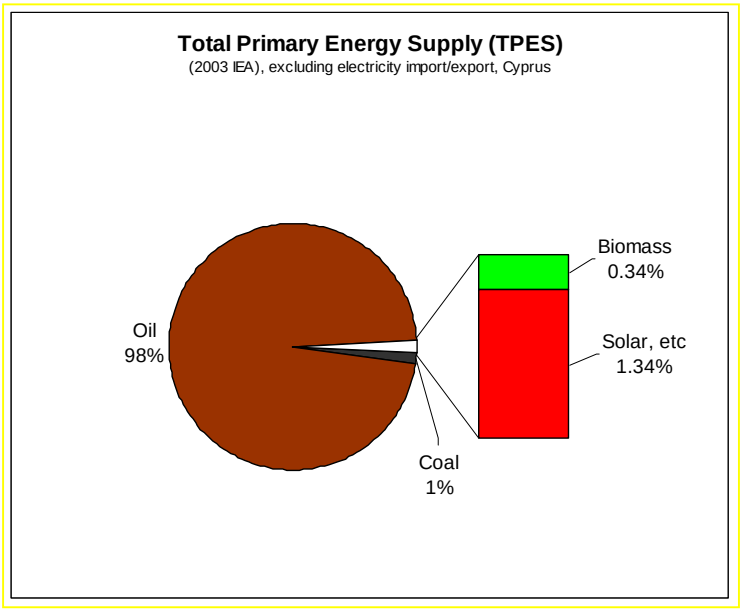


Energy Supply and Demand

The energy supply of Cyprus is extremely dominated by imported oil, which provides 98% of the total primary energy supply (TPES).
There is no domestic production of any fossil fuels (2003-IEA).
The TPES was 111 PJ in 2003. It increased by 8.5% in 2003.

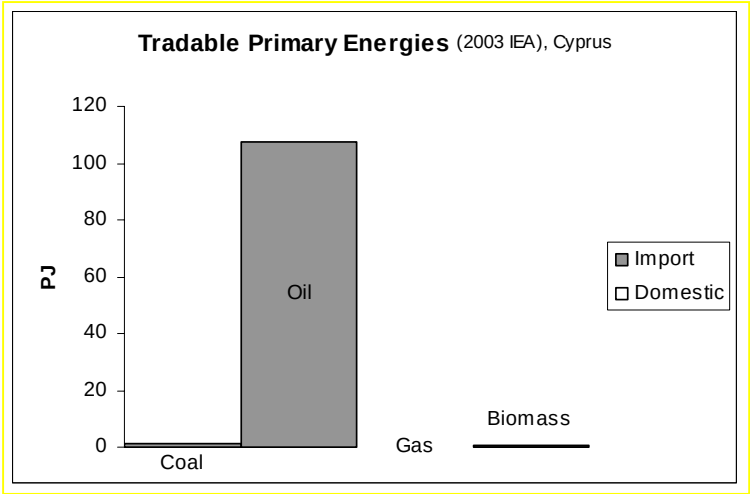
In the supply structure, oil is dominant, covering 79% of total final consumption (TFC), followed by electricity, covering 17%. Gas is not used (TFC, 2003-IEA).

Cyprus has not imported electricity (2003-IEA).
District heating is not used.



The demand structure is dominated by transport, followed by industry and residential consumption. Of the small industrial production sectors, half of the energy is used for non-metallic minerals (48%) (2003 IEA).

Transport includes aviation, which accounts for about 35% of transport energy use.
"Others/non-specified" is primarily non-energy oil use along with agriculture.



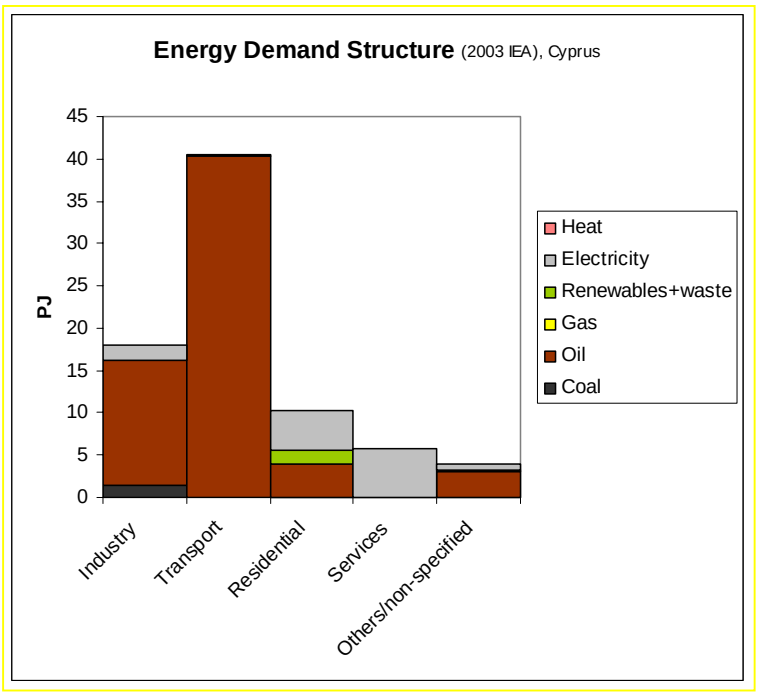
Electric Power Supply

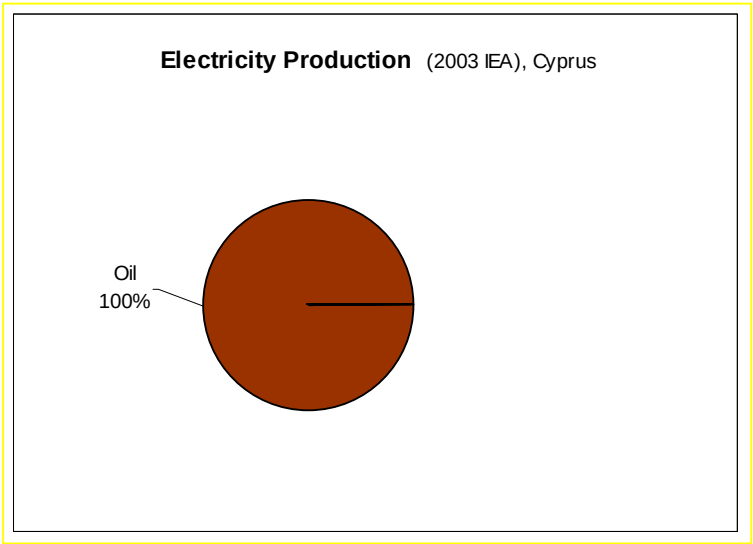
The power supply structure of Cyprus is totally dominated by oil-fuelled power stations that supply 100% of the country's electricity.
The total production was 4 TWh in 2003. (IEA).

The efficiency of the power sector is low, as co-generation of heat and electricity is little used, and the losses in the electricity and CHP sector are 2.2 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 5.5% of electricity production.

There is no power production from CHP plants.

The electricity distribution losses of 4.2% are below the EU average (2003 IEA).





Renewable Energy

Cyprus' renewable energy use is mainly from solar thermal and biomass.

The largest use of renewable energy is solar thermal, of which Cyprus had remarkable development, mainly for hot water, during the 1980's and 1990's, and currently has the largest solar collector surface in any EU country (0.58 m^2/capita). The level has been almost constant since 1998, about 415,000 m^2. The solar thermal market of 30,000 m^2 annual installed collector surface (2004) is replacing old installations.

Second in renewable energy is biomass in the form of wood, used in the service and residential sectors. (2003 Eurostat). PV is also used on the island; the installed capacity was 190 kWp by the end of 2004.

Cyprus is endowed with good potentials for increased use of renewable energy, for solar, windpower and biomass.

Renewable Energy Promotion and Policies

On Cyprus, renewable energy is mainly promoted with subsidies and feed-in tariffs. Within the EU, Cyprus has a national target of producing 6% if its electricity from renewable energy (compared with 0.01% in 2004) to be reached by 2010. The installation rate for renewable energy electricity is almost zero. The renewable-electricity target could be reached by 100-MW windpower with annual production of 2,400 full-load hours. Cyprus does not have a reduction target in the Kyoto Protocol (non-annex-1 country).

National coordination of renewable energy development is carried out by the Cyprus Institute of Energy (CIE), under the Ministry of Commerce, Industry and Tourism.

Subsidies can be given to wind, solar, biomass, and landfill-gas utilisation, on the order of 30%-40% of investments.

Feed-in tariffs are available for renewable electricity. The standard tariff is 6.3 €c/kWh. Special schemes are available for PV and windpower:

- PV: up to 5 kW: 20.4 €c/kWh;
- Wind: 9.2 €c/kWh for the first five years; then, for 10 years, 4.8-9.2 €c/kWh, depending on annual wind speed.

Biofuels can be supported with investment grants of up to 40% of biofuel production facilities, along with lower vehicle taxes for flexible-fuel cars. In addition there is an intention to use biofuels in government vehicles. Most emphasis is on used edible oils as biofuels and on their conversion to biodiesel.

The main drivers for the future development of renewable energy are expected to be national policies as well as increasing prices of imported energies.

A number of barriers have slowed the development of renewable energy in recent years. Main barriers are:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Energy infrastructure set up for oil use.

Geographical Distribution of Renewable Energy

No special geographical variation; but few free places are available for windpower on the densely populated island.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was notified to the European Commission in October, 2004.

The European Commission accepted the plan in December, 2004, and it was then enforced for the 13 installations covered. In 2005-07, the NAP covers the emissions of 5.7 $MtCO_2$ annual average, equivalent to 60% of total GHG emissions. For the power sector, allocations are on average 66% above average emissions for 1990-2003. Annual credits of 3.9 $MtCO_2$ on average are given to the energy sectors (IEA 2005 and EU NAP).

Sources and Information:

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Barometer: Solar Thermal, PV 2005. EurObserv'er, Systemes Solaire, and EUFORES.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

CIE: Cyprus Institute of Energy, under Ministry of Commerce, Industry and Tourism, www.cie.org.cy.

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CZECH REPUBLIC

Population:
10.2 million (2004)
GDP:
87 billion € (2004) = 8,520 €/capita

Greenhouse-gas emissions:
145.4 million tons CO_2 equivalent (2003) = 14.2 tons/capita

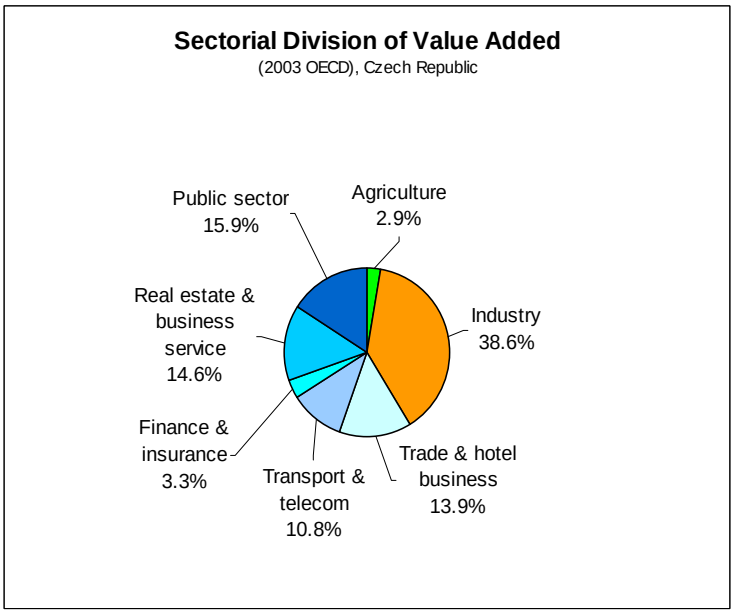
Economic Sectors

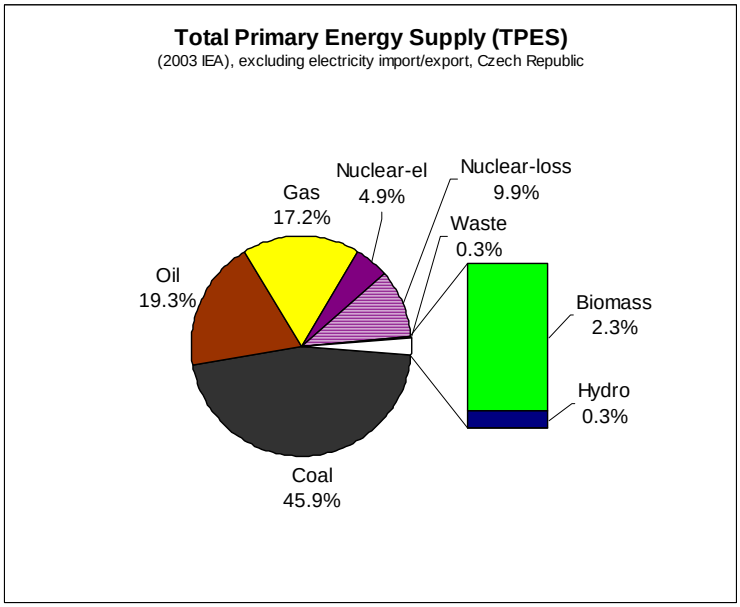
The service sectors contribute 58 % of the value added of the Czech Republic, which is one of the lowest in the EU; and the industry is 38.6%, which is one of the EU's highest.

The economy of this new EU country has shown a steady increase in GDP, with a growth higher than the EU average (3.2-4.4 % in 2003-04).
The GDP/capita is about 38% of the EU average, but it is the second-highest among the new EU countries on the continent.

The unemployment rate is close to the EU average (9.1 % in 2005); however, it has grown since 2002, when there was a low point of 7.3%.
The Czech Republic has balance problems from a deficit of state finances, which doubled in 2003 and suddenly dropped in 2004 (-12.5% of the GDP in 2003, and -5% of GDP in 2005), and a negative current account balance in its foreign exchange, which is slightly increasing since 2000 (-6.1% of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer EU countries, the Czech Republic receives support form EU structural funds.

The country has a strong machinery industry in which huge structural changes took place in the early 90s. This led to closure of inefficient companies and the rest was privatized or directly sold to foreign investors. Geographically, the industry is located in throughout Bohemia and Moravia, which historically are administrative regions of the Czech Republic.





Energy Supply and Demand

The Czech energy supply is dominated by coal (46 %), which is almost all domestic. This is followed by imported oil (19 %), imported gas (17 %) and nuclear energy (15 %). The renewable energy play a smaller role (2.5%) in the total primary energy supply (TPES). (2003-IEA).

The Czech Republic is a net exporter of coal. The net export was 11% of its coal production in 2004.

The TPES was 1,880 PJ in 2003, not including electricity exports. It has been increasing since 1999 at approx. 1 % per year (TFC, 2003-IEA).
A considerable part of the power is exported; in 2003, net electricity export was 22% of net production.

tion.

In the final demand, coal is still used in all sectors (14% of TFC), while district heating is important, covering 10% of TFC (2003 IEA).

The demand structure is dominated by industry (36%) followed by residential (23%) and transport (23%) consumption.
Among industrial sectors, the chemical and petrochemical industry is the largest energy consumer. It accounts for 24 % of the industrial energy consumption. This is closely followed by iron and steel, which consume 22%, and by non-metallic minerals (12 %), machinery and transport equipment (11%), and food (9%).

Transport includes aviation, which represents about 4.5 % of transport energy use.

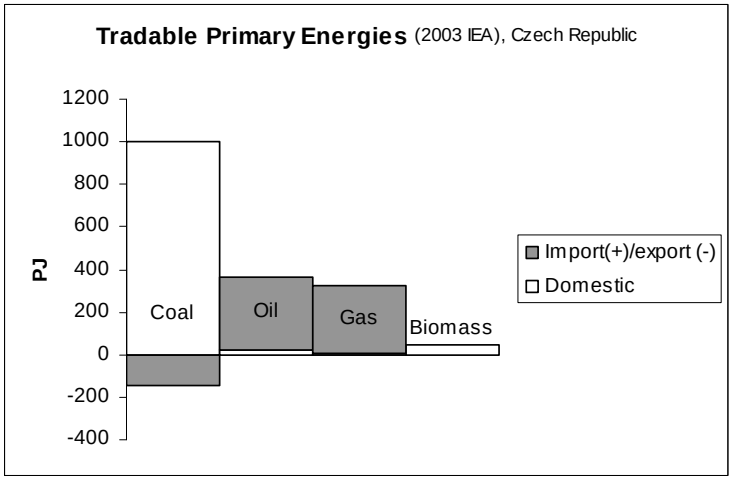
"Others/non-specified" is primarily non-energy oil use. It also includes agriculture and non-specified energy use.

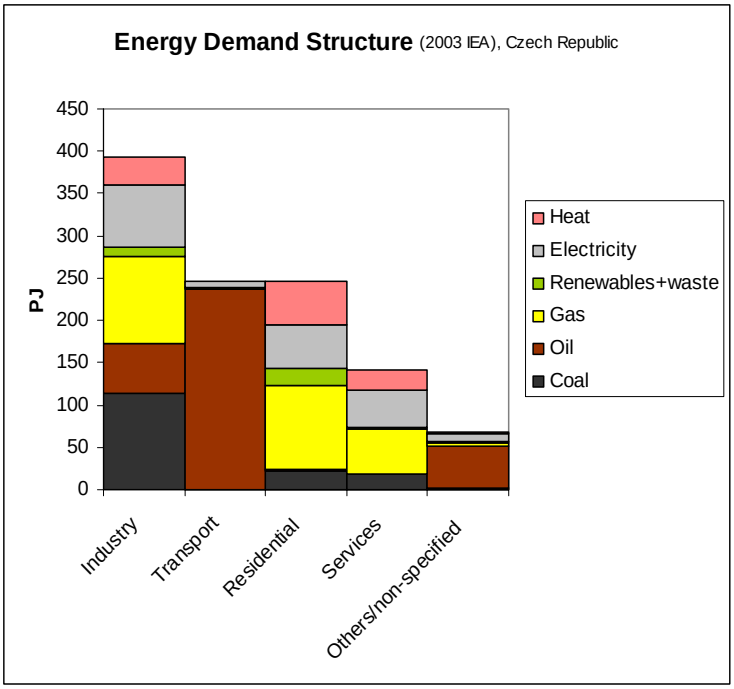
Electric Power Supply

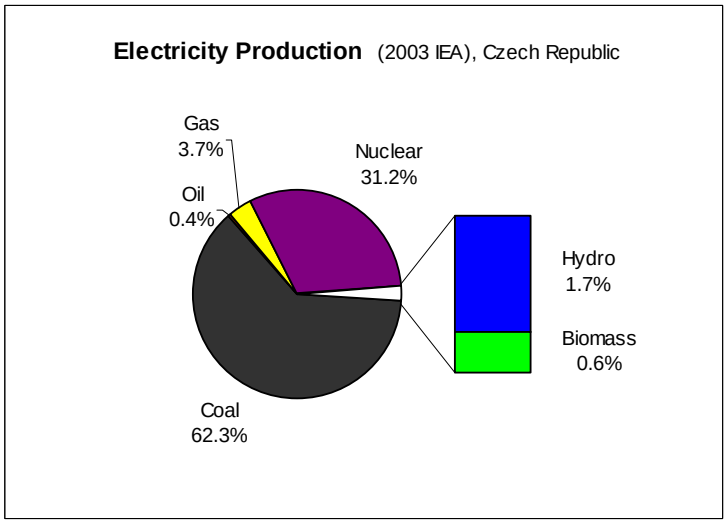
The Czech power supply structure is dominated by coal power stations that supply 62 % of the electricity, followed by nuclear (31%), hydro (1.7%), and biomass (0.6%).
The total production was 82.8 TWh in 2003. (IEA).

The efficiency of the power sector is reasonable, as cogeneration of heat and electricity is somewhat used, and the losses in the electricity and CHP sector are 1.5 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 11 % of electricity production.
23 % of the power production is from CHP plants.

The 2003 electricity distribution losses of 6.9% were close to the EU average (2003 IEA).







Renewable Energy

In the Czech Republic, the renewable-energy sector consists mainly of biomass and hydro power. All other renewable energy sources have negligible impact on energy statistics. Production of energy from the renewables is still very low and covered 2.9 % of total primary energy consumption in 2004. Biomass represented 2.4%, hydro 0.4% and the rest came from municipal waste. The share of renewable electricity was 4 % in 2004.

The highest share in renewable electricity production was in hydro power plants (2,019 GWh) and then in biomass (752 GWh), where an important role was played by electricity produced in the pulp and paper industry (296 GWh). Electricity produced in this industrial sector was practically all consumed on site. A significant amount of power was produced from biogas as well (139 GWh). Wind and solar power played no role in the energy statistics of 2004. Nevertheless, the development of wind power showed strong growth in 2005 and, based on the number of project proposals, it will increase its share in the near future. There were 48 wind-power plants in operation at the end of the year 2004. Total installed capacity was 16 MW, an increase of 55% over the 2003 level. Total power production achieved 9.9 GWh. Average annual utilization was 12%. The development of wind power continued in the year 2005.

In general, neither renewable electricity nor the total share of renewables have shown any increase in recent years. Despite governmental support, the very latest figures show that in the first half of the year 2005, the share of renewables in electricity production decreased by 5.8%. The largest part of the decline was in co-firing of biomass and coal (70% less compared to 2004) by the leading power producer, CEZ. By this step CEZ responded to the reduction of feed-in tariffs set by the state energy regulatory authority.

On the other hand, CEZ was able to increase production in its hydro power plants by 2.7 % in the first half of the year 2005. All of that increase was met by large hydro and was achieved by higher utilization of hydro power plants. Hydro power production was reduced in 2004 mainly due to major flooding in the Czech Republic. Quite considerable increase of power production was achieved in wind-power plants (42 % rise) as well as a negligible rise in solar power with total production of 5,000 kWh in the first half of the year 2005.

In the Czech Republic, wide-scale biomass utilization is the cheapest way of increasing the share of renewable energy sources in energy generation, since the potential of inexpensive energy from other renewable sources is severely limited. Potential for large hydro power plants is practically used by now, so, from the perspective of meeting the target of 8 % share of RE electricity by 2010, the Czech Republic has to do a lot in the near future. This target means doubling the recent figure. Reserves are also in the area of solar thermal use for heating purposes. Here the main obstacle is the high initial cost of the system. Nevertheless, the payback time of such installations is getting shorter with constantly rising energy prices.

Renewable Energy Promotion and Policies

The Czech renewable-electricity target as a member of the EU is 8% by 2010 (compared with less than 3% in 2003). Czech Republic has set a biofuels target of 3.7% for 2006 (compared with 1.2% in 2003).

In order to create appropriate conditions, the government adopted a very progressive law on support of renewables. The key financial measure, which should attract investors, is a 15-year guarantee of feed-in tariffs for new installations. This law seems to be the best legislative measure supporting renewables in all of the new EU member states. Unfortunately, the law does not cover the production of heat from transportation, for which other supportive mechanisms are suggested. First impact on development of renewables can be seen in the wind-power utilization, which was practically unknown 3-4 years ago. Now this sector together with biomass-firing boilers is showing growth. In the wind sector, the large windmills are being introduced by strong investors, whereas in the biomass sector, the small wood-firing boilers are becoming very interesting for single-family house owners. The Czech ministry for Environment is also providing the wind map for potential investors, which presents areas with the wind velocities attractive to building turbines as well as national land with protected areas where construction is forbidden. Despite attractive feed-in tariffs for photovoltaics, no major investments were announced in last year.
Feed-in tariffs in the year 2006 for wind power have been set at 0.08 EUR/kWh; for biomass, 0.10 EUR/kWh; for geothermal energy, 0.16 EUR/kWh; and for solar energy, 0.46 EUR /kWh.

Feed-in tariff is the main support mechanism. Tax exemptions that were in force before January 1, 2004, when a lower VAT was applied for renewable technologies, were cancelled after the country joined the EU. VAT increased from 5% to 22%. Some investment support is also provided by grants from the State Environmental Fund, but there is no mandatory obligation to support all installations. The support depends on the project and generally varies from 30% to 80% of investment costs. Another type of support is the access to EU structural funds (SF), which can be used for funding renewable-energy technologies. Experience from the year 2005 shows that there has not been much interest in using SF for renewables so far.

Tax exemptions are used to support biofuels in transport.

The main barrier for larger development of renewables seems to be low support for renewable-energy heat and even the lack of information amongst the public. In the case of wind power, the obstacles are sometimes being created by the local administration that has to approve all new installations.

Good chances for the development of renewables reside with the municipalities, which can receive funds from different sources, including EU structural funds. This support can be up to 70-80% of investment costs (40% for private companies) but until now has been almost untouched.

The national coordination of renewable-energy development is carried out by Ministry of Industry and Trade and the Ministry of Environment. Some regional energy agencies are also dealing with promotion of renewables.

Geographical Distribution of Renewable Energy
Hydro power plants are located mainly on the river Vltava and biomass is used all around the country with the exception of major cities.

National Allocation Plan for EU Emissions Trading.

The Czech government adopted its National Allocation Plan on October 6, 2004. The originally proposed emissions allocated to Czech industry of 322.98 $MtCO_2$ (for three years 2007-2009) were reduced to 292.8 $MtCO_2$ (97.6 $MtCO_2$ in annual average) under pressure from the EU, equal to 67% of greenhouse gas emissions. Annual energy-sector emissions are 21 $MtCO_2$ on average.

In the second half of 2005, the emission-trading market was opened, but the national register was not functioning. All together, 436 entities are entitled to trade allowances, which have been granted for free to them according to their respective past emissions. The amount of emissions included in the trading system's existing facilities is 65% of the Czech Republic's total greenhouse-gas emissions in 2010. There are no results yet as to what the impact will be of the emission-trading system on the energy sector and especially on development of renewables. Nevertheless, the private power utilities seem to be the winners and are preparing for the selling of allowances. The situation in the public heating sector and in the facilities owned by the municipalities will depend on the weather conditions (tough or mild winters). Some industries such as chemicals and pulp and paper are complaining about allocated amounts; increasing their industrial production will mean that they will have to buy allowances.

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- 2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.
- OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.
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- EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Brussels, 2004.
- IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.
- EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.
- The law on renewable energy support Nr. 180/2005 Coll.
- Annual statistical report of State Energy Regulatory Authority for the year 2004.

DENMARK

Population:
5.4 million (2004)

GDP:
196 billion € (2004)
= 36,312 €/capita

Greenhouse-gas emissions:
74.0 million tons CO_2 equivalent (2003) = 13.7 tons/capita

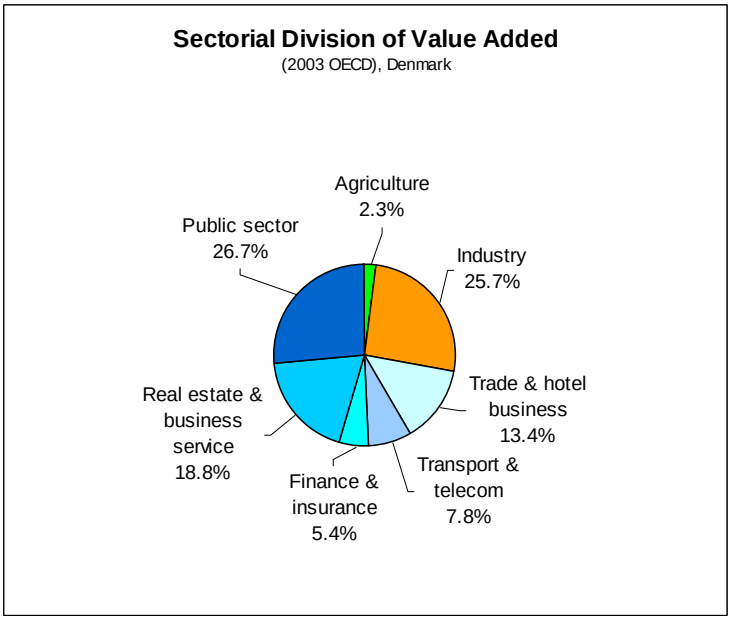
Economic Sectors
Private service sectors contribute 46% of the value added of Denmark. The public sector contributes 27%, one of the highest values in the EU. Agriculture contributes 2% and industry 26%, both close to the EU average.

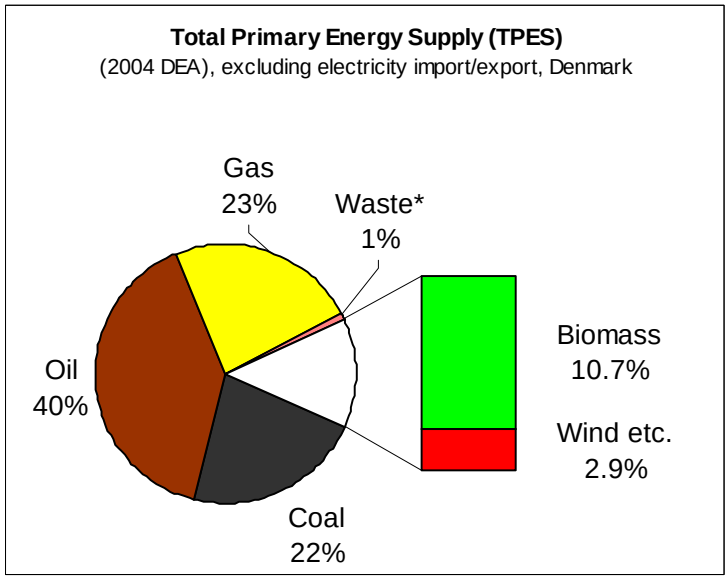
The Danish GDP per capita is very high, 61% above average in the EU, while the GDP growth rate is 2.1 % in 2004, which is slightly below the EU average. The economy is generally in good shape with a very low unemployment of 5.4%, surplus on state finances (2.3% of GDP in 2004) and a positive current account balance in its foreign exchange (2.7% of GDP in 2003) (Eurostat 2005).

Industries include iron, steel, nonferrous metals, chemicals, food processing, machinery, textiles, electronics, construction, wood products, shipbuilding, and windmills. Known as the home of Lego (toys), Carlsberg (beer), A. P. Moller-Maersk (shipping and oil), Vestas (windmills), Danfoss (regulation), Bang & Olufsen (audio, video); Royal Copenhagen (porcelain).

Energy Supply and Demand
The Danish energy supply is dominated by domestic oil that covers 40% of the total primary energy supply (TPES), followed by gas (23%), coal (22%) and renewable energy (13%) in 2004.
Danish production of oil in 2003 was 169% of domestic use, while the domestic production of gas was 145% of Danish use. There is no domestic production of coal (2003-IEA).
The TPES was 850 PJ in 2004, not including electricity exports. It decreased by 5% in 2004, because of decreased electricity exports.
In the supply structure, oil is dominant, covering 48% of total final consumption (TFC), followed by electricity, covering 18%, and heat, covering 16%. (TFC, 2004-DEA).

Denmark has exported electricity in recent years, e.g., 7% in 2004 (2004-DEA), but 20% in 2003. District heating is widely used, supplying 16% of TFC equal to about 55% of space heat demand.

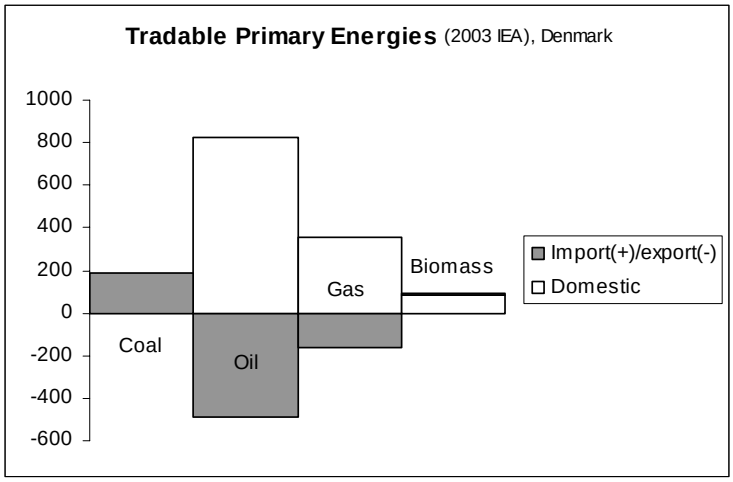




* Non-renewable waste

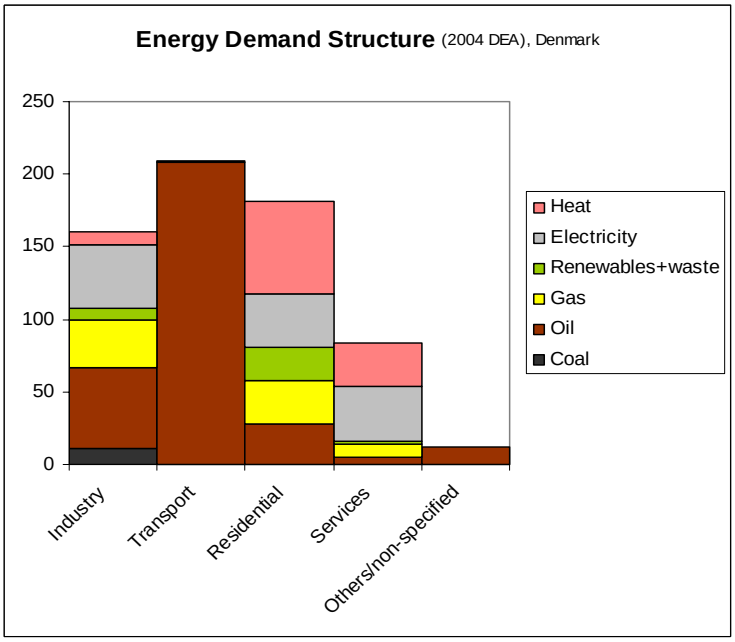
The demand structure is dominated by transport and residential consumption, together consuming 61% of TFC, while industry consumes 19%. Among industrial sectors, the food and tobacco is the largest energy consumers. It accounts for 25% of industrial energy consumption, followed by non-metallic minerals (mainly cement, 20% of industrial consumption), machinery (11%), and wood and paper (10%) (2003 IEA).

Transport includes aviation, which represents about 17% of transport energy use.
"Others/non-specified" is primarily agriculture.



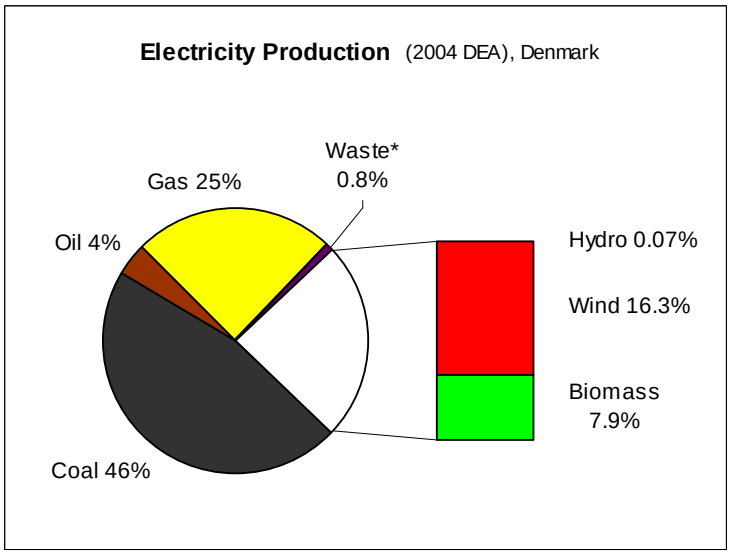
Electric Power Supply

The power supply structure of Denmark is dominated by coal power stations that supplies 46% of electricity production, followed by gas (25%), wind (16%), and biomass (8%, partly as co-firing with coal) (2004 DEA).
The total production was 38 TWh of which 2.9 TWh were exported (2004 IEA).



The efficiency of the power sector is remarkable high for a country without hydropower. The losses in the electricity and CHP sector are 0.87 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. This is because cogeneration of heat and electricity is widely used, and also because of windpower. Included in losses is the power sector's own consumption of 5% of electricity produced.
88 % of the power production is from CHP plants (IEA 2003).

The electricity distribution losses of 4.6% are below EU averages (2004 DEA).



* Non-renewable waste

Renewable Energy

The renewable energy in Denmark is mainly generated from biomass, renewable municipal waste, and wind power.

The largest use of renewable energy is biomass (2004), of which solid biomass is by far the most important (94%), supplemented with a small amount of biogas (6%). There has been a stable yearly increase from 1990 to 2003 in energy production from biomass (85% increase). The largest share of biomass excluding waste is straw (1/3), followed by wood-chips and wood pellets, each ¼ of biomass. Most of the wood pellets are imported.

Second most important ranks the energy production from renewable municipal waste. Also in this sector there has been a stable yearly increase of production between 1990 and 2004 (240%). It supplies half the primary energy than biomass do, and is most burned in incinerators with energy recovery, mixed with other wastes.

The third highest is wind power. Between 1990 and 2004, the production has increased more than 10-fold and it is the largest renewable contributor to electricity production.

Most of the biomass and the renewable municipal waste are used by CHP plants and heat plants. Another significant part is used for residential, and only a small insignificant part is used in the industry sector.

Denmark has been in the forefront of renewable-energy development in the 1990's and is still leading in windpower, both with the largest installed windpower capacity per capita and with the largest share of electricity consumption covered by windpower (20% of net consumption in 2004 equivalent to 16.3% of production including losses and export). It is also leading in the sense that the largest windpower company, Vestas, is Danish.
Another interesting feature of the development is that Denmark has one of the largest non-hydro-renewable contributions to electricity production in the EU, 24% in 2004, including energy from biodegradable waste
Denmark is still in the front regarding:

- Off-shore windpower; more than 300 MW installed capacity.
- Use of straw for heating and CHP; 32% of solid biomass use was straw in 2004.
- Solar heating in district heating with the world's largest solar heating plant, 5000 m^2.

There is increasing importation of biomass from Central and Eastern Europe. 25% of wood used in 2004 for energy was imported, primarily for wood pellets and wood chips.

Denmark is endowed with good potentials for increased use of renewable energy, for windpower, energy crops, biogas, solar energy (even though insolation is lower than that of Southern Europe), and, in the future, also wave-power.

Renewable Energy Promotion and Policies
In Denmark, renewable energy is mainly promoted with fossil-fuel taxation and through planning. In addition, there are feed-in tariffs, loan guarantees, R&D, and tenders for off-shore windpower, as well as quality control of biomass, solar and windpower.
As part of the EU, Denmark has a national target of generating 29% of its electricity from renewable sources (compared with 24% in 2003) to be reached by 2010. The target for renewable energy in transport is set to 0.1%; but this was challenged by the EU Commission, which finds it too low compared to the 5.75% reference value set in the EU. In addition, it should be mentioned that the Danish greenhouse-gas target in the EU burden-sharing under the Kyoto Protocol is a 21% reduction; and that currently Denmark is far from this target. The installation rates of renewable energy have gone down considerably since the current government came into power in 2002, and the main development is now increased use of solid biomass to replace remaining use of mineral oil for heating. 15% of household energy use is still fuelled by heating oil.

National coordination of the renewable-energy development is carried out by the Danish Energy Authority. Information offices for renewable energy were shut down by the government in 2002, but some of them remained and were recently re-established with energy-efficiency information funding and with some information on renewable energy. Similarly, funding was cut for technical centres on solar energy, biogas, and combustion of biomass in 2002, but was re-established in 2004 at a lower level. The technical centre for windpower has remained, with stable governmental funds.

Taxes of fossil fuels and electricity increase the consumer costs of these types of energy considerably for residential energy use and for part of the service sector. This is probably the most important current driver for increase of renewable energy, in particular biomass for heating.

Windpower receives a feed-in tariff, which is set to the electricity wholesale sport market price plus 0.10 DKK/kWh (1.3 €cent/kWh), and a maximum of 0.36 DKK/kWh (5 €cent/kWh), both for 20 years. Windpower projects that replace old (10-30 years old) windmills can get additional support, adding up to almost 8 €c/kWh for the first 6-8 years for two times the capacity they replace.

Biogas plants and certain biomass CHP can get 0.60 DKK/kWh (8€c/kWh) for the first ten years and then 0.40 DKK/kWh (5.4 €c/kWh) for the next ten years.

Solar PV can be connected with net metering, i.e., they are installed behind the consumers' meter and if they produce more than the consumption, the meter simply runs backwards. Current household electricity prices including taxes are 1.60 DKK/kWh /21 €cent/kWh), which is the price that PV effectively receives with net metering.

Neither of these support mechanisms has been enough to support development, and in 2004 and 2005 installations of windpower were about 5 MW, adding 0.1% to the windpower capacity each year, while development of biogas and biomass CHP have been less than that. Previous feed-in tariffs of about 8 €c/kWh were supporting most of the currently installed renewable-electricity capacity.

A tendering system is used for off-shore windpower. In 2005, two off-shore windparks of 200 MW each were tendered, one in the North Sea and one in the Baltic Sea. They will be installed in 2006-2008. The first tender gave a price of 0.518 DKK/kWh (7 €cent/kWh), which was higher than had been expected by the government. No further tenders are planned currently.

Municipal loan guarantees have been an important mechanism for development of biomass heating and CHP and of district heating systems connected to them. Most of these systems are consumer cooperatives. With the loan guarantee they can get cheap funding.

Danish heat supply is regulated with heat-planning regulation, allocating a certain heat supply to each house in the country. This has been important to build up the district-heating network. It has also been used to change certain district-heating systems to biomass heating and CHP. Further, it has been used to prohibit other systems from changing from natural gas to biomass.

Denmark has integrated windpower considerations into spatial planning, reserving certain sites for windmill groups. This was important for the development in 1995-2002.

A research and development (R&D) program supports certain forms of renewable energy. It is partly funded by the state budget, partly by a levy on electricity consumers.

A number of barriers have slowed the development of renewable energy, resulting in doubts that the renewable energy and climate targets can be reached. The barriers can be grouped into a number of categories:
- Support levels for renewable electricity are insufficient to support the development.
- There is very little consumer information in renewable energy.
- There is no promotion of use of renewable energy in transport.

Geographical Distribution of Renewable Energy

There is a higher share of windpower in western Denmark than in eastern Denmark, western Danish windpower production covers about 25% of electricity consumption. Since the two parts of the country are not connected electrically, the challenge to regulate an electricity system with a large share of windpower is mainly up to the western Danish grid operator, but it has not caused instability problems.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was notified to the European Commission in March, 2004.

The European Commission accepted the plan in July 2004, and it was then enforced for the 378 installations covered. In 2005-2007, the NAP covers emissions of 33.5 $MtCO_2$ annually average, equivalent to 45% of total GHG emissions. Credits of 7.23 $MtCO_2$ annually average are given to the energy sectors. (IEA 2005 and EU NAP)

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition, (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

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Wind Barometer 2005. EurObserv'er, Systemes Solaire, and EUFORES.

European Wind Energy Press Release, February 1, 2006: European Record for Windpower.

DEA: Danish Energy Authority, website, www.ens.dk.

Danish Organisation for Sustainable Energy (OVE).

ESTONIA

Population:
1.35 million (2004)

GDP:
9 billion € (2004) = 6,669 €/capita

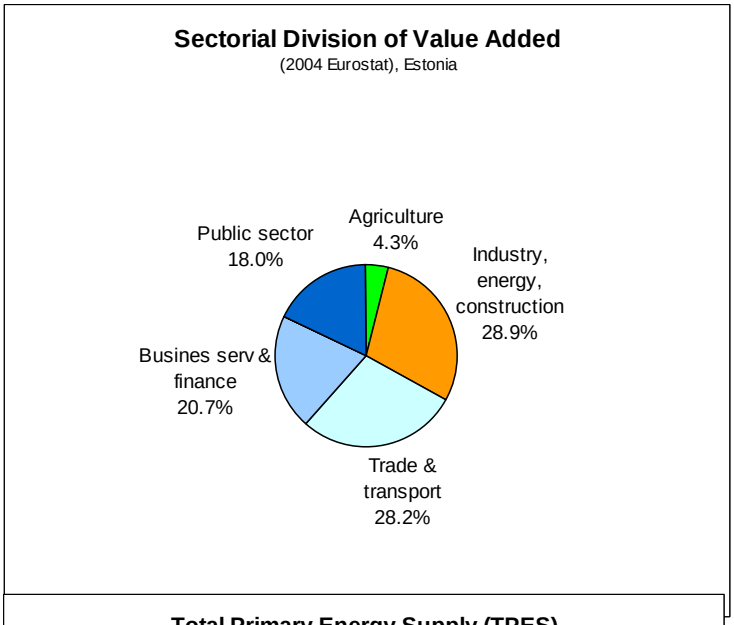
Greenhouse-gas emissions:
21.4 million tons CO_2 equivalent (2003) = 15.8 tons/capita

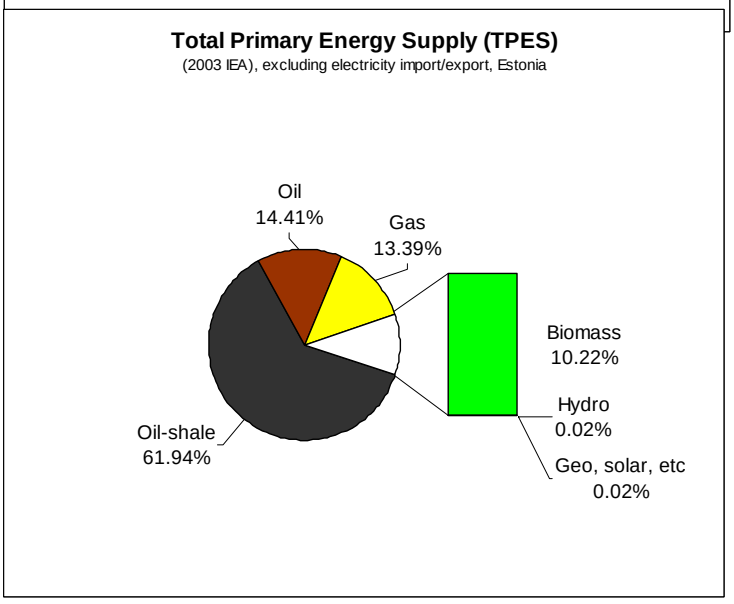
Economic Sectors
The service sectors contribute less of the value added (67%) than the EU average, while agriculture (4.3%) and industry (28.9) each exceed the EU averages for their respective sectors.

This new EU country, which previously belonged to the Soviet Union, has an economy with a steady increase of GDP since 2000, where the growth is higher than the EU average (6-8 %). The GDP/capita is about 1/3 of the EU average, and is one of the lowest in the EU.

The unemployment rate is around the EU average (9.7 % in 2004); it has decreased, with fluctuations, from a high point of 13.6 % in 2000. Estonia has a small surplus on state finances, which is 1.7% of the GDP in 2004, but it has a negative current account balance in its foreign exchange, which doubled in 2002, becoming the highest in the EU (-13.2% of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer EU countries, Estonia receives support form EU structural funds.

Leading industries include engineering, electronics, wood and wood products, textiles, information technology, and telecommunications. Estonian economy is moving from energy-intense products to high information technology using the Internet, e-banking, and mobile phones. Estonia was the first to come up with the concept of e-government and Internet voting. Geographically, northern Estonia has the major share (60%) of the country's GDP.





Energy Supply and Demand
Estonia is the only country in the world where oil shale, a solid fossil fuel with high ash and sulphur content (included as "coal" in graphs), is the key primary source of energy.
It contributes about 60% of the total primary energy supply (TPES) . The shares of the imported oil and gas are each 14% of TPES. (2003-IEA).

The TPES was 210 PJ in 2003, not including electricity exports. TPES increased by 8.9 % in 2003.

In the supply structure, the oil is dominant, covering 32% of total final consumption, followed by heat (18%), electricity (17%), gas (13%). (TFC, 2003-IEA).

Estonia has exported electricity in recent years, which increased from 7 % in 1998 to 23% in 2004 (2005 SOE). It also exports biomass, more than 10% of its production.

The district heating is widely used, supplying 81 % of the total heat consumption (2005 SOE).

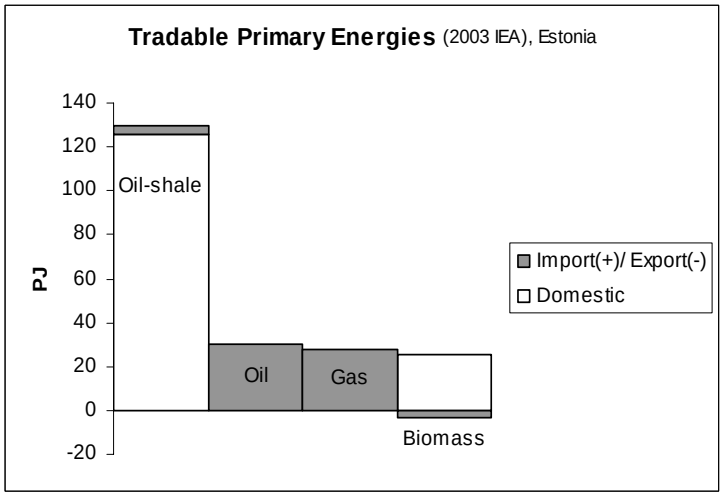
In the demand structure, the biggest component is the residential consumption (34%), followed by industry (25%) and transport (24%). Among industrial sectors, the chemical and petrochemical and the wood industries are the largest energy consumers. They account for, respectively, 23%, and 18% of the industrial energy consumption, followed by non-metallic minerals (15%), textiles (10%), and construction (6%) (2003 IEA).

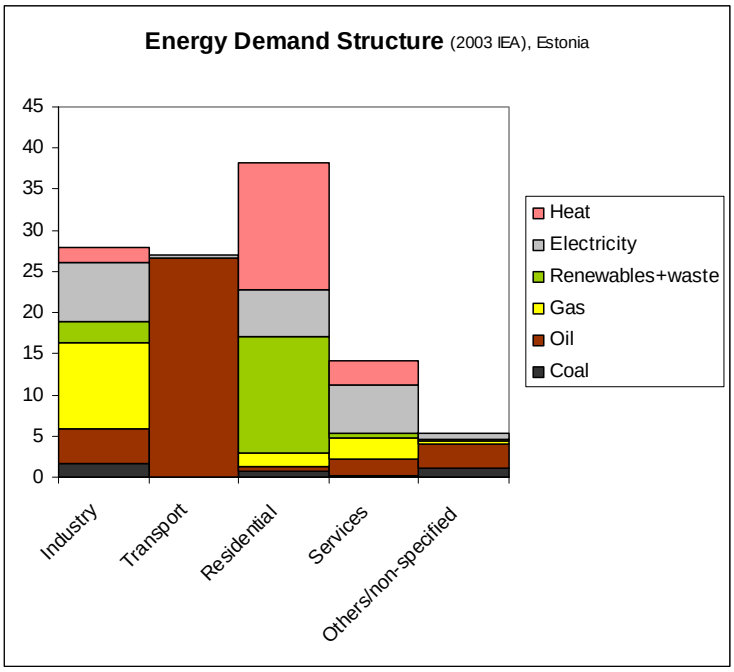
Transport includes aviation, which represents about 8 % of transport energy use.
Others/non-specified is primarily agriculture, and includes also non-energy oil use.

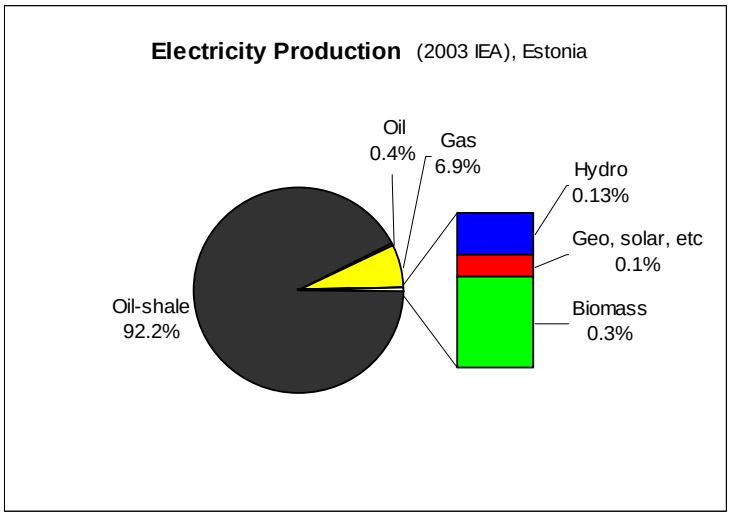
Electric Power Supply

Estonia's power supply structure is dominated by oil-shale power stations that supply 92 % of electricity production, followed by gas (6 %), oil (0.4%), and hydro (0.1%) (2003 IEA).
The total production was 10.2 TWh in 2003 (IEA).

The efficiency of the power sector is moderate, because cogeneration of heat and electricity is somewhat used, while the large oil-shale plants have low efficiencies.
The losses in the electricity and CHP sector are 1.7 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 14.5 % of electricity production.
10% of the power production is from CHP plants.
The electricity distribution losses of 14 % are higher than the EU average (2003 IEA).







Renewable Energy

The Estonian renewable energy is mainly biomass used for heating. It is primarily wood waste and most of it is used in households, but there is also considerable use in industry and district heating. The share of firewood in the primary energy supply in Estonia is ca 12%. Biomass production has gradually increased in recent years (2003 IEA).

In 2004, 17.1 MW windpower was installed, which increased the 2.9 MW installed capacity to 20 MW, multiplying it fivefold. (Wind Barometer 2005.)

By the end of 2005, the total wind-energy application in Estonia has reached 32.4 MW. The construction is under way to launch Viru-Nigula (24 MW), Ontika (56 MW), Kunda (7 MW) and Türisalu (22 MW) windfarms. The Estonian Energy Main Grid has made contracts to erect windfarms with total output power of up to 192.4 MW.

Renewable Energy Promotion and Policies

In Estonia, renewable energy is mainly promoted with a fixed price for electricity from renewable energy and with a 0% VAT for renewable energy (Sales Tax Act). Within the EU, Estonia has a national target of generating 5.1 % of its electricity from renewable energy (compared with 0.5 % in 2003), as well as a target of 5.75% alternative energy in transport (Estonian Transport Master Plan 2006 - 2013), both to be reached by 2010.
The share of CHP electricity in power production should go up to 20% by the year 2020 according to the Estonian Energy Master Plan 2015.

National coordination of renewable-energy development is carried out by the Ministry of Economic Affairs and Communications.

Renewable electricity receives 5.2 € cents /kWh. The price is paid for 7 years for biomass and hydro, and 12 years for wind. The electricity price for renewable energy is 1.8 times the residential price. The Electricity Market Act came into force in July, 2003.

The main drivers for the development of renewable energy are national policies. In recent years, increasing prices of imported energies have given an additional impetus to investments in renewables.

A number of barriers have slowed the development of renewable energy, resulting in. The barriers can be grouped into a number of categories:

- Lack of proper legislation for promoting renewable energy.
- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.

Geographical Distribution of Renewable Energy

While biomass and solar installations are located throughout the country, windpower is mainly concentrated on the West Estonian Archipelago and in the coastal areas of West-Estonia.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was published in May, 2004. The European Commission accepted the plan in October, 2004, and it was then enforced for the 43 installations covered.
In 2005-2007, the NAP covers the emissions of 18.95 $MtCO_2$ annually, equivalent to 69% of total GHG emissions from the industrial and energy sector. This is equal to 80 % of the Business-as-Usual predictions of the installations covered. Annual credits of 16.30 $MtCO_2$ on average are given to the energy sectors. (IEA 2005 and EU NAP)
The Estonian greenhouse-gas trading register was open on the 1st of November, 2005.

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition, (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Brussels, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: EurObserv'er, Systemes Solaire, and EUFORES.

Statistical Office of Estonia (SOE, http://pub.stat.ee).

Estonian Energy Master Plan 2015.

Estonian Transport Master Plan 2006 - 2013.

Estonian National Allocation Plan, May 2004.

FINLAND

Population:
5.2 million (2004)

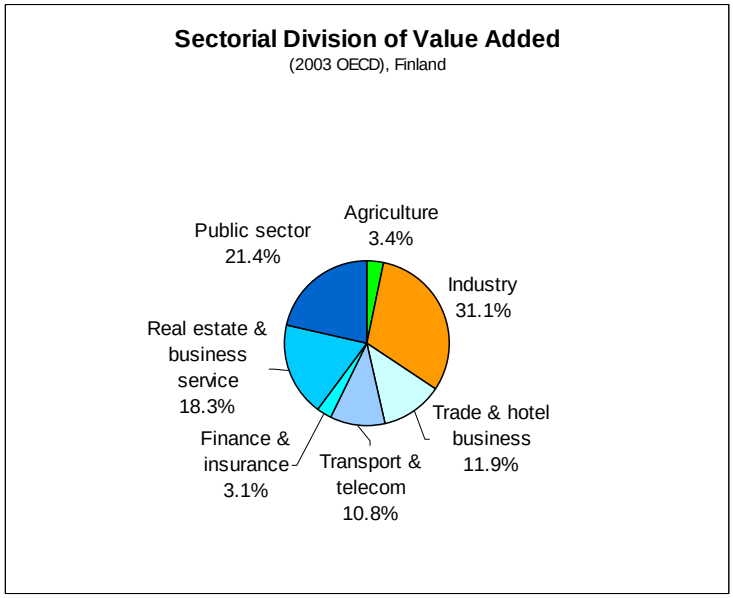
GDP:
150 billion € (2004)
= 28,737 €/capita

Greenhouse-gas emissions:
85.5 million tons CO_2 equivalent (2003) = 16.4 tons/capita

Economic Sectors
Private service sectors contribute 44% of the value added of Finland, while industry and agriculture together contribute 34%, slightly above the EU average.

The economy is generally in good shape with an unemployment rate of 8.8% (2004) - close to EU average, with a surplus on state finances (2.1 % of GDP in 2004) and a positive current account balance in its foreign exchange (4.1% of GDP in 2003) (Eurostat 2005).

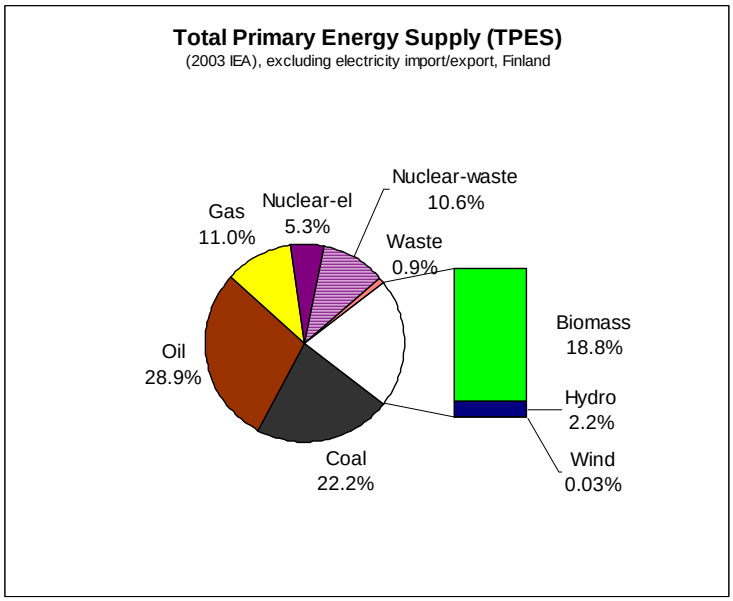
The leading industries are wood pulp and paper, communication electronics (Nokia), metal products, machinery, scientific instruments, foodstuffs, chemicals, textiles.
Geographically, the wood industry is in the center of the country, while other industries are in the southern parts, near the Baltic Sea and the Bay of Finland.



Energy Supply and Demand
The Finnish energy supply is distributed among oil, coal, renewable, and gas+nuclear, each contributing roughly ¼ of the total primary energy supply (TPES). There is no domestic gas production, while domestic oil production only covers 1.5% of oil supply. Domestic coal covers 23% of the coal supply. (2003-IEA).

The TPES was 1,227 PJ in 2003, not including electricity imports. It is increasing by up to 4% per year, driven by increased consumption in all sectors including industry. In the supply structure, oil and electricity are dominant, covering, respectively, 34% and 26% of total final consumption (TFC), closely followed by renewables (18% of TFC) (2003-IEA).

Finland has imported electricity in recent years. Net import was 6% in 2003, but as high as 17% in 2003 (2003-IEA). The Finnish electricity trade consists of import from Russia and trade with Scandinavia that depends of the rainfall that feeds the hydro power. In wet years there will be high imports, while in dry years, as in 2003, there will be lower net imports (importing from Russia and exporting to Scandinavia).



The district heating is widely used in Finland, supplying 14 % of TFC.

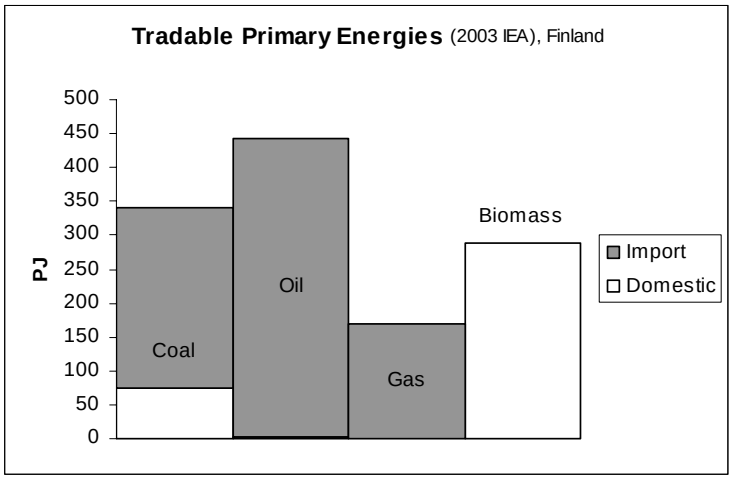
The demand structure is dominated by the industry that consumes 46% of TFC, followed by the residential consumption (20% of TFC). Among industrial sectors paper, pulp, and print is very dominating. It consumes 53% of industrial energy consumption, followed by iron and steel (9 % of industrial energy consumption), and chemical (9%) and wood industry (4%) (2003 IEA).

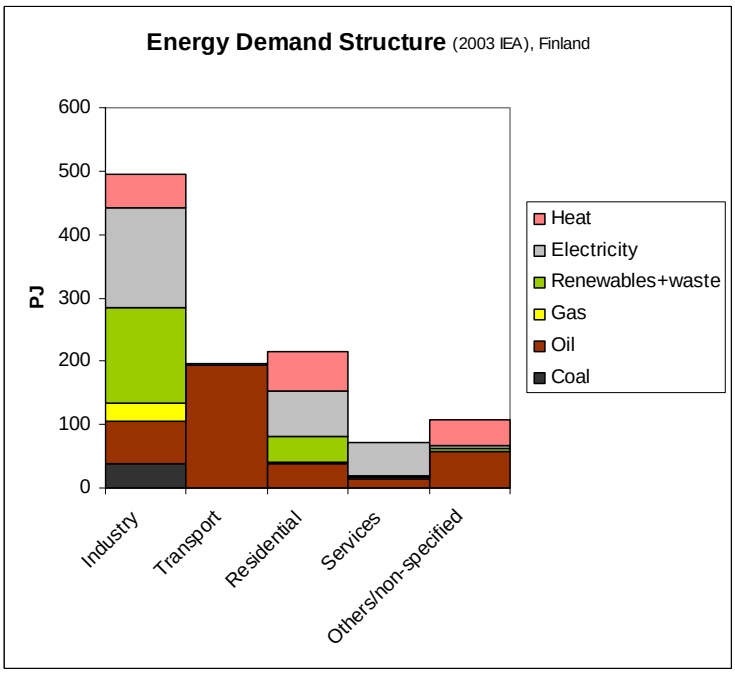
Transport includes aviation that is about 11% of the transport energy use.
Others/non-specified is primarily agriculture, and includes also non-energy oil use, and non-specified energy use.

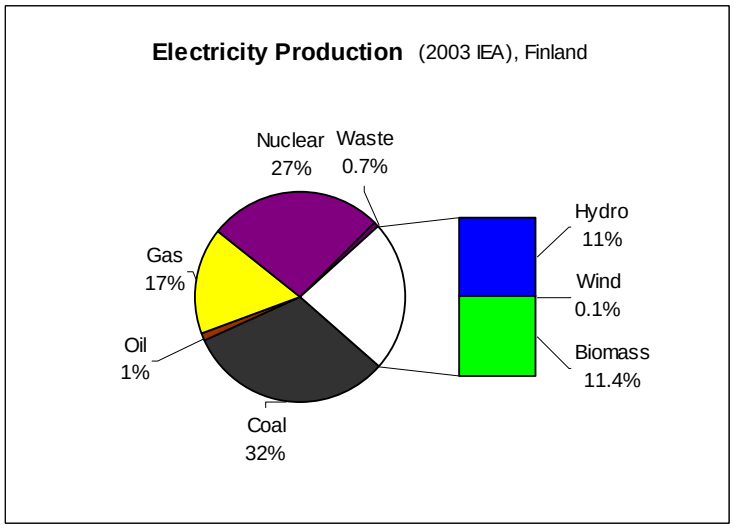
Electric Power Supply
Finnish power supply structure is a mix of coal electricity and CHP plants that supplies 32% of electricity production, nuclear power (27%), gas power (mainly CHP – 17%), hydro (11%, but higher in wet years), biomass (11%).
The total production was 84 TWh (2003 IEA).

The efficiency of the power sector is high as co-generation of heat and electricity is widely used. The losses in the electricity and CHP sector are only 0.9 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 5.7 % of electricity production.
35% of the power production is from CHP plants.

The electricity distribution losses of 4.4% are below the EU average; the heat distribution losses of 7% are also low (2003 IEA).







Renewable Energy

The Finnish renewable energy is solid biomass and hydro, with small amounts of wind and biogas.
The largest use of renewable energy is biomass in the paper and pulp industry (52% of the sectors consumption), followed by heat and power production and residential energy use (19% of residential consumption). Renewable energy has seen steady growth, with an increase in biomass use and with steady hydro production, although with substantial variations in hydro production from year to year depending on rainfall.

Finland has the largest use of wood per capita in the EU and is leading in a number of technologies in the use of wood for energy. These include:

- CHP from wood, with steam cycle as well as gasification systems.
- Finnish fireplaces, a traditional use of wood for heating that has been improved to be more efficient, more user-friendly, and cleaner in combustion.
- Use of byproducts from the paper and pulp industry, including "black liquor" that is used for the industry's own energy consumption.

There is still room for substantial increase in the use of use of biomass as well as a large, unused windpower potential and a largely unused biogas potential. It is also possible to increase the value of the renewable energy by increasing biomass CHP use.

Renewable Energy Promotion and Policies
In Finland, renewable energy is mainly promoted with information, tax exemption, and subsidies. Within the EU, Finland has a national target of generating 31.5 % of its electricity from renewable energy (compared with 25% in 2002 and 21% in 2003 because of low rainfall) to be reached by 2010. Finland also has additional targets such as 500 MW windpower by 2010. The installation rates for renewable energy are not sufficient to reach the EU targets. Regarding biofuels for transport, Finland set a target of 0.1% in 2005.

The most important national coordination of renewable-energy promotion is carried out by MOTIVA, the Finnish energy agency that is also in charge of energy efficiency.
A number of regional energy agencies, organised in different ways, promote renewable energy with demonstrations, education, information, etc. Some of them have received EU support for their operations during their establishment and first years of existence.

Tax exemptions for electricity tax are the main support for renewable electricity. The tax exemption is 4.2 €c/kWh for biomass and small hydro, while it is 6.9 €c/kWh for windpower and some biomass electricity, such as electricity generated from wood chips from forestry. The total price also includes the electricity price, which is dependent of the Nordic electricity market. Since 2002, average power prices on this electricity pool have been around 3 €c/kWh, though with large variations (Nordpool). This leads to total prices on the order of 7-10 €c/kWh, but because of the fluctuations in the power price, it does not give the investor the certainty that simpler feed-in tariffs would provide. The electricity tax exemption (refund) has been the major driver in the development of biomass power while it has not had a similar effect for windpower.

Subsidies on the order of 30%, sometimes 40%, are available to new developments, to demonstrate the use of new technologies. The subsidies are only available for commercial companies.

Biogas for transportation is exempted from vehicle tax, and there is a partial tax relief for liquid biofuels for testing.

The main drivers of the development of renewable energy are national policies, including the requirement of tax exemption for renewable power. In recent years, increasing prices of imported energies have given an additional impetus to investments in renewables, particularly in biomass.

A number of barriers are slowing the development of renewable energy. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies, and is true for biogas and solar.

- Unambitious target for windpower.
- Too-low tariff to start windpower development, and uncertainty about price due to fluctuating power price.
- Generally low energy prices.

Geographical Distribution of Renewable Energy

The wood use is mainly in the central and southern parts of the country, which are, respectively, the centres of forestry and of population.

National Allocation Plan for EU Emissions Trading

The European Commission accepted the Finnish national allocation plan (NAP) in October, 2004.
In December, 2004, the Finnish government adopted the plan finally, which enforced it for the 535 installations covered for 2005-2007.
In 2005-2007, the NAP covers the emissions of 45.4 $MtCO_2$ annually in average equivalent to 59% of total CO_2 emissions in 2002, but with an increase of 4% from 2005 to 2007. This is equal to 97% of the Business-as-Usual predictions of the installations covered. Annual credits of 32 $MtCO_2$ on average are given to the energy sectors and 2.5 $MtCO_2$ are reserved for new entrants (IEA 2005).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

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IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

Barometer: 2005. EurObserv'er, Systemes Solaire, and EUFORES.

Nordpool: Nordpool website: www.nordpool.no.

Information on biofuels from Premia, December 2005, presented at the conference Clean Vehicles and Fuels, Nov. 2005, Stockholm, www.premia-eu.org.

FRANCE

Population:
59.9 million (2004)

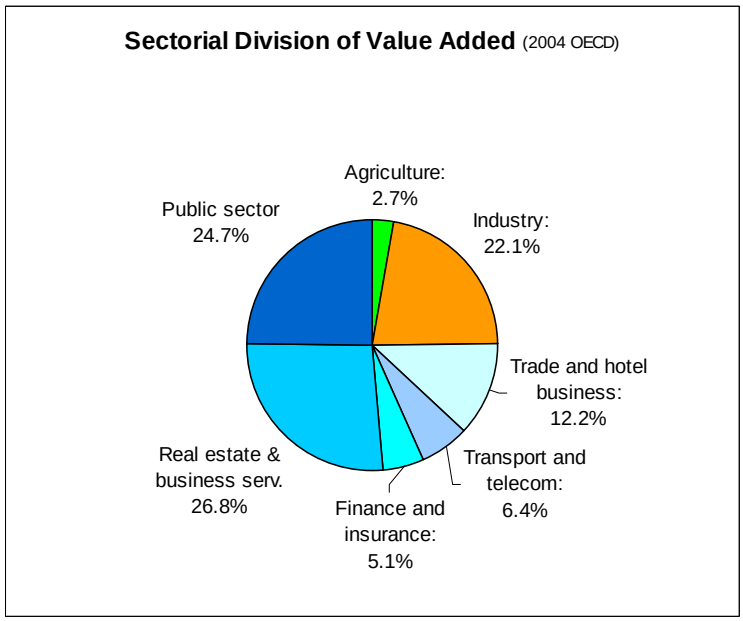
GDP:
1,648 billion €
(2004) =
27,512 €/capita

Greenhouse-gas emissions:
557.2 million tons CO_2 equivalent
(2003) =
9.3 tons/capita

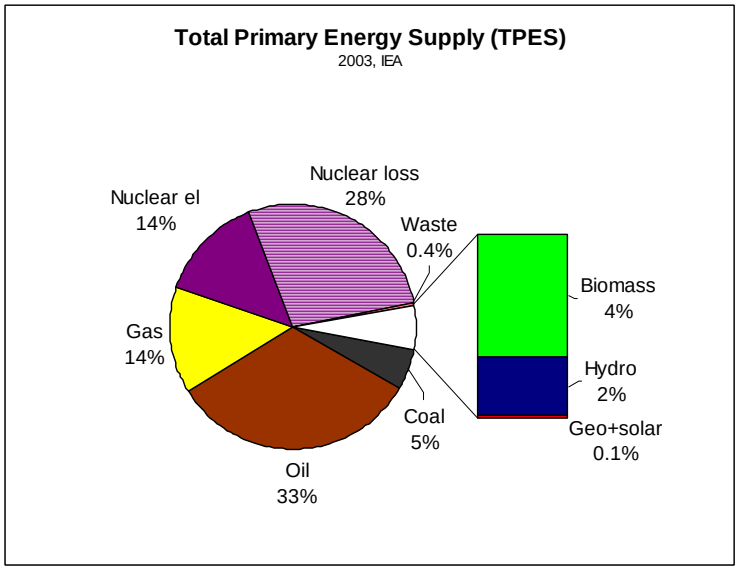
Economic Sectors
The service sectors contribute 76% of the value added of France, and the public sectors alone contribute 26%, both of which are above EU average. The industry sector contributes 22% of value added, which is below EU average.

The French economy is troubled by substantial unemployment (10.1% in 2004), deficit on state finances (the governments net lending was 3.5% in 2004), and, since 2004, a negative current account balance in its foreign exchange.

As a large country, France has a large and diverse industrial sector. France's leading manufacturing industries are metallurgy, mechanical and electrical engineering, chemicals, and textiles. French textiles and clothing are renowned for their style. Other major products include automobiles (e.g., Citroën, Peugeot, Renault), aircraft (Mirage, Airbus), and energy supply equipment (Areva). France is a leading arms exporter, and a major producer of steel, aluminium, sulphur, and bauxite. Growth industries include microelectronics, telecommunications, and aerospace. France's agricultural production ranks first in the EU.
Geographically, the industry is most concentrated around Paris, along the Paris-Lyon-Marseilles axis, around Toulouse and in northern France.



Energy Supply and Demand
The French energy supply is dominated by imports of fossil and nuclear fuels, while renewable energy plays a smaller role with 6% of the Total Primary Energy Supply (TPES)[1]. The domestic production of fossil fuels is even smaller, about 1.5% of the TPES (2003-IEA).
The TPES was 14,400 PJ in 2003 including electricity exports. It has been increasing during the last decade, driven by increasing electricity production and by transport. In the supply structure, oil is still dominant, supplying 51% of total final consumption (TFC, 2003-IEA) with electricity and gas each contributing 20% to TFC.



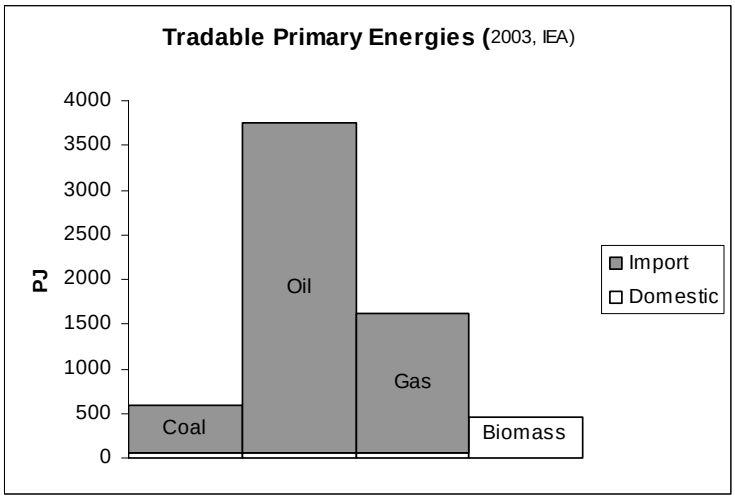
[1] 2003-figures from IEA. The figures understate the real importance of renewable energy because IEA methodology sets nuclear primary energy to 3 times nuclear electricity production. This is important in a country like France with large use of nuclear power. If primary nuclear energy is taken as electricity production as it is done for hydro and wind energy, the renewable share is 8.5%.

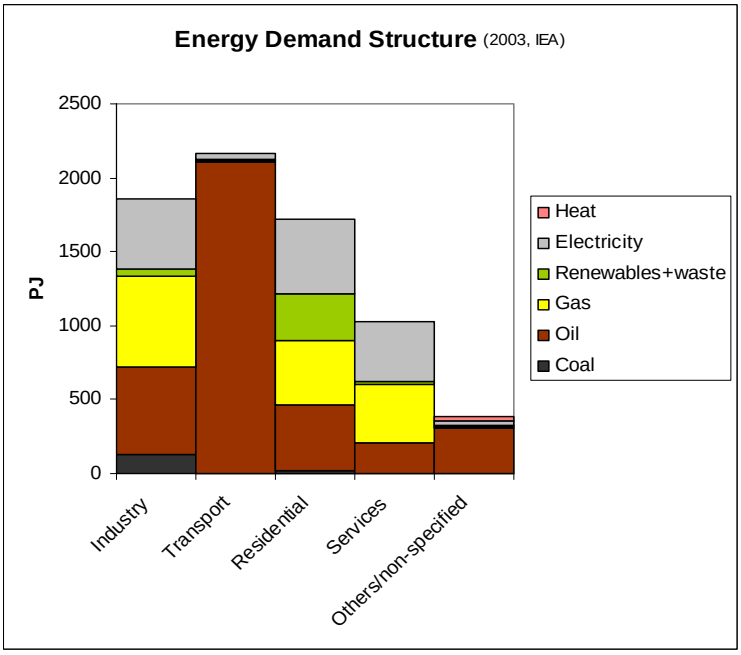
In addition, France had a net export of electricity of 13% in 2003 (IEA). It exports to most neighbouring countries, particularly Spain, Italy, and the UK.
The district heating is very small in France, supplying only 0.4% of TFC.

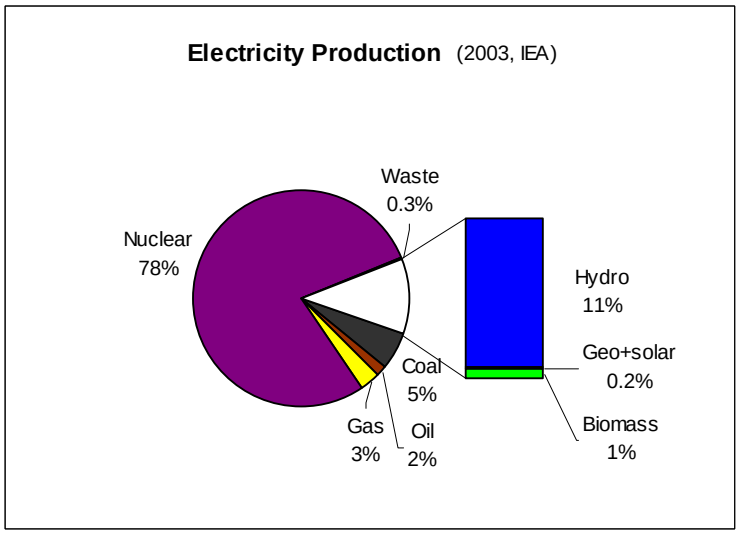
The French demand structure is dominated by transport and residential energy consumption. Among industrial sectors, the chemical industry is the largest energy consumer. Including feed-stocks, it accounts for 38% of industrial energy consumption, followed by food and tobacco (11%), cement and other non-metal minerals (10%), iron and steel (9%), machinery including transport equipment (9%), and paper, pulp and print (8%).
Transport includes aviation, which represents about 13% of transport energy use.
Others/non-specified include agriculture, non-energy oil use, and non-specified energy use.

Electric Power Supply

The French power supply structure is dominated by nuclear power, which supplies 79% of electricity production of 562 TWh (2003). It is also very centralised, with the national power company (Electricité de France) owning most of the power sector. The high share of nuclear in the power sector requires a large degree of flexibility of the other parts of the power system, because the nuclear power plants preferably are operated with constant production for longer periods of time. Important to achieve this are hydro pump-storage power plants and the export of off-peak electricity. The need to export nuclear power in off-peak periods and the overcapacity of power are important drivers for the French exportation of electricity. In 2003, the net export was 13% of the net power production, a figure that has varied by a few percentage points in recent years.
The efficiency of the power sector is low, as co-generation of heat and electricity is little used, and the losses in the electricity and CHP sector are 2.0 times the useful production of electricity and heat delivered to the grids, according to IEA methodology[1]. Included in that calculation is the power sector's own relatively high consumption of 10% of electricity production.
Only 0.6% of the power production is from CHP plants.
The electricity distribution losses of 6% are not high compared with the EU average.







Renewable Energy

The French renewable energy is dominated by the traditional use of wood for domestic heating as well as by use of hydropower. France uses more wood for energy than any other EU country. France is also known for pioneering tidal power and for a tradition of geothermal heating in certain places, including Paris and some overseas departments[2]. The use of wood and other solid biomass declined slightly during the 90's, about 4% in 1990-2003, according to IEA. A major driver behind this was replacement of traditional wood-based heating with gas. The other existing renewable energies remained stable. Of the new technologies, wind, biofuels for transport, and biogas did increase in the 90's, but remained at a low level except for remarkable development of some of the overseas departments. In biofuels, France held a leading position in the EU around the year 2000.

The introduction of renewable energy is now speeding up, with recorded increases in most renewable energies since 2002, reflecting the effects of increased promotional activities starting in 1999 and 2000 combined with increasing fossil fuel prices. During 2004,

- Windpower capacity increased by almost 60% to 390 MW. It increased further to 757 MW in 2005.
- Solar thermal installation increased by 10% to 793,000 m^2.
- PV capacity doubled to 20 MW.

Also, in the use of biomass, the trend now is toward increasing consumption combined with changes of equipment to modern wood-burning facilities, such as automatic boilers, often fuelled with wood-chips. The development of biodiesel has come to a temporary halt because of the end of reductions of transport-fuel taxes.

France is endowed with large potentials for renewable energy. It has one of the largest potentials for windpower in the EU, as well as good potentials for solar energy throughout the country, but in particular in the southern, Mediterranean parts. It also has some unused potential for biomass, including biogas; for geothermal; and for small hydro. It has a large forestry industry, as 25% of the surface is forest, giving it the potential to increase biomass use by up to 80%. In the future, wave-power off its Atlantic coast might contribute to its energy supply.

Renewable Energy Promotion and Policies

In France, renewable energy is mainly promoted with information, subsidies, and fixed prices for electricity sold to the grid. Within the EU, France has a national target of generating 22.1% of its electricity from renewable energy as well as a target of 5.75% renewable energy in transport, both to be reached by 2010. In addition, the French national energy agency ADEME has set short-term targets for renewable- electricity technologies, of which the largest target by far is for windpower: 2,000-5,000 MW by 2007. The installation rates for renewable energy have to increase substantially to reach these targets.

Information dissemination and promotion of renewable energy are carried out by the national energy agency ADEME together with agencies of the regions and municipalities; in many cases EU support is also involved. The majority of the informational and promotional activities rely on the regional and local authorities, resulting in very different activity levels in different regions and municipalities. Some regions have placed particular emphasis on renewable energy, such as the Rhône-Alpes and Alsace as well as Brittany (Bretagne). Currently there are 14 local, mainly municipal, and 10 regional energy agencies promoting renewable energy and energy efficiency. Of these, 15 have received EU support for their operations, mostly during their establishment and first years of operation.

Various subsidies support the development of renewable energy. A national support scheme gives investment support for renewable energy for heating as well as for renewable-electricity systems. The current subsidy level is 40% of equipment costs, equivalent to about 30% of system costs, which is subtracted from income tax. In addition, there are subsidies for experimental installations, support for feasibility studies for larger systems, and further regional subsidies in some regions. Special subsidies are available for public buildings including social housing, in certain cases up to 70% of investments. Also, projects in urban-renewal areas can receive special subsidies.

Renewable-electricity projects of up to 12 MW of installed capacity are supported with feed-in tariffs that vary from technology to technology. To kick off windpower, the first 1,500 MW of wind power is supported with a feed-in tariff for 15 years, starting with 8.38 €c/kWh for the first five years and then reduced depending on energy production. Thus, projects in low-wind areas receive the same payment for 15 years, while projects in high-wind areas receive only 5.41 €c/kWh after five years.

Small hydro, biogas, landfill gas and biomass plants all can receive feed-in tariffs for 15-20 years with payments of 4.6-6.1 €c/kWh, for some technologies with a possible bonus for cogeneration of heat and electricity (CHP). This means that a biomass CHP plant can receive about a 30% bonus, giving a feed-in price of 6,10 €c/kWh for 15 years, if it utilizes a minimum of 70% of heat production. Different rates are applied for the feed-in tariffs for grid-connected PV in different regions. The general PV tariff from onward 2006 is 22.5 €c/kWh with a special high tariff of 30 €c/kWh applied to the island of Corsica and to overseas departments.
In general, tariffs are reduced by 3.3%/year.

Renewable-energy systems of above 12 MW and landfill gas are supported with tendering procedures. Tenders are made for windpower on land and at sea (offshore), for biomass, for biogas, and for landfill gas.

In addition, renewable energy is supported with certain tax breaks, a guarantee fund for investments in energy efficiency and renewable energy in small and medium sized enterprises (FOGIME), a public-private investment fund for energy efficiency and environment (FIDEME) that can cover up to 25% of investments, and some research and development programs.

To fund some of the informational activities and subsidies, ADEME uses income from the Tax on Petroleum Products (TIPP).

The main drivers for the development of renewable energy are national policies and the increasing prices of imported energies. Public interest and public pressure seem to be another driver in some regions, such as in the Rhône-Alpes and the Alsace regions. This coincides with negative public attitudes towards nuclear power in these regions.

A number of barriers have slowed the development of renewable energy, resulting in relatively slow response to the increasing support for renewable energy that started in 1999-2000. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Passive or negative attitude of suppliers of electricity and gas, both of which are state-owned, very centralised entities with high profiles and substantial communication budgets to reach the public with their messages.
- Complicated and lengthy administrative procedures to obtain permission to construct windpower plants and other larger renewable energy installations.
- Lengthy procedures and high costs for grid-connections of renewable energy plants producing electricity.
- In particular for windpower, very vocal, local protesters against many projects. Most windpower projects have been driven by developers and investors that were not local to the area, making it easier for protesters to gain local support. The protests are partly driven by interests in preserving the landscapes for esthetical and tourist reasons.
- Administrative barriers to the formation of cooperatives, where local citizens could invest in larger renewable-energy projects such as windpower.
- Most local energy agencies are part of the municipal structure, which can limit the efficiency of their outreach to the public.

Geographical Distribution of Renewable Energy
While biomass and solar installations are located throughout the country, windpower is mainly located in the northern and western parts towards the North Sea and the Atlantic, as well as in smaller windy areas at higher altitudes in the eastern part of the country. Geothermal energy for direct heating is by nature limited to certain areas such as around Paris and in the Eastern part, e.g., in the Alsace region.

France's National Allocation Plan for EU Emissions Trading
The first French National Allocation Plan (NAP) was published on July 6, 2004, covering 2005-2007.
On October 20, 2004, the European Commission accepted the plan on the condition of two amendments.
On January 18, 2005, an amended NAP was published for 2005-07, allocating 156.5 $MtCO_2$ annually of which 5.69 $MtCO_2$ are for reserve and for new entrants. Of this 60 $MTCO_2$ in annual average is for the energy sector.

On February 25, 2005, two ministerial decrees were issued, which enforced the NAP and set the list of 1,172 installations included and their allocations of allowances for 2005-2007.

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

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EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: Solar Thermal, Biofuels. PV, Wind Barometers 2005. EurObserv'er, Systemes Solaire, and EUFORES.

European Wind Energy Association Press release, February 1, 2006: European Record for Windpower.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

Personal communication with Pierre Lecuelle, formerly Agence Locale de l'énergie Mulhouse Sud Alsace, France.

GERMANY

Population:
82.5 million (2004)

GDP:
2,216 billion € (2004) = 26,850 €/capita

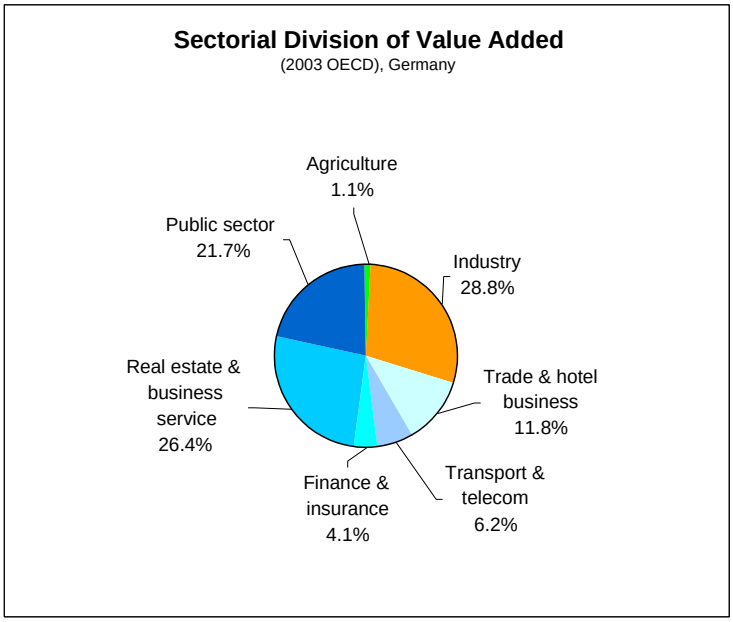
Greenhouse-gas emissions:
1,017.5 million tons CO_2 equivalent (2003) = 12.3 tons/capita

Economic Sectors

Private service sectors contribute 49% of the value added of Germany, which includes a large real-estate and business-service sector (26%). The public sector is around the EU average (22%). The industry sector contributes 29%, which is slightly above the EU average, while agriculture contributes 1% to the economy, which is below EU average.

The German economy is the largest in the EU. Germany's contribution comprises 22% of the EU GDP. The German GDP per capita is 19% above the average GDP of the EU, while the GDP growth rate is 1.6% p.a., which is below the EU average. The unemployment rate of 9.5% is slightly above the average for the EU. Germany has a deficit on state finances (-3.7% of GDP in 2004) but a positive current account balance in its foreign exchange (2.3% of GDP in 2003) (Eurostat 2005).

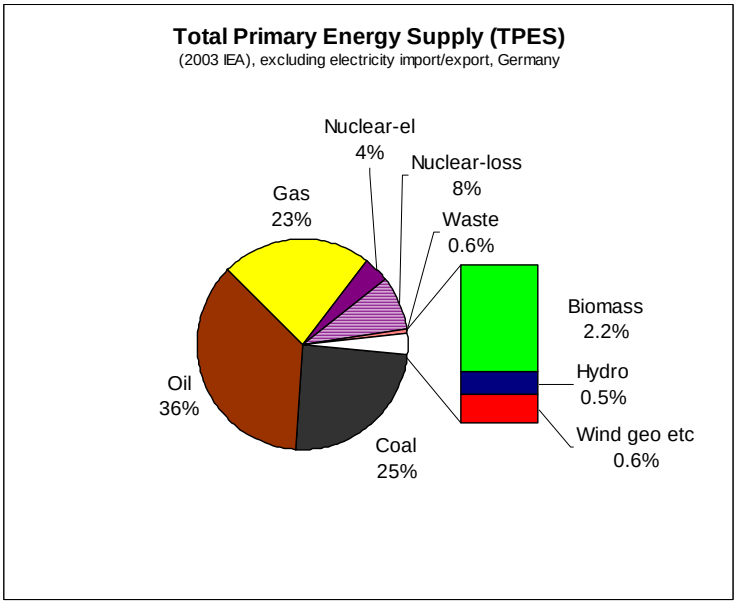
As a large country, Germany has leading and technologically advanced industries ranging from energy and computers (Siemens) to machine-building, iron & steel (Krupp) and vehicle manufacturing (VW, BMW, Opel, Audi) to chemicals and pharmaceuticals (Bayer).



Energy Supply and Demand

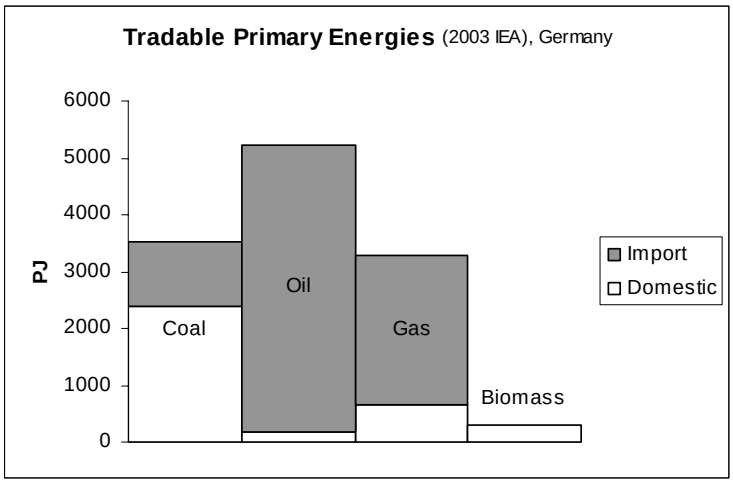
The energy supply of Germany is based on oil, coal and gas, which contribute, respectively, 36%, 25% and 23% of the total primary energy supply (TPES). Domestic production covers 68% of the coal supply and 20% of the gas supply, while the domestic production of oil is 3% of the oil supply (2003-IEA). The domestic coal production is highly centralised. The TPES was 14338 PJ in 2003, not including electricity exports. It increased by 0.3% in 2003. In the supply structure, oil is dominant, covering 48% of total final consumption (TFC), followed by gas, covering 25%, and electricity, covering 18%. (TFC, 2003-IEA).

The district heating is used in many parts of Germany, supplying 3.4% of TFC.



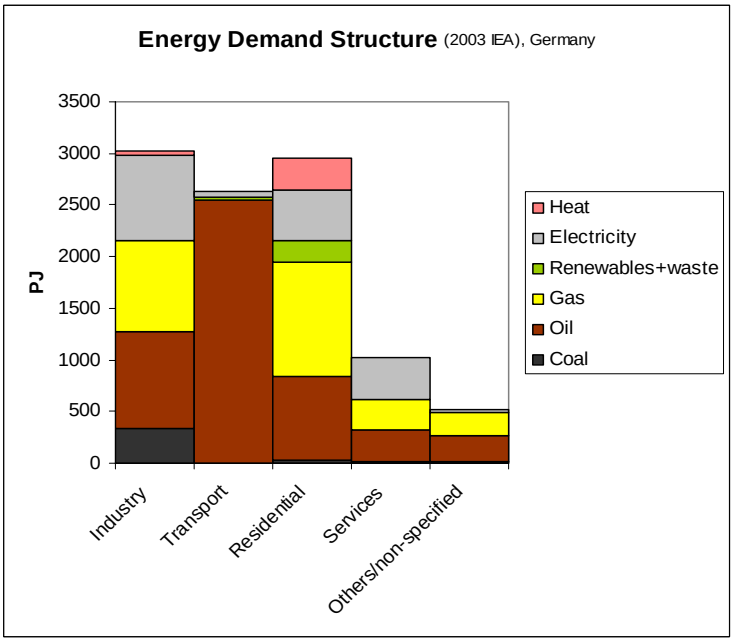
The demand is about equally divided among industry, residential and transport sectors, with service sectors playing a smaller role.
Among industrial sectors, the chemical industry is the largest energy consumer. It accounts for 43%of industrial energy consumption, followed by iron and steel (12%), non/metallic minerals (9.3%) and food and tobacco (6.3%) (2003 IEA).

Transport includes aviation, which represents about 12% of transport energy use.
Others/non-specified is primarily non-energy oil use followed by agriculture. It also includes non-specified energy use.

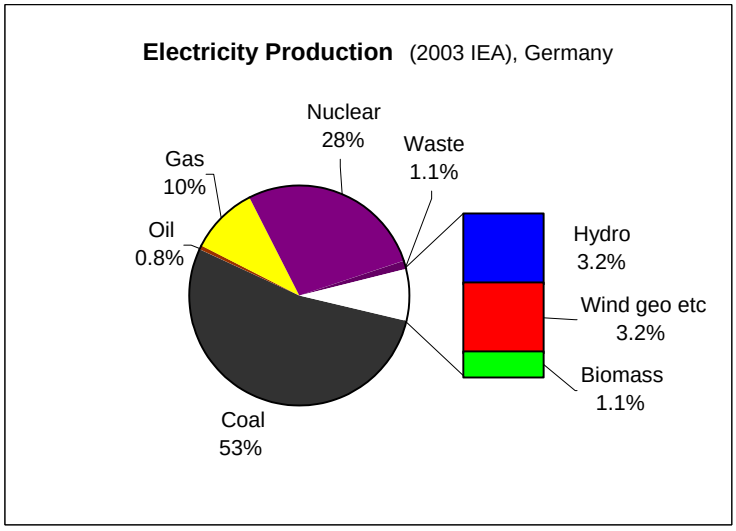


Electric Power Supply

The power supply structure of Germany is dominated by coal power stations that supply 53% of electricity production, followed by nuclear (28%), gas (10%), and renewable energy (7.5%) (2003 IEA).
The total production was 594 TWh (2003 IEA).



The efficiency of the power sector is not high, as a large part of the power is produced from lignite and nuclear power plants with low efficiencies; further, cogeneration of heat and electricity is not used as widely as in Scandinavia. The losses in the electricity and CHP sector are 1.5 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 12% of electricity production.
The electricity distribution losses of 6.3% are close to the EU average (2003 IEA).



Renewable Energy

The German renewable energy is mainly generated from biomass, hydro, wind power, and, to a lesser degree, renewable municipal waste and solar energy. There is also ongoing development of geothermal resources.

The largest use of renewable energy is in the form of biomass (2003), of which solid biomass is most important (78% of biomass use), followed by biogas (13.5%) and liquid biomass (8.5%). This sector is rapidly developing. Since 1995 there has been growth of 101% in the production of biomass energy.

The second most important renewable energy is windpower, which, since 2004, has produced more electricity than hydropower. Whereas the production of hydro has been more or less stable since 1990, the production of wind power has boomed since 1990 and Germany today is the leader among the European Union countries in the use of windpower. At the end of 2005, Germany had more 80% more windpower than the second largest country (Spain). The annual increase in installed capacity is decreasing (2,037 MW in 2004, 1808 MW in 2005); but when the large plans for offshore windpower materialize, the installation rates will go up again. Windpower now covers about 4% of Germany's electricity demand (2005) and the installed capacity is 18,428 MW (end of 2005).

The use of biomass and waste resources is concentrated in a few sectors. The main use is within the residential sector (47%). Almost the same amount is used in electricity plants and in CHP plants (46%). The transport sector consumes less (6%). This corresponds to the liquid biomass, mainly biodiesel, used in cars. In fact, biodiesel makes up 1% of the overall vehicle fuel consumption. Germany is the leading country within the European Union regarding production of biodiesel, with 1,035,000 tonnes in 2004, a 45% increase from 2003. This production represents more than half of the total production of biodiesel within the European Union (53.5%). Germany is planning to increase its bioethanol production from cereals with a planned output of 500,000 tonnes of bio-ethanol per year.

Regarding consumption of primary energy from wood energy, Germany was the fourth largest in 2004 (after Finland, Spain, and France) and with respect to electricity generation from wood energy, Germany ranks third (2004) in the European Union (after Sweden and Finland). From 2003 to 2004 there has been a marked increase in German wood use: a 21% increase in total use and more than a doubling of electricity production, both from 2003.

Germany is the second largest producer of biogas in the EU, after the UK. Germany is particularly active in the field of agricultural biogas use.

In solar energy, Germany is by far the leading country in the European Union with respect to photovoltaic power installed, with installed capacity of 363MWpeak in 2004, resulting in a total of 794 MWp by the end of 2004, and development has continued in 2005. In the second country, Luxembourg, only 13 MWp was installed in 2004. With respect to solar thermal use, as well, Germany is the leading country in the EU, with a market share of 46% corresponding to 780,000 m^2; the total installed collector surface was 6.20 million m^2 by the end of 2004. The second country, Greece, has less than half of the market size, with just 215,000 m^2 installed in 2004. Germany's solar thermal market in 2004 was 4% higher than in 2003, in spite of a reduction in the installation subsidy.

Renewable Energy Promotion and Policies

In Germany, renewable energy is mainly promoted with information, feed-in tariffs, subsidies, and low-interest loans.

Within the EU, Germany has a national target of generating 12.5% of its electricity from renewable energy (compared with 7.6 % in 2003) to be reached by 2010. The installation rates for renewable energy seem sufficient to reach the target. The new conservative prime minister has promised to continue the renewable energy policies as part of the coalition agreement with the social democratic party, in spite of statements to the opposite effect before the election.

There was a target for biofuels in transport of 2% by 2005. The target was reached in 2004.

Informational activity is carried out by national, regional and local energy agencies, often in large campaigns in cooperation with market actors and other stakeholders. The most successful example of this is probably the solar thermal campaigns starting in 1998 that made Germany the European leader in solar thermal. 17 local and regional energy agencies are supported by EU.

Feed-in tariffs for renewable electricity with fixed prices have been the support mechanism of choice since 1990 for the promotion of windpower, small hydro, as well as, in recent years, for biomass and PV. The tariffs started as 90% of consumer electricity tariffs, but have been changed to "cost-covering tariffs" that are set to cover the costs of renewable investors. They are divided into different tariffs for different technologies, with special high tariffs for PV, several times higher than consumer electricity prices. The tariffs are set high enough to make investments interesting for investors without demands for high returns, i.e., with returns higher than bonds and lower than stocks. The tariffs are reduced gradually to reflect the technological development by which new technologies gradually become cheaper. The present levels are (for plants that will be installed in 2006):

- PV: 41-56 €c/kWh, with the highest tariff for facade-integrated plants below 30 kWp and the lowest for solar fields; rates reduced 5%/year[1].
- Windpower, onshore: 8.4 €c/kWh for 5-20 years, with longest time for lowest production, then decreased to 5.3 €c/kWh for the remaining period up until 20 years; rates reduced 2%/year[1]; tariffs for offshore about 10% higher.
- Biogas, below 20 MW electric with CHP: 10.1-13.1 €c/kWh for 20 years, with the highest tariff to small plants below 150 kWe, rated reduced 1.5%/year[1]. Without CHP, about 10% lower tariffs.
- Landfill gas below 5 MWe: 6.5-7.4 €c/kWh for 20 years, with the highest tariff to plants below 500 kWe, tariffs reduced 1.5%/year[1]. Higher tariffs for certain innovative technologies.
- Solid biomass from forestry (wood) and energy plantations, below 5 MWe: 13-17 €c/kWh for 20 years, with the highest tariff to small plants below 150 kWe, tariffs reduced 1.5%/year[1]. Above 5 MW: as for biogas.
- Small hydropower, below 5 MWe, 6.65 – 9.67 €c/kWh for 30 years, with the highest tariff to plants below 500 kWe. Hydropower 5-150 MW can get tariff for 15 years, 3.7-6.65 €c/kWh depending on size.
- Geothermal 7.16 – 15 €c/kWh for 20 years, with the highest rate for plants below 5 MWe.

Subsidies are given for solar thermal collectors, biomass and biogas heating, and CHP plants. The subsidies are given according to installed size, such as 110€/m^2 solar collector (flat plate) and 60 €/kWthermal for automated biomass boilers with efficiency higher than 88%. Certain users, such as schools, also get subsidies for PV installations.

Low-interest loans are given to larger installations of biomass, to small hydro, and previously also to windpower. Usually the interest is 1% below market level. The loans are mainly via the German KfW[2].

Tax exemptions are used for liquid biofuels for transport that are not subject to vehicle fuel taxes.

The national coordination of renewable-energy development is carried out by the DENA, the German Energy Agency, www.dena.de.

The main drivers for the development of renewable energy are national policies. In recent years, increasing prices of imported energies have given an additional impetus to investments in renewables.

A number of barriers have slowed the development of renewable energy. Currently barriers are delaying the use of offshore windpower. These are questions about how to share the cost of grid-connections to existing grids, administrative uncertainties, and long procedures.

Geographical Distribution of Renewable Energy

Biomass, wind and solar are used throughout the country, but the best wind conditions are in the northern parts of the country, while the solar conditions are best in southwestern Germany.

National Allocation Plan for EU Emissions Trading

[1] Reductions are for future plants, whereby the tariffs for new plants are reduced every year; but the existing plants get the same agreed tariffs for the entire period of 15, 20 or 30 years.

[2] Kreditanstalt fur Wideraubau, a German public bank for investments, including smaller investments.

The first National Allocation Plan (NAP) was notified to the European Commission in March, 2004. The European Commission accepted the plan in July 2004 under condition of smaller amendments, and the plan was then enforced for the 1,849 installations covered.

In 2005-2007, the NAP covers the emissions of 499 $MtCO_2$ annually average, equivalent to 50% of total GHG emissions. About 360 $MtCO_2$ (annual average) of the allocations are for the energy sector. (EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union, COM(2004)366 final.Commission Staff Working Document, European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometers: Solar Thermal, Wind, Wood, PV Barometer 2005. EurObserv'er, Systemes Solaire, and EUFORES.

German Energy Agency, DENA, website www.dena.de.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

GREECE

Economic Sectors
Private service sectors contribute half of the value added of Greece, which includes a relatively large tourist sector that contributes substantially to the Greek economy. The public sector is relatively small compared with those of other EU countries, while agriculture contributes substantially more to the economy in Greece than in other EU countries. Industry contributes about half of the value added of private services.

The economy is troubled, with a high unemployment of 10.5%(2004), deficit on state finances (-6.6% of GDP in 2004) and a negative current account balance in its foreign exchange (-6.4% of GDP in 2003). (Eurostat 2005).

Greece receives substantial EU support in the form of structural funds for the poorer parts of EU.

One-third of the population of Greece lives in the area around the capital, Athens. This is mainly because of the development of the industrial activity and services in the area.
The main industrial activity of Greece covers the fields of petroleum product refining and their derivatives, metallurgy, mineral ores, beverages and bottling, foodstuffs, paper, cement, tobacco, and textiles (GMFA).
Geographically, the industrial activity is concentrated in the major urban centres, in Athens and Thessaloniki. However, the tourist industry is mainly developed in the south of Greece, and especially in the islands. The main mining activity takes place in the north of Greece, which is rich in lignite and marble.

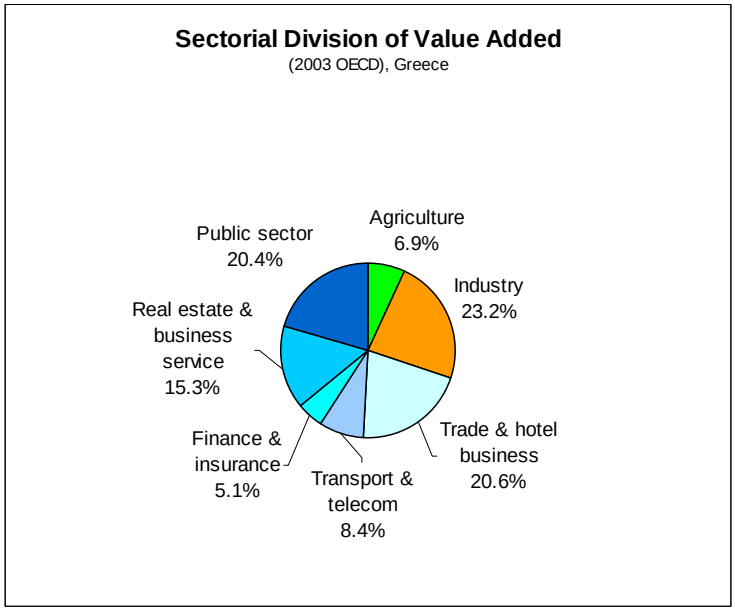
Energy Supply and Demand
The Greek energy supply is dominated by imported oil and by domestic lignite (brown coal) that is mainly used for electricity production. Imported gas also plays a role together with renewable energy that contributes 5.2% of the total primary energy supply (TPES). Domestic production of oil and gas is less than 1% of oil and gas supply. (2003-IEA).

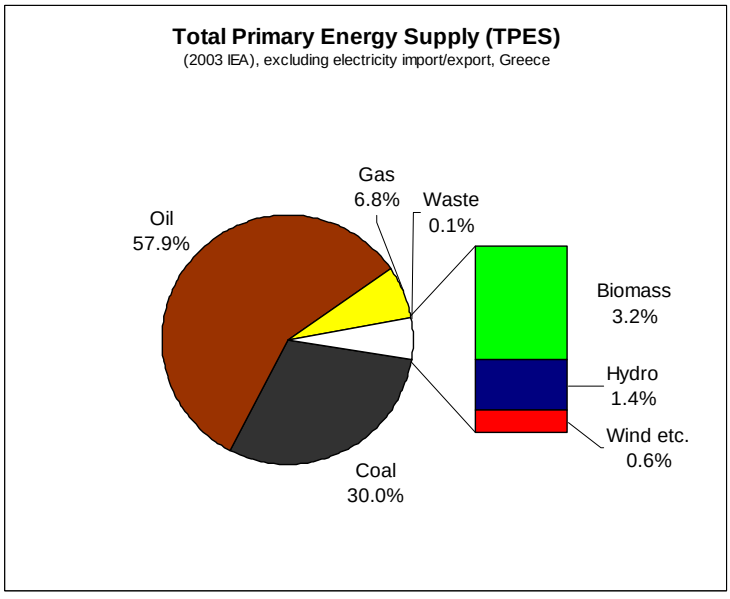
The TPES was 1,227 PJ in 2003, not including electricity imports. It is increasing by ½ - 1% per year, while industrial energy consumption is slowly decreasing by about ½ % per year.

Population:
11.0 million (2004)

GDP:
167 billion € (2004) = 15,125 €/capita

Greenhouse-gas emissions:
137.6 million tons CO_2 equivalent (2003) = 12.5 tons/capita





In the supply structure, oil is dominant, covering 71% of total final consumption, followed by electricity, covering 19%, and by renewables, covering 5% (TFC, 2003-IEA). Oil is dominating in all sectors except service, where electricity is dominating.

Greece has imported electricity in recent years, 4% in 2003. (2003-IEA).

The district heating is not much used, supplying only 0.1 % of TFC.

The demand structure is dominated by transport and residential consumption. Among industrial sectors, non-metallic mineral is the largest energy consumer. It accounts for 25% of industrial energy consumption, followed by industries producing non-ferrous metals 18 (%), food and tobacco (16%) and chemicals (9%) (2003 IEA).

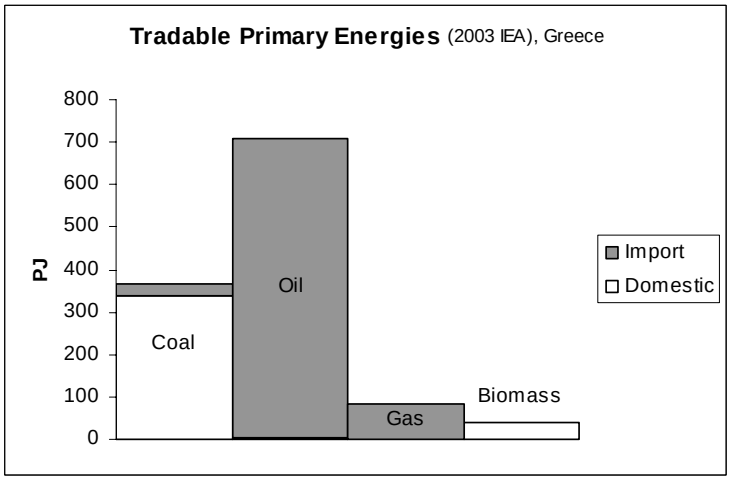
Transport includes aviation, which represents about 15 % of transport energy use.

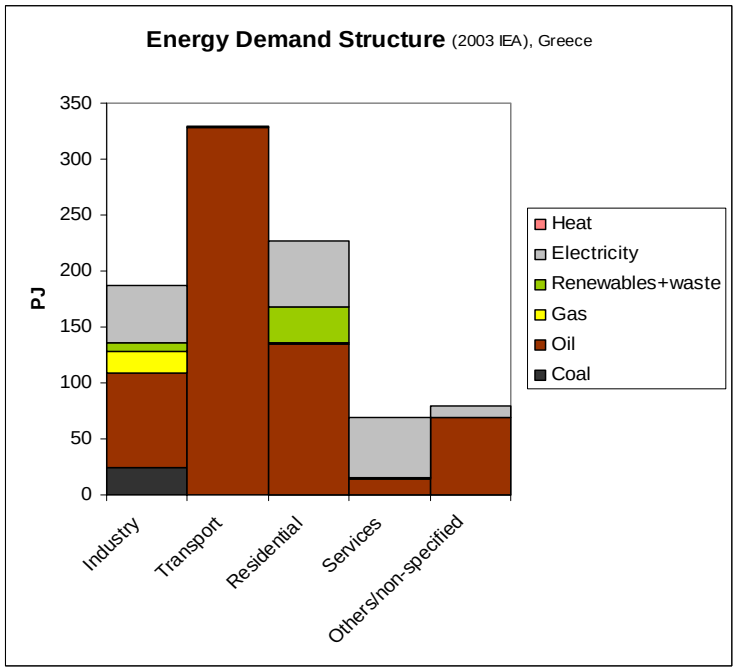
Others/non-specified is primarily agriculture; the same category includes non-energy oil use and non-specified energy use.

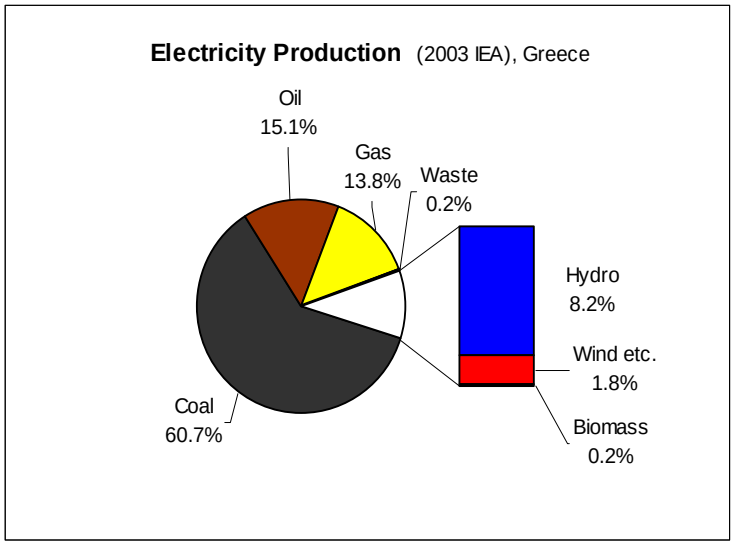
Electric Power Supply

The Greek power supply structure is dominated by coal-fired power stations that supply 60 % of electricity production of 53.6 TWh, followed by gas (14%), oil (15 %), and renewables (10%), of which 8% came from hydroelectric plants. (2003 IEA)
In 2004, the share of renewables was 12%, of which 10 % came from hydroelectric plants. (Greek Ministry of Development).

The efficiency of the power sector is low, as co-generation of heat and electricity is little used, and the losses in the electricity and CHP sector are 1.7 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 11 % of electricity production. Only 6% of the power production is from CHP plants.
The electricity distribution losses of 10% are above the EU average (2003 IEA).







Renewable Energy
The Greek renewable energy is hydro, biomass, solar, wind, and a smaller amount of geothermal.
The largest use of renewable energy is in the form of hydropower. Hydro production increased by a factor of 2.7 in 1990-2003 and there is still room for some additional increase.
Second in renewable energy is biomass, in particular biomass for domestic use (12% of domestic energy use), and for the food industry (25% of food industry energy use). This is mostly solid biomass, but the industry also uses biogas (2003 IEA).
In 2004, the Greeks had the second-largest national market for solar heating in Europe (after Germany), with installation of 215,000 m^2 of solar heating collectors. The installed capacity of solar heating is also the second largest in Europe: 2,826 million m^2 equivalent to 0.26 m^2/capita (Barometer). This development took off in the late 1980's with domestic production of simple solar heaters, mostly thermosiphon systems with direct circulation of hot tap water. To start the development, national subsidies/tax breaks and information campaigns were introduced; but the progress now is continuing without subsidies. A large part of the systems are for single-family use, where the family installs solar heating as the primary source of heating of their domestic hot water. In the Greek weather conditions, the solar heaters are able to provide hot water around the year with little need for backup. Some systems have electric heating as backup.

In recent years windpower has been developed, using good wind conditions in many sites around the Mediterranean Sea, including the Greek Islands. The development started in the mid-1990's, and while development has been slower than expected, windpower production reached 1 TWh in 2003 and development continued with 90 MW installed in 2004, adding 24% to the capacity in just one year (Barometer).
In recent years a slow development of PV for electricity has started, in particular on the Greek islands.
Greece also has geothermal energy, but current installed capacity is only 80 MW thermal for heating purposes.

Greece is endowed with good potentials for increased use of renewable energy, for solar heating and electricity, for windpower, as well as some unused potential for biomass including biogas, and for small hydro. There are some limitations to windpower, as offshore windpower is limited because most of the seas are too deep, and a number of the potential windpower sites have conflicts with other land uses; but there is still a large unused windpower potential.

Renewable Energy Promotion and Policies
In Greece, renewable energy is mainly promoted with information, tax exemptions, subsidies, and feed-in tariffs. Within the EU, Greece has a national target of generating 20.1% of its electricity from renewable energy (compared with 10.2% in 2003), as well as a target of 5.75% renewable energy in transport, both to be reached by 2010. According to estimations, the installed capacity from renewable-energy electricity by 2010 will not reach the target of 2,800 MW. Market estimations are that the capacity by 2010 will not exceed 1,200-1,400 MW from windpower, if there is no dramatic change of the current tendencies.

The coordination of the renewable-energy development is carried out by the Centre for Renewable Energy Sources (CRES). Central in the promotion of renewable energy are CRES and seven regional agencies, each organised by the region or in an association of municipalities, mostly involving EU support. Of the seven regional centres, six have received EU support for their operations, mostly during their establishment and first years of operation.

The Regulatory Authority for Energy has a responsibility to comment to the Ministry of Development on the applications for renewable-energy projects' installations as well as to monitor their implementation.
In 2002 an agency for the commercial management of renewable energy was established.
The island of Crete has developed a special renewable-energy island programme, but its plan for self-sufficiency from renewable energy was rejected.

Tax exemptions have been crucial in the development of renewable energy, in particular for solar heating. Since 1994 investors have been allowed to deduct 75% of costs for renewable energy from income tax, equal to a subsidy of about 30%. This law is on halt currently for budgetary reasons.

Subsidies ranging from 30% up to 50% have been given to different renewable energy technologies, including windpower, solar heating and geothermal heating. A special law supports energy investment of private companies; but others can also obtain subsidies via "Operational Program Competitiveness", partly supported by the EU.

Renewable electricity from windpower receives feed-in tariffs set to 90% of consumer price, equivalent to about 7 €c/kWh on the mainland and 7.8 €c/kWh on the islands, where electricity is more expensive (EU 2004). According to the new draft law on renewables the feed-in tariff for electricity produced by wind power will be 0.88€/kWh. In the last version of the draft law for the promotion of RES, the exact feed-in tariffs for the electricity produced by PV are not included and there is a debate on this at the moment. It is supposed that there will be a decision on that soon, because it is very important for the development of PV in Greece. In the first version of the draft law, by agreement among different stakeholders, there was a tariff of about 0.43-0.59 €/kWh. Today's feed-in tariff for PVs is estimated at 0.066-0.09 €/kWh (end of 2005). The draft law is under public consultation until the end of January, 2006.
To fund some of the information activities and subsidies, EU structural funds are used.

The main drivers for the development of renewable energy are national policies. In recent years, rising prices of imported energies have given additional impetus to investments in renewables.

A number of barriers have slowed the development of renewable energy. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Complicated procedures to obtain permission for larger renewable-energy systems such as those for windpower. Efforts are in progress to introduce a procedure with a single application.
- Administrative difficulties in connecting windpower plants to the national grid.
- Some potential windpower sites are in regions with grids too weak to connect to windparks.
- Dependence on the domestic but poor lignite (brown coal).

Geographical Distribution of Renewable Energy
While biomass and solar installations are located throughout the country, windpower is mainly located on the islands and on windy areas of the mainland.
In 2005, the installed capacity of renewable energy was 620 MW, of which 525 MW were produced by 92 windparks that exist in Greece. Most of the windparks are installed in Evia, Crete, Thrace and on big islands like Kos, Lesvos, Samos and Hios; there is also a tendency of expansion towards the Peloponnesus and central Greece (Sterea Ellada).
Energy from biomass is produced only in Attiki (20.69 MW), in Central Macedonia (2.74 MW), in Thessaly (0.35 MW) and in Crete (0.17 MW). The small-scale hydroelectric plants contribute 68 MW.
The application of PVs is very limited. The applications that are connected to the system are in Attiki (0.2%), in central Macedonia (0.15%) and in Crete (0.80%). Including the photovoltaic systems that are not connected to the system, the total installed capacity at the beginning of 2006 was estimated at about 5 MW.

National Allocation Plan for EU Emissions Trading
The first National Allocation Plan (NAP) was published in December, 2004. The European Commission accepted the plan in June, 2005, and it was then enforced in Greece for the 141 installations covered. In 2005-07, the NAP covers the emissions of 74.3 $MtCO_2$ annually, equivalent to 53% of total GHG emissions in Greece. This is equal to 98% of the Business-as-Usual predictions of the installations covered. Credits of 56 $MtCO_2$ (annual average) are given to the energy sectors (IEA 2005). In 2005, the Public Electricity Company spent about 80-120,000,000 € to buy credits for emissions.

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition, (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

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Website of the Greek Economy: www.economy.gr; GMFA: Greek Ministry of Foreign Affairs.

3rd National Report for the level of development of Renewable Energy for the year 2010, Min. of Development, Energy Depart., Oct. 2005.

Greek market estimations and MEDITERRANEAN SOS Network.

HUNGARY

Population:
10.12 million (2004)

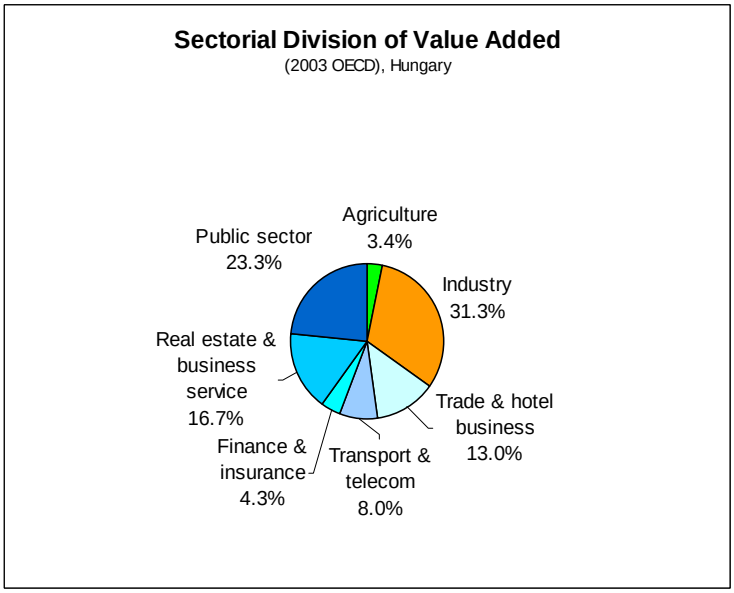
GDP:
81 billion € (2004) =
8,007 €/capita

Greenhouse-gas emissions:
83.2 million tons CO_2 equivalent (2003) =
8.2 tons/capita

Economic Sectors
Private service sectors contribute 42 % of the value added of Hungary, while industry and agriculture together contribute 35%, which is slightly above the EU average.

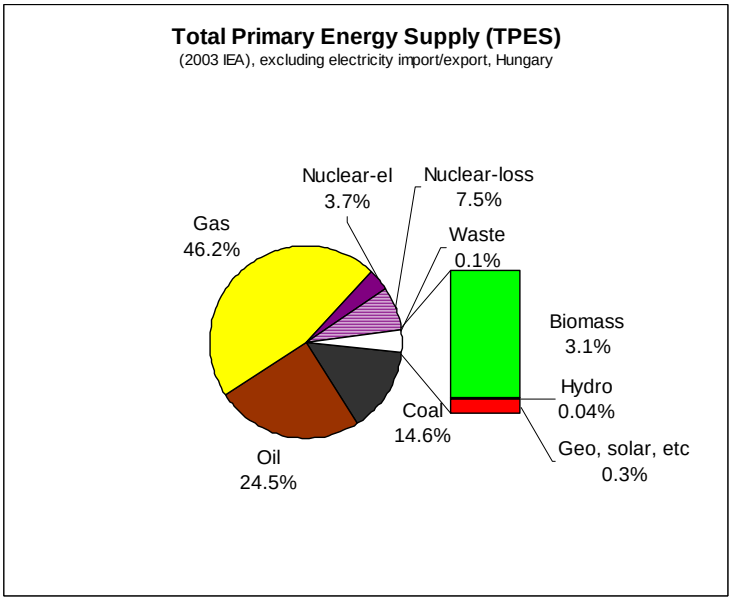
The economy of this new EU country has shown a steady increase of GDP, where the growth is higher than the EU average. (4.6-6.3 % in 2004-05). The GDP /capita is the third highest among the new EU countries in the continent, but it is still only 36% of the EU average. The country has some balance problems with a deficit on state finances (-5.4 % of GDP in 2004) and a negative current account balance in its foreign exchange (-9% of GDP in 2003). Unemployment has decreased to 6 % in 2004, which is less than the EU average (Eurostat 2005). As one of the newer and poorer EU countries, Hungary receives support from EU structural funds.

Hungary is placed centrally in Europe. Geographically, the one-third of the population lives around the capital, but other towns are also becoming important, partly because of foreign investments in production facilities motivated by low-costs (1/3 of the EU average), and a skilled workforce. Important industries are pharmaceuticals, food processing, manufacturing, and the lighting industry (GE / Tungsram). A number of newer industries, e.g. telecommunications and automobiles (Audi, Suzuki) have realised significant growth.



Supply and Demand
The Hungarian energy supply is dominated by gas (almost half), which is mainly imported from Russia. This is followed by the mainly imported oil and coal (lignite), which is mainly domestic. Renewables and nuclear play smaller roles in the supply. Domestic production of oil and gas are, respectively, 26% and 19% and they are declining (2003-IEA).

The TPES was 1,063 PJ in 2003, not including electricity imports. It has been increasing slightly since 2000, but it is still below the 1990 level.
In between 1990-1995, it was falling, due to the closing down of inefficient, mainly heavy industries. (2003-IEA).



In the supply structure, gas is dominant, covering 41% of total final consumption (TFC), followed by oil, covering 30%, and electricity, covering 14% (TFC, 2003-IEA).

Hungary has imported electricity in recent years: 24% in 2003, but "only" 13% in 2002 (2003-IEA). The district heating supplies 7 % of TFC.

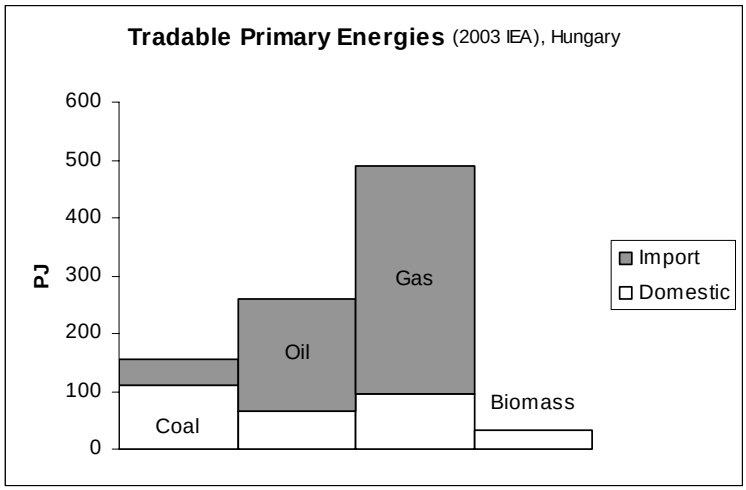
The demand structure is dominated by residential consumption (34%) followed by industry (24%), transport (20%), and services (16%). Among industrial sectors the chemical and petrochemical industry is the largest energy consumer. It accounts for 28 % of industrial energy consumption, followed by non-metallic minerals (14%), food and tobacco (12 %) and iron and steel (11%) (2003 IEA).

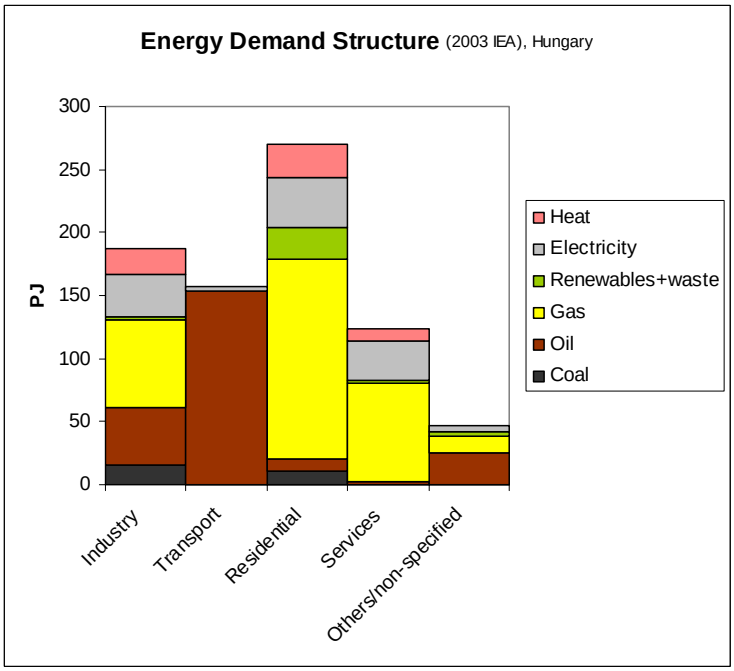
Transport includes aviation, which represents about 5.5 % of transport energy use.
"Others/non-specified" is primarily agriculture. It also includes non-energy oil use, and non-specified energy use.

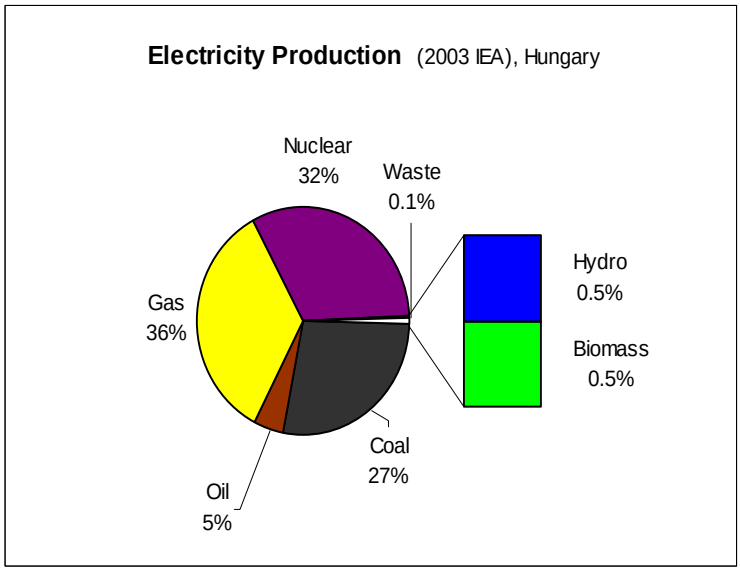
Electric Power Supply
Hungary's power supply structure is distributed among gas, nuclear, and coal each contributing roughly 1/3 of the total electricity production, followed by oil (5%), as well as hydro and biomass each at 0.5%.
In 2003, the total electricity production was 34 TWh. (2003 IEA).

The efficiency of the power sector is reasonable as cogeneration of heat and electricity is used, and the losses in the electricity and CHP sectors are 1.6 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 16 % of electricity production.

54.4 % of the power production is reported as being from CHP plants. This is because the Hungarian authorities report the country's nuclear power plant as CHP plants, even though the useful heat production from the nuclear power plants is only a small fraction of the nuclear electricity production. If nuclear is not included as CHP, the CHP production is 22% of electricity production, which is higher than the EU average.
The electricity distribution losses of 14.6 % are double of the EU average (2003 IEA).







Renewable Energy

The Hungarian renewable-energy use is mainly biomass, along with a smaller amount of hydro and geothermal.
- The largest use of renewable energy is in the form of biomass, which was 3.1 % of the energy supply and 0.5 % of the county's power production in 2003 giving half of the renewable electricity in 2003. The production doubled in the period of 2001 to 2002 and there is still big potential for increases. In 2004, the electricity production from biomass increased 5 times compared to the level in 2003. The rise continued in 2005, after the introduction of higher feed-in tariff. There is substantial further potential for using forestry waste and straw. In the period of 2005-2006, energy plantations were started.
- Second in renewable energy is geothermal, which is about 0.3 % of the TPES, and there is no geothermal power production in 2005. The geothermal energy is more suitable for heat supply than for electricity production. Geothermal energy is widely used for heating of greenhouses, district heating, and swimming pools. There was no geothermal electricity production by the end of 2005, but there are possibilities in 5-10 places.
- The third renewable energy is hydropower covering 0.5% of the power production of the country (2003), which was half of the renewable-electricity in 2003. There are 31 hydro power plant with a total of 55 MW of capacity. There is only small further potential of 10-15 MW for small hydro power plants.
- The feed-in tariff system, and the increased price of 9 €c raised the interest of private investors in harvesting the wind potential. In 2004-2005, 8 windmills were installed and in 2005, a volume of 350-MW wind power plants got permission and are in the planning stages. In addition, permissions were sought for 1,600 MW.
- There were no biofuels in 2003. Bioethanol is started to be produced by alcohol companies. In 2005, 2 production facilities for biodiesel were built.
- Solar thermal energy is very limited in Hungary opposite to the neighbouring Austria.
- The use of biogas is one of the lowest in Europe, however, there is large potential of using the manure of animals for producing biogas.

Renewable Energy Promotion and Policies

Within the EU, Hungary has a national target of 3.6 % of its electricity to be covered with renewable energy (1 % in 2003), as well as a target of 4% renewable energy in transport (0 % in 2003), both to be reached by 2010. There is also an aim of about 6% for renewables of the energy supply (3.4 % in 2003).
The major driving forces are the feed-in tariff system based on the Electricity Act, the biofuel incentives and support based on the Biofuel Resolution, as well as the support schemes of the National Energy Efficiency Plan (NEP)/Structural Funds (SF), information raising awareness, and the increasing energy prices.
- The Electricity Act introduced a feed-in tariff system for renewables since January, 2003. The increase of the price to 9 €c for renewable electricity since September, 2005 gave a big momentum to renewables. The limitation of the minimum size of the installation has stopped.
- The support of biofuels was decided in the Governmental Decree of 2233/2004 (IX.22) and the target for biofuels is 4 % of fuels by 2010. Biofuel distributors get refunds of excise duty when they include a 4.4% bio component into the fuel.
- Information is essential: In Hungary there is a national energy agency, Energy Centre Hungary, which is giving information, makes publications, and administers the NEP/SF funding. There is an energy advisory network, Green Energy Network (ZEH) established by 10 environmental NGOs. These organisations publish brochures, give advice and information, locally and make campaigns. Five of them developed a do-it-yourself workshop, where people can make their own solar collectors similarly how it is done in Austria. The organizations are also member of the Hungarian Network of Eco-counselling Offices (Kötháló). The ZEH network got support in 2002-03 from a Phare Macro project for their work giving free information to the public.
- New support in the form of earmarked funding for renewable energy is expected, once the National Energy Strategy is ready, by the first quarter of 2006. There was a support scheme for solar thermal installations, which helped the start of the industry.
- The NEP funding stopped in 2004. There is a new possibility for funding through Structural Funds for investments bigger than 125 million HUF: For renewables electricity, 700 million HUF was available in 2005; and 2,020 million HUF will be available in 2006. (250 HUF= 1 Euro)

Barriers are:
- Little awareness of the renewable-energy advantages, and of environmental consequences of using traditional fuels. Generations grew up without learning about the environment and renewables in the school.
- The salaries are about 1/3 of the EU average, which means that people have less money to invest into a solar thermal collector as in Austria.
- Not enough support schemes for renewables. The previous support scheme stopped, e.g. the 30% support for solar thermal installations to houses. New programs are needed with easy applications, and quick procedures. Though, these are expected to start in 2006.
- There is no exact time period defined in the law as to how long time the price is insured in the feed-in tariff system. The price of the feed-in tariff system was changed several times, which gives an impression of instability. There are signs of efforts to slow down the rapid development.

Geographical Distribution of Renewable Energy
Biomass installations (some previous coal power plants) are mainly located in the hilly part of the country. Wind mill potential is in the northwest and southeastern part of the country. Geothermal wells are mainly in the southeastern plain of the country. There are 30 small hydro power plants on several rivers.

National Allocation Plan for EU Emissions Trading
The first National Allocation Plan (NAP) was notified to the European Commission in October, 2004. The European Commission accepted the principles of the plan in December, 2004, but it is only expected to be approved by the EU at the end of January, 2006, and the emission trading is expected to start in the period of February-April, 2006. This happens after a substantial delay.

In 2005-2007, the NAP covers the emissions of 31.2 $MtCO_2$ annually, equivalent to (IEA 2005). 97.5 % is planned to be allocated to 170 companies' 261 installations, and 2.5 % will be sold by the state.

Sources and information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European. Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

Barometer: EurObserv'er, Systemes Solaire, and EUFORES.

Hungarian Energy office (MEH) (www.eh.gov.hu).

GKM: Hungarian Ministry of Economy and Transport, (www.gkm.gov.hu).

KvVM: Hungarian Ministry of Environment and Water, (www.kvvm.hu).

Structural Funds: Energy Centre Hungary, (www.energycentre.hu).
ZEH, Zöld tech, Kötháló.

IRELAND

Population:
4.0 million (2004)

GDP:
149 billion € (2004)
= 36,994 €/capita

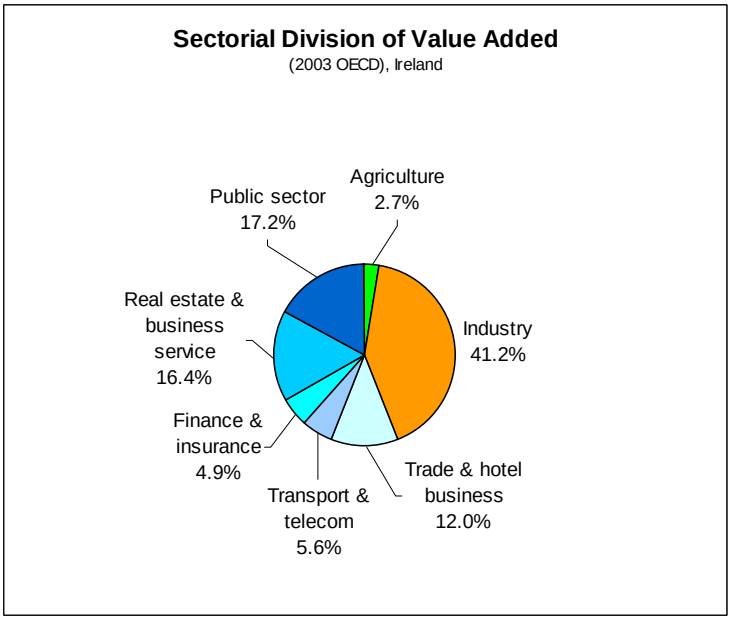
Greenhouse-gas emissions:
67.6 million tons CO_2 equivalent (2003) = 16.8 tons/capita

Economic Sectors

Private service sectors contribute 39% of the value added of Ireland. This includes a large industrial sector, which contributes 41% to the Irish economy. This is substantially more than the EU average. The public sector is relatively small (17%).

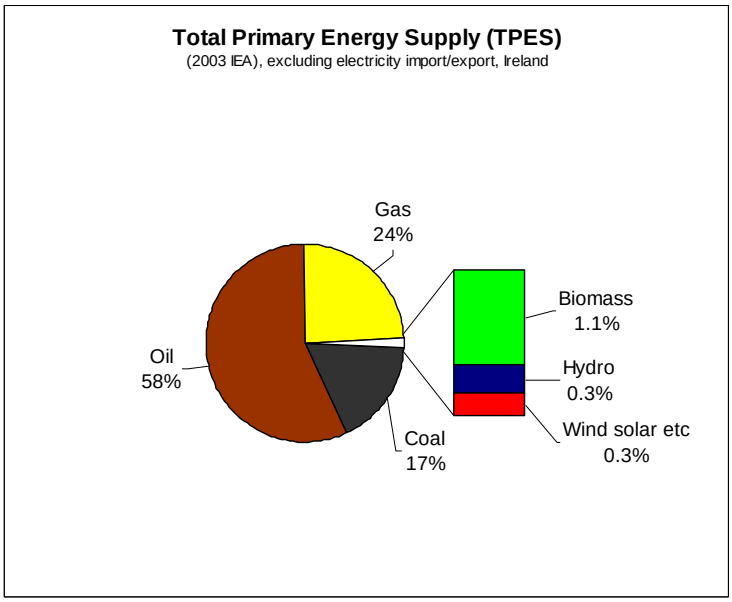
The Irish GDP per capita is among the highest in the EU, 64 % above the average, while the GDP growth rate increased by 4.5% in 2004, significantly above the average of the old EU countries, which generally have lower growth rates. The economy is generally in a good shape, with the lowest unemployment rate in the EU (4.5 in 2004) and a surplus on state finances (1.4% of GDP in 2004) but a slight and growing negative current account balance in its foreign exchange (-1.4% of GDP in 2003) (Eurostat 2005).

Industries include steel and other metals, gypsum, mining, food products, brewing, textiles & clothing, chemicals, pharmaceuticals, machinery, vehicles, and shipbuilding. Prominent companies include Guinness (beverages), Glanbia (food products), Kerry Group (food products), and CRH (construction materials). One-third of all the personal computers sold in Europe are made in Ireland. IT hardware companies like Apple, Hewlett-Packard, Seagate, Oracle and Sun Microsystems have factories in Ireland.



Energy Supply and Demand

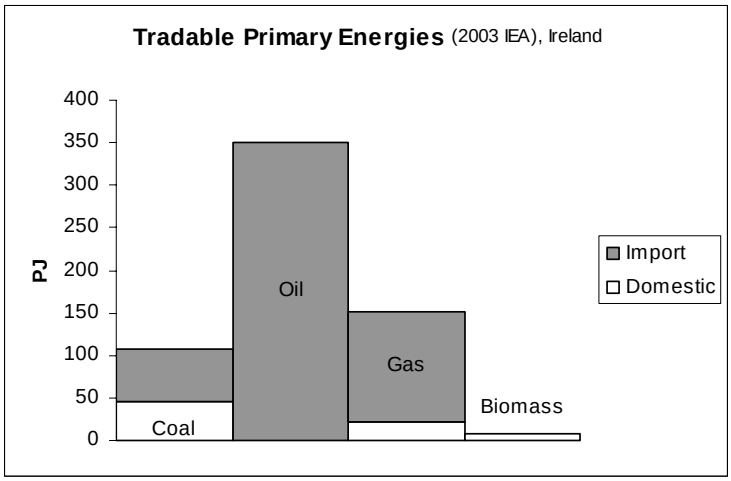
The Irish energy supply is dominated by imported oil that contributes 58% of the total primary energy supply (TPES), followed by gas (24%) and coal (17%).
The domestic production of coal (as lignite and peat) is 42% of the total used and, of gas 15% of the total used; there is no domestic production of oil (2003-IEA).
The TPES was 619 PJ in 2003, not including electricity imports. It decreased by 1.5% in 2003, but increased steadily up until 2003.
In the supply structure, oil is dominant, covering 67% of total final consumption (TFC), followed by electricity, covering 17%, and gas, covering 11%. (TFC, 2003-IEA).



Ireland has imported electricity in recent years, 5% in 2003 (2003-IEA).
The district heating is very small.

The demand structure is dominated by transport, followed by residential and industry consumption. Among industrial sectors, the food and tobacco is the largest energy consumer. It accounts for 27% of industrial energy consumption, followed by non-metallic minerals (15%), chemical industry (15%) and non-ferrous metals (9%) (2003 IEA).

Transport includes aviation, which represents about 18% of transport energy use.
Others/non-specified is agriculture and non-energy oil use.



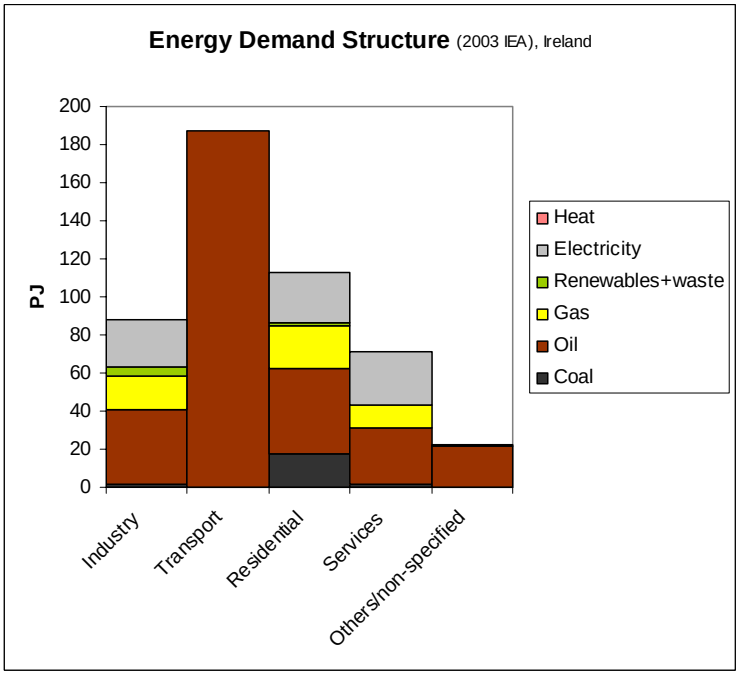
Electric Power Supply

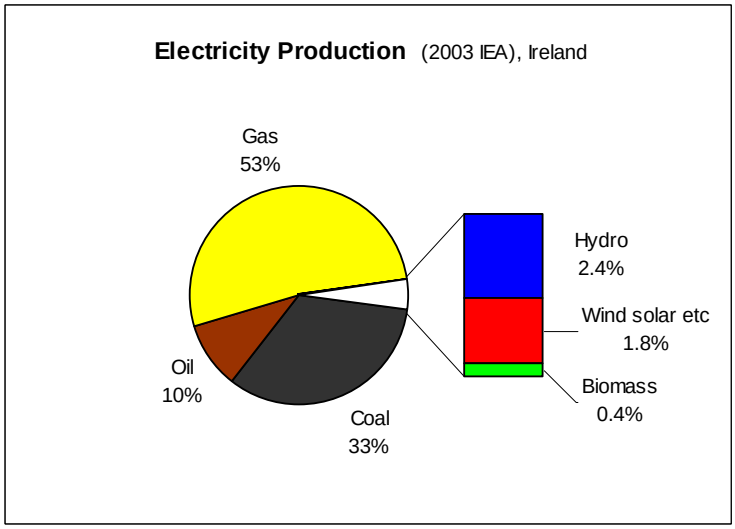
Ireland's power supply structure is dominated by gas-power stations that supply 53% of electricity production, followed by coal including lignite & peat (33%), oil (10%), and hydro (2%) (2003 IEA). The total production was 25 TWh (2003 IEA).

The efficiency of the power sector is relatively low, as cogeneration of heat and electricity is little used, and the losses in the electricity and CHP sector are 1.4 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 6% of electricity production.

2% of the power production is from CHP plants.

The electricity distribution losses of 9% are above the EU average (2003 IEA).





Renewable Energy

The renewable energy in Ireland is generated from biomass, hydro, and wind power.

The largest use of renewable energy is in the form of biomass (2003), of which solid biomass is the most important (85%), supplemented with a smaller amount of biogas including landfill gas (15%). The yearly production has not changed significantly since 1995. In fact, Ireland is the only country in the European Union that has had a negative growth (0.6%) in consumption of primary energy from wood energy between 2003 and 2004.
The main users of biomass energy are industries (the wood and wood products and the food sectors). The other user of biomass energy is the residential sector (27% of the entire biomass supply).

The second most important renewable energy is hydro. The production has been stable since 1990 with large yearly fluctuations due to variations in rainfall.

The third source of renewable energy in Ireland is windpower. Since 1995, windpower has grown from almost nothing to 496 MW by the end of 2005.

Ireland has large wind resources and also large potentials for additional use of biomass including biogas. In the future, wavepower could contribute to the electricity supply.

Renewable Energy Promotion and Policies
In Ireland, renewable energy is mainly promoted with information, tendering, subsidies, and tax exemptions.
Within the EU, Ireland has a national target of generating 13.2 % of its electricity from renewable energy (compared with 4.6% in 2003) to be reached by 2010. The installation rates for renewable energy have been too small to reach the target.
Ireland has also set a target of 0.13% biofuels in transport by 2006.

The national coordination of renewable-energy development is carried out by Sustainable Energy Ireland (SEI). Information services are handled by the Renewable Energy Information Office of Sustainable Energy Ireland, as well as by two regional and nine local energy agencies. Most of the regional and local energy agencies have received EU support for their operations, mostly during their establishment and first years of operation.

Tendering under the Alternative Energy Requirement (AER) has set prices for renewable electricity:

- Windpower 5.2-5.7 €c/kWh for onshore,
- Windpower 8.4 €c/kWh for offshore,
- Biomass including biogas 6.4-7 €c/kWh, and
- Small hydro 7 €c/kWh.

Subsidies are given for feasibility studies (usually up to 45%), biomass heating (up to 25%), and demonstration projects in all renewable energies (25%)

Tax reductions of biofuels have supported some development of liquid biofuels for transport.

The main drivers for the development of renewable energy are national policies. In recent years, rising prices of imported energies have given an additional impetus to investments in renewables.

Several barriers have slowed the development of renewable energy. The primary barriers have been relatively low levels of support and relatively low fossil-fuel prices.

Geographical Distribution of Renewable Energy
A large part of the windpower has been in some favourable sites that have good wind conditions and few alternative land uses. A large part of future wind is expected to be offshore.

National Allocation Plan for EU Emissions Trading
The first National Allocation Plan (NAP) was notified to the Commission in March, 2004.
The European Commission accepted the plan in July, 2004, and the plan was then enforced for the 143 installations covered. In 2005-07, the NAP covers the emissions of 22.32 $MtCO_2$ annually average, equivalent to 34.4 % of total GHG emissions. Credits of 17.84 $MtCO_2$ (annual average) are given to the energy sectors including mineral oil refining (IEA 2005 and EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition, (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

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IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Sustainable Energy Ireland (SEI) website, www.sei.ie.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

Information on biofuels from Premia, December 2005, presented at the conference Clean Vehicles and Fuels, Nov. 2005, Stockholm, www.premia-eu.org.

ITALY

Population:
57.9 million (2004)

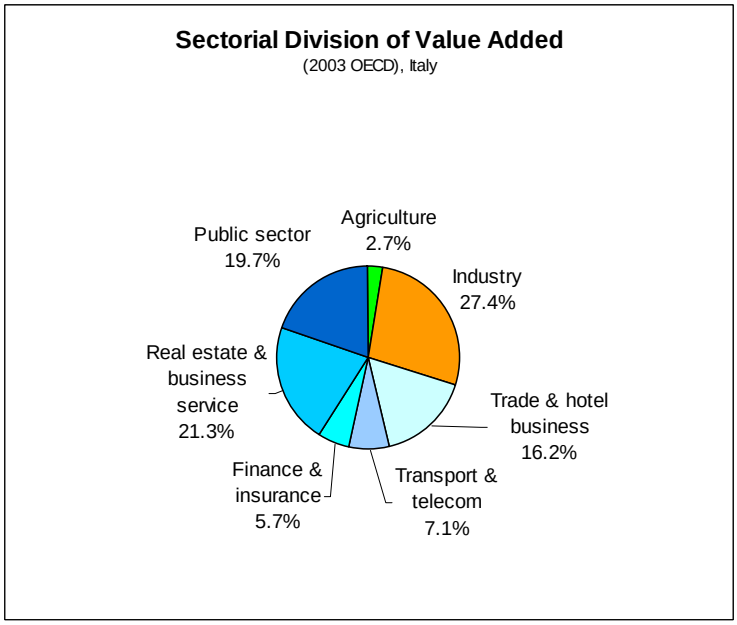
GDP:
1,351 billion €
(2004) = 23,338
€/capita

Greenhouse-gas emissions:
569.8 million tons
CO_2 equivalent
(2003) =
9.8 tons/capita

Economic Sectors
Private service sectors contribute 51% of the value added of Italy, which includes a relatively large trade and hotel-business sector (16%). The public sector is relatively small, while agriculture contributes 3%, which is slightly higher than the EU average.

The Italian economy contributes 13% to the EU GDP. The GDP per capita in Italy is close to the average in the EU, while the GDP growth rate is among the lowest in the EU. The unemployment rate is 8%, which is slightly below the EU average. Italy has a deficit on state finances (-3.2% of GDP in 2004) and a negative current account balance in its foreign exchange (-1.4% of GDP in 2003) (Eurostat 2005).

Industries include machinery, iron and steel, chemicals, food processing, textiles, motor vehicles, clothing, footwear, and ceramics. Prominent Italian companies include: Fiat (motor vehicles and heavy equipment); Pirelli Group (one of the world's largest tire manufacturers); Finmeccanica (aircrafts, armaments), ENI, Benetton Group, Marzotto and Figli (all clothing); and many fine producers of wine, olives, and olive oil.

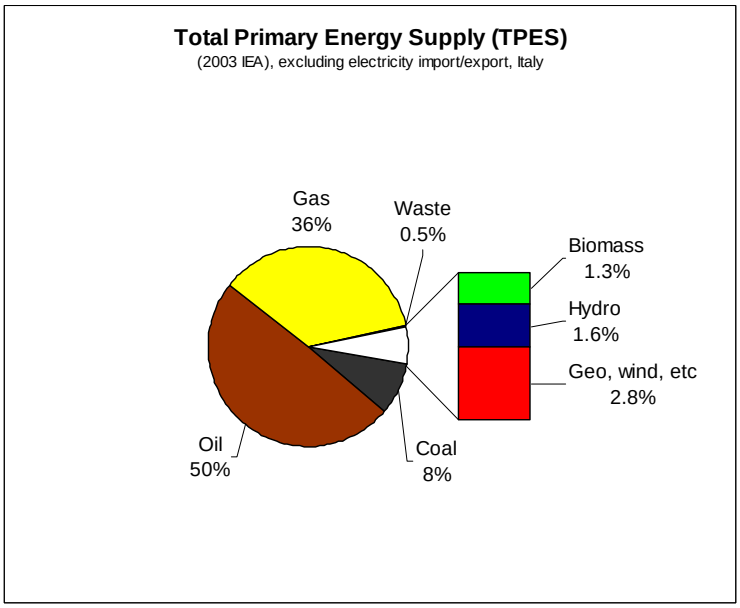


Energy Supply and Demand

The Italian energy supply is dominated by imported oil that contributes 50 % of the total primary energy supply (TPES), followed by gas (36 %).
Domestic production covers 18% of the gas supply and 7% of the oil supply (2003-IEA).

The TPES was 7296 PJ in 2003, not including electricity imports. It increased by 4.3% in 2003.
In the supply structure, oil is dominant, covering 49% of total final consumption (TFC), followed by gas, covering 30%, and electricity, covering 18%. (TFC, 2003-IEA).

Italy has imported electricity in recent years, 20% in 2003 (2003-IEA). The district heating is little used.

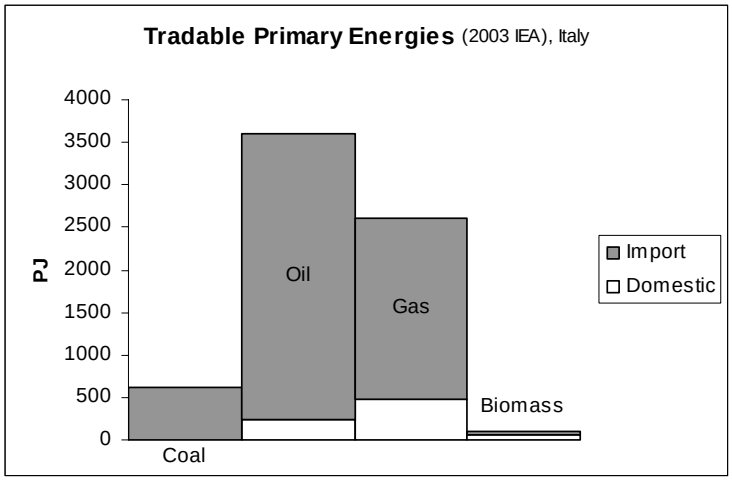


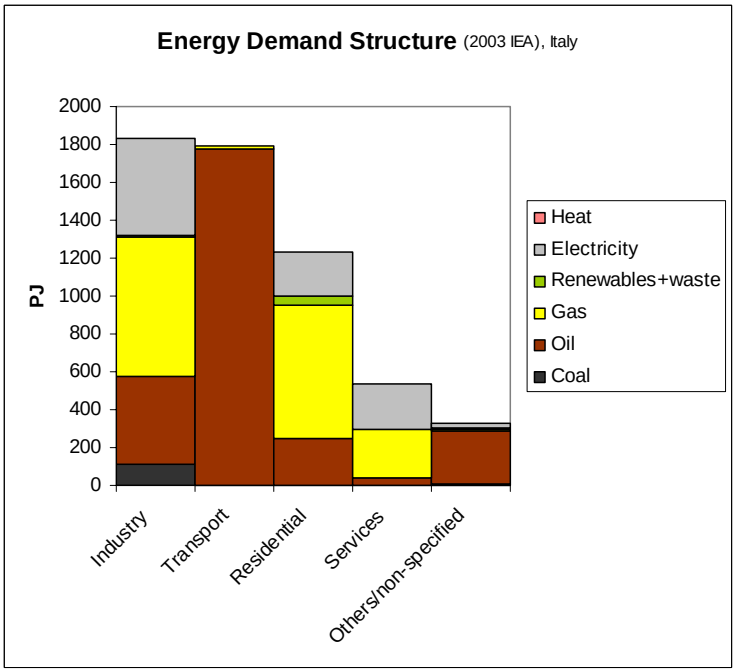
The demand structure is dominated by industry (32%) and transport (31%), followed by residential consumption (22%). Among industrial sectors, the chemical and petrochemical industry is the largest energy consumer. It accounts for 24% of industrial energy consumption, followed by non-metallic minerals (19%), irons and steel (13%) and machinery (11%) (2003 IEA).

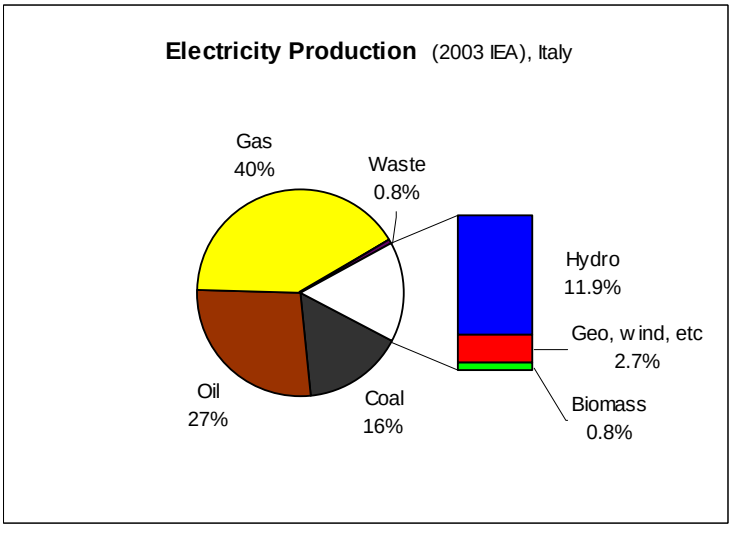
Transport includes aviation, which represents about 9 % of transport energy use.
Others/non-specified is primarily non-energy oil use and agriculture.

Electric Power Supply
The power supply structure of Italy is dominated by gas power stations that supply 40% of electricity production, followed by oil (27%), coal (16%), and hydro (12%) (2003 IEA).
The total production was 283 TWh (2003 IEA).

The efficiency of the power sector is close to EU average; the losses in the electricity and CHP sector are 1.5 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 8% of electricity production. 25% of the power production is from CHP plants. The electricity distribution losses of 8% are close to the EU average (2003 IEA).







Renewable Energy

The Italian renewable energy is geothermal, hydro, biomass, solar, and wind. The largest use of renewable energy was geothermal energy in 2003, followed by hydro and biomass. The use of all renewable energy sources has been increasing in recent years except hydropower.

Geothermal energy is mainly used for electricity and district heating while half of the biomass is used in electricity and CHP plants, 1/3 for residential use and the rest is shared between agriculture and industry. A part of the biomass is imported; in 2003 it was 21% of consumption.

In 2004 and 2005 the Italian windpower sector has developed strongly, doubling capacity to 1,717 MW by the end of 2005.

Italy has an active biofuels market and was the third-largest producer of biodiesel in 2004 (after Germany and France). Recently, it has increased its bioethanol production.

Italy also has an active PV market, with 4.3 MW installed in 2004 and a total capacity of 30 MW by the end of 2004. In addition, 55,000 m^2 of solar thermal collectors were installed, adding 13% to the solar thermal collector surface.

Italy is endowed with good potentials for increased use of renewable energy, for windpower, solar, and biomass including biofuels. There is also a smaller additional geothermal potential.

Renewable Energy Promotion and Policies

In Italy, renewable energy is mainly promoted with information, renewable energy certificates, obligations to buy renewable electricity, tax reductions, and development funds.
Within the EU, Italy has a national target of generating 25 % of its electricity from renewable energy (compared with about 13% in 2003) to be reached by 2010. The installation rates for renewable energy have been too slow to reach the target, but they are increasing.

The national coordination of the renewable energy development is carried out by ENEA, the Italian Agency for New Technologies, Energy and the Environment.
16 regional energy agencies and 24 local energy agencies are involved in information dissemination and promotion of renewable energy. Most of them receive or have received EU support for their operations, mostly during their establishment and first years of operation (ManageEnergy).

An obligation requires all electricity suppliers to the Italian market to supply 2% from renewable-electricity plants established after April, 1999; the share gradually increases to 3% in 2007. The suppliers are covering this with green certificates that are issued for renewable-energy producers that produce more than 50 MWh/year. Certificate prices have been 8-9 €c/kWh.

For PV, net metering is used, whereby consumers can let the electricity meter run backwards in periods with higher PV production than consumption.

In 2005, Italy introduced a beneficial feed-in tariff system for PV installation 1 kW – 1000 kW. Tariffs are 0.44-0.50 €/kWh. For installations above 50 kW there will be a tender procedure and the tariff is limited to the first 1,000 MW of installations. Tariffs are degression is 5%/year from 2007.

In 2005, Italy introduced “white certificates”, which require electricity and gas suppliers to prove that they have carried out a certain number of energy-efficiency measures. Energy-efficiency investments can generate white certificates that can be bought by the utilities as a proof of their activities. Renewable energy such as solar can be included in these activities.

Each year a certain quota of biodiesel and bioethanol for transportation is fully or partly exempted from energy/CO_2 taxes. This has led to increasing use of biofuels for transport; but in 2005 the quota for biodiesel was decreased while the bioethanol quota was increased. The total quota used to be 300,000 ton/year.

There is a tax credit for users of district heating based on geothermal energy or biomass.

Subsidies have been given to demonstration plants and to municipalities investing in renewable energy.

The main drivers for the development of renewable energy are national policies. In recent years, rising prices of imported energies have given an additional impetus to investments in renewables.

A number of barriers have slowed the development of renewable energy. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Administrative problems in obtaining permission for renewable-energy installations.
- High costs of grid connections.
- Inadequate, unstable support for renewable energy.

Geographical Distribution of Renewable Energy

While biomass, solar, and windpower are located throughout the country, geothermal energy is naturally confined to geological hot areas, such as near Mount Vesuvius.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was notified in May, 2004. The European Commission accepted the plan in May, 2005 under condition of smaller amendments, and the plan was then enforced for the 1,240 installations covered with a ministerial decision of May 2005.
In 2005-2007, the NAP covers the emissions of 232 $MtCO_2$ annual averages. ETS covers 47% of total GHG emissions. This is equal to 0.3% above the base year, 2000. Credits of 180 $MtCO_2$ annual averages are given to the energy sectors, including allowances for new entrants. (EU NAP and Italian NAP Decision).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Schema di Decisione di assegnazione delle quote di CO2 per il periodo (2005-2007), Ministry of Environment, Italy, 2005.

Barometer: Solar Thermal, PV, Biofuels Barometers 2005. EurObserv'er, Systemes Solaire, and EUFORES.

EWEA, European Wind Energy Association Press release, February 1, 2006: European Record for Windpower.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

LATVIA

Population:
2.32 million (2004)

GDP:
11 billion € (2004) =
4,743 €/capita

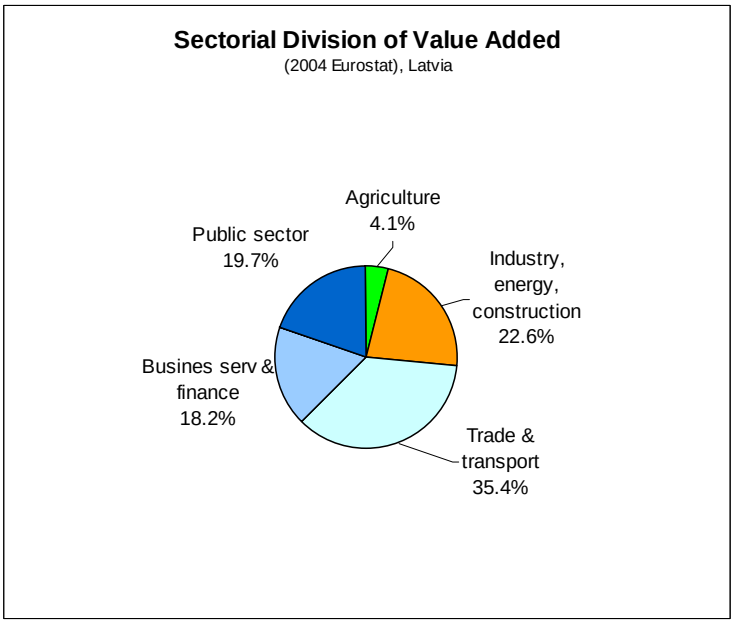
Greenhouse-gas emissions:
10.5 million tons CO_2 equivalent (2003) =
4.5 tons/capita

Economic Sectors
The service sectors contribute 73% to the value added, around the EU average but higher in trade and transport contributions and lower in those from business. The industry contribution (23%) is around the EU average and agriculture's (4.1 %) is almost double the EU average.

This new EU country, which previously belonged to the Soviet Union, has an economy with a steady increase of GDP since 2000, where the growth is much higher than the EU average (7%-9.8 %). The GDP/capita is less than 1/4 of the EU average and is the lowest in the EU.

The unemployment rate is a little above the EU average (9.8 % in 2004); it decreased gradually from a high point of 14 % in 1998-99.
Latvia has a troubled economy, with a small deficit on state finances, which is -0.9 % of the GDP in 2004, and a negative current account balance in its foreign exchange, which is high in the EU (-8.2 of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer EU countries, Latvia receives support from EU structural funds.

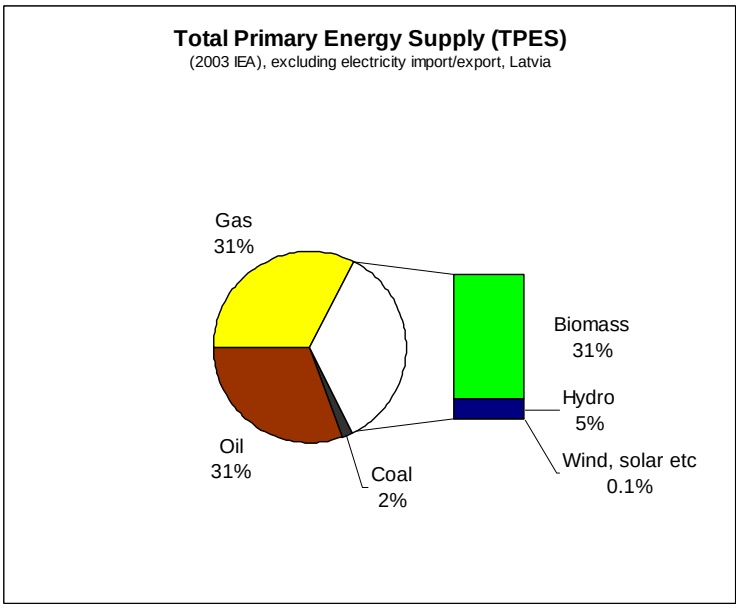
The leading industries, which also contribute to exports, are mainly timber and paper, food products, textiles, and agricultural machinery. The country is highly dependent on imports for energy and raw materials.



Energy Supply and Demand

The Latvia energy supply comes from 3 main sources, imported gas, imported oil and domestic biomass, each contributing about 1/3 of the total primary energy supply (TPES); followed by 5% from hydropower. (2003-IEA).
About 22% of the domestic production of biomass energy is exported.
The TPES was 171 PJ in 2003, not including electricity imports. It increased by 4 % in 2003.
In the supply structure, oil contributes 33%, and gas and electricity each contribute 12 %, of the TFC. (TFC, 2003-IEA).

Latvia have large imports of electricity, 67% in 2002, which increased to 75% in 2003. (IEA).



The district heating is widely used, supplying 16.8% of TFC.

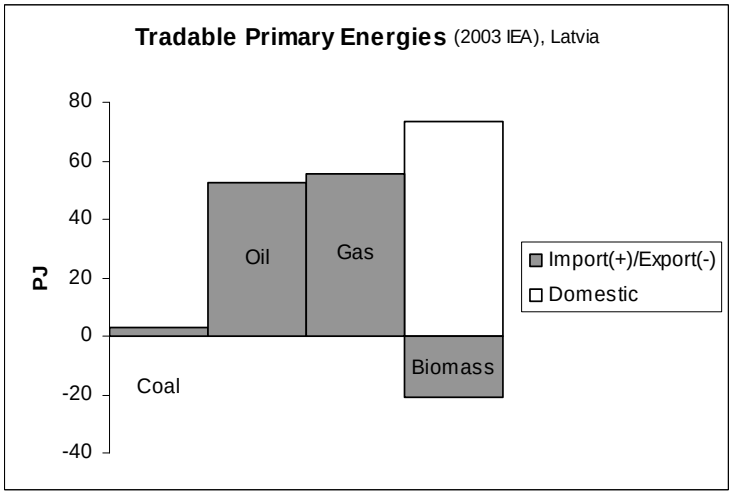
The demand structure is dominated by the residential sector's consumption (38%), followed by transport (24%) and (17%) industry. Among industrial sectors, the wood industry is the largest energy consumer. It accounts for 23% of industrial energy consumption, followed closely by the food industry (21%) and then by iron and steel (17%), non-metallic minerals (14 %), and textiles (8%)(2003 IEA).

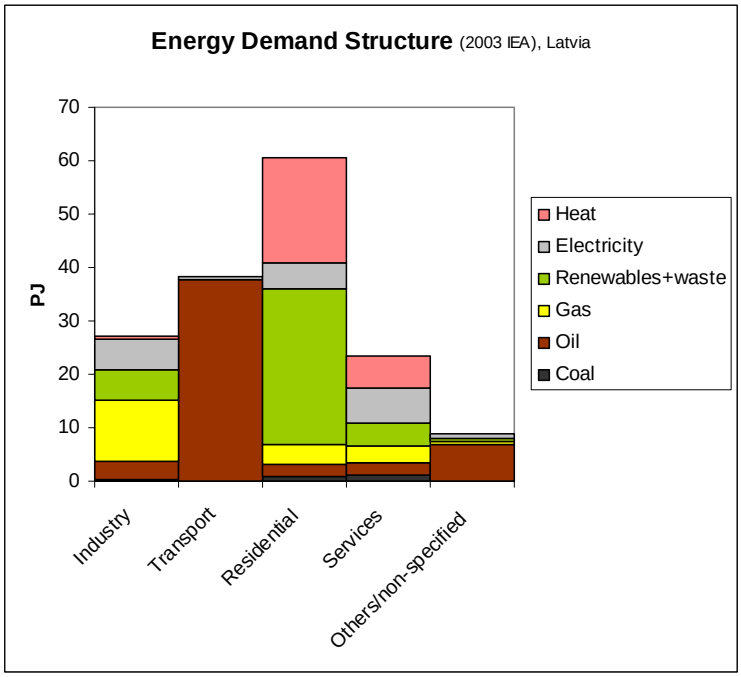
Transport includes aviation, which represents about 15 % of transport energy use.
Others/non-specified is agriculture, non-energy oil use, and a small non-specified energy use.

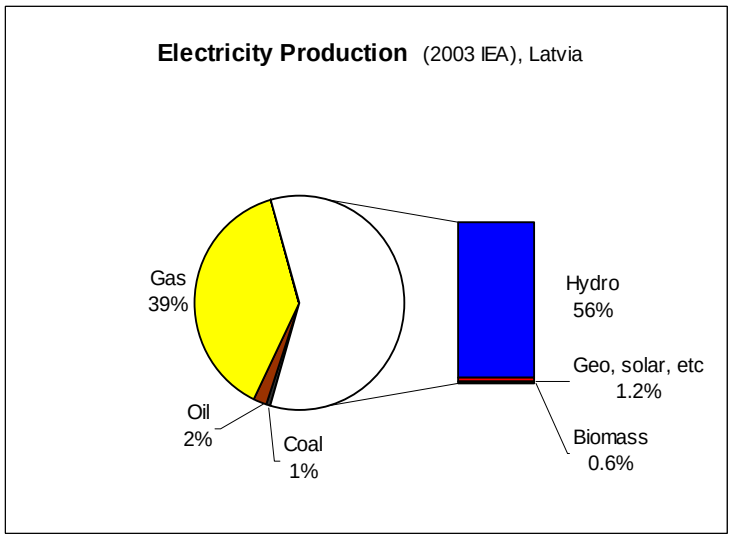
Electric Power Supply
Latvia's power supply structure is dominated by hydropower stations that, in 2003, supplied 56 % of electricity production, followed by gas with 39% (2003 IEA). The total production was 4 TWh in 2003. (IEA).
The production from hydropower plants was 8% lower in 2003 than in 2002, because 2003 was a dry year.

The efficiency of the power sector is high, as co-generation of heat and electricity is widely used as well as hydropwer. The losses in the electricity and CHP sector are only 0.25 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 13% of electricity production.
41% of the power production is from CHP plants.

The electricity distribution losses of 14 % of supply are much higher than the EU average (2003 IEA).







Renewable Energy

Latvia's renewable energy is mainly from biomass, hydro, and wind.

Hydropower contributes more than half of the electricity supply. There are 3 big hydropower plants. The number of small hydropower plants increased from 103 to 144 in the period 2001-2003. The small hydropower plants' production increased from 18 to 57 GWh in the period from 1998 to 2003. There is still unused potential; about 65 % of the technical potential is used. (2003 IEA, Eurostat).

The use of biomass for heat generation is growing by 10%-12% annually. It was 31% of the primary energy supply in 2003 (2003 IEA). Wood briquettes and pellets are produced from 200,000 m^3 of wood waste from sawmills annually. There is big potential in using biomass in CHP plants. In 2002, landfill gas also started to be used.

The total wind installed capacity is growing. In 2003, 24 MW of capacity was installed. The potential represents around 2,000 MW. A further 100 MW of installed capacity was under preparation in 2003, but only 1 MW was realised in 2004. This is a result of the change in the price of the electricity. (Barometer)

Both in 2002 and in 2003, Latvia has used 2,500 t biodiesel, which is 0.3% of the total amount of transport fuels. There are plans for new production units from 2007 onward.

Renewable Energy Promotion and Policies

Towards the EU obligation, Latvia has a target of generating 49.3% of its electricity output by 2010 from renewable energy (compared with 42.4 % in 1997, but already in 2003 it was 56 % from hydropower). The target for renewable energy in transport is 5.75% to be reached by 2010.

The main driver for the development of renewable energy is the feed-in tariff. Until January 1st, 2003 Latvia had a unique feed-in tariff, which was double the average electricity price for a period of 8 years after grid-connection for wind and small hydropower plants (less than 2MW). This tariff was very successful in promoting renewables, especially in the small-hydropower sector.
The new tariff system since January, 2003 differentiates between the specific RES and provides particular regulations for electricity produced in CHP plants. The price has decreased and is now sometimes subject to approval by the Regulator.

In recent years, the legislation in Latvia has undergone a number of changes related to energy production from renewable energy. In 2001, the Law on Energy was amended particularly with regard to the use of RES. On the basis of this law, several Cabinet of Ministers regulations (CMR) were adopted in 2002.

Latvia has adopted a policy program for production and use of biofuel for 2003-2010. State funding is planned to be increased 10 times from 2005 levels in the forms of grants to biofuel producers, financial aid to rapeseed cultivation areas, subsidies for development of processing plants, and reduced excise duty rate.

Barriers are:
- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies. There are no regional energy agencies or SAVE agencies (ManageEnergy).
- The plan to build an undersea cable from Finland to import cheap electricity.
- Political support has decreased in Latvia since 2003.

Geographical Distribution of Renewable Energy

Latvia has 3 big and 150 small hydropower plants on the rivers; there is still unused potential on the Daugava River. The potential for developing wind energy alongside the Baltic Sea coastline is very good. Currently, the existing geothermal resources in the western part and Riga region are not being used. The use of solar energy is currently not widespread in Latvia. Two pilot projects on solar thermal were implemented in Aizkraukle.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was submitted in April, 2004. The European Commission accepted the plan in October 2004, and the plan was then enforced for the 95 installations covered after amendments to the NAP in October, 2004. An amendment (inclusion of more installations) was approved by the EU Commission in April, 2005 and was included in the NAP with an amendment in May, 2005.
In 2005-2007, the NAP covers annual emissions of 4.58 $MtCO_2$ on average, equivalent to 36% of total GHG emissions. Credits of 3.15 $MtCO_2$ annually are given to the energy sectors (Combustion) (IEA 2005 and EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition, (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: 2005. EurObserv'er, Systemes Solaire, and EUFORES.

Information on biofuels from Premia, December 2005, presented at the conference Clean Vehicles and Fuels, Nov. 2005, Stockholm, www.premia-eu.org.

LITHUANIA

Population:
3.45 million (2004)

GDP:
18 billion € (2004) =
5,224 €/capita

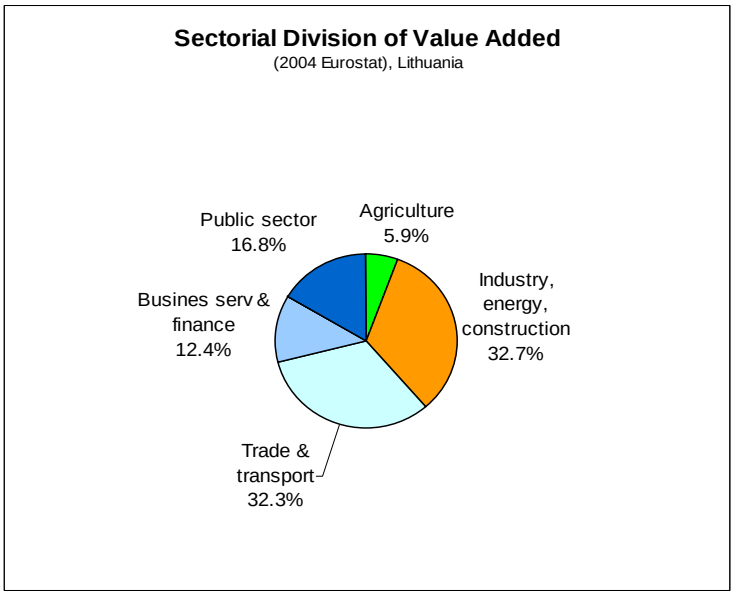
Greenhouse-gas emissions:
17.2 million tons CO_2 equivalent (2003) =
5.0 tons/capita

Economic Sectors
Lithuania's service sectors contribute less of the value added (61 %) than the EU average, while the contribution of agriculture (5.9%) is almost triple the EU average and that of industry (33.3%) is also much higher than the EU average. The share of the business services is very low (12%), almost half of the EU average, while trade and transport is relatively high.

This new EU Country, which previously belonged to the Soviet Union, has an economy with a steady increase of GDP since 2000, where the growth is much higher than the EU average (10%-7 %). The GDP/capita is less than 1/4 of the EU average, and is one of the lowest in the EU.

The unemployment rate is a little above the EU average (10.9 % in 2004); it decreased gradually from a high point of 16.4 % in 2002.
Lithuania has financial problems, with a small deficit on state finances (-1.4 % of the GDP in 2004) and a negative current account balance in its foreign exchange, which is high in the EU (-6.9 of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer EU countries, Lithuania receives support from EU structural funds.

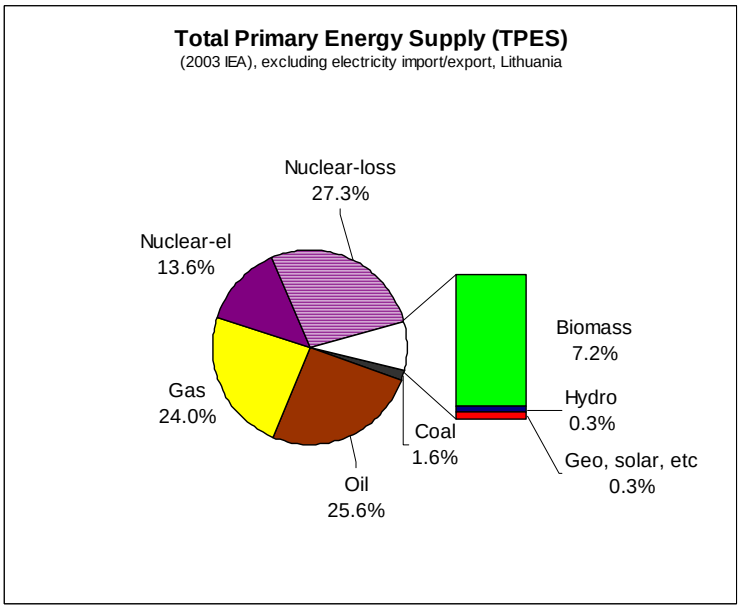
Industries include metal-cutting, machine tools, television sets, refrigerators, petroleum refining, shipbuilding/repairing, furnitures, textiles, food processing, fertilizers, agricultural machinery, and electronic components.



Energy Supply and Demand
Lithuania's energy supply is dominated by imported gas and by mainly imported oil that contributes half of the total primary energy supply (TPES). This is followed by nuclear power and by biomass. Domestic production covers 20% of the oil supply. The domestic production of biomass covers 7.2 % of the TPES. (2003-IEA).
The TPES was 378 PJ in 2003, not including electricity exports. It increased by 4% in 2003. (IEA)

In the supply structure, oil and gas together cover slightlymore than half of total final consumption (TFC): respectively, 34% and 22%. (2003-IEA).

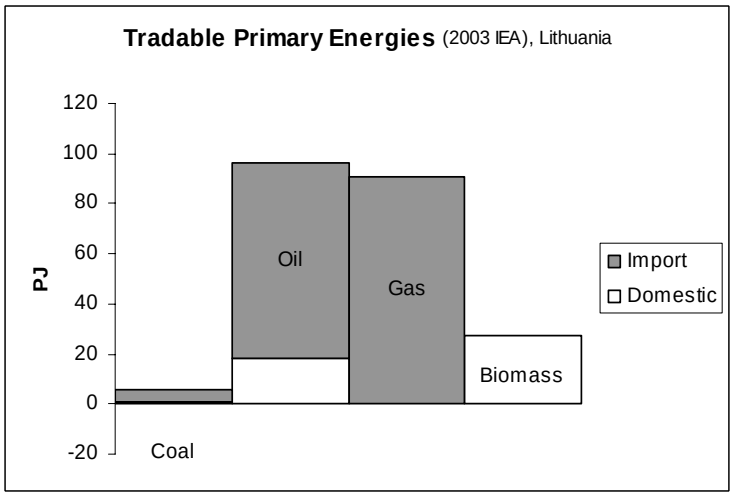
Lithuania has had a net export of electricity in recent years, 44% of the net production in 2003. (IEA).



The district heating is widely used, supplying 16% of TFC.

In the demand structure the industrial and residential sectors are the biggest consumers, each representing 29% of the demand; followed by transport at 26%. Among the industrial sectors, the chemical and petrochemical industry is the largest energy consumer. It accounts for half of the industrial energy consumption. (2003 IEA).

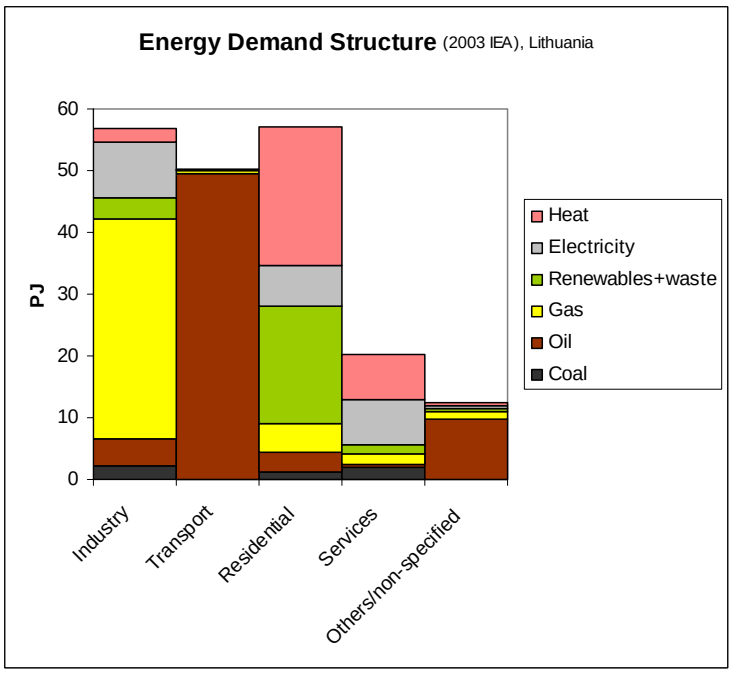
Transport includes aviation, which represents about 13% of transport energy use.
Others/non-specified is primarily non-energy oil use, and it also includes agriculture.



Electric Power Supply

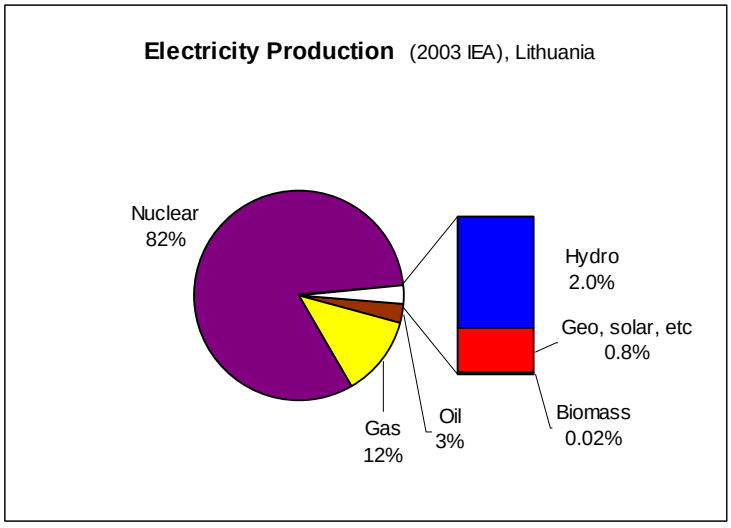
Lithuania's power supply structure is dominated by nuclear power (Ignalina power plant), which supplies 82% of the electricity production, followed by gas (12%), oil (3%), and hydro 2% (2003 IEA). The total production was 17.3 TWh (2003 IEA).

The efficiency of the power sector is reasonably high, as cogeneration of heat and electricity is widely used, and the losses in the electricity and CHP sectors are 1.6 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 15.3 % of electricity production.



98% of the power production is reported as being from CHP plants. This is because the Lithuanian authorities report the country's nuclear power plant as a CHP plant, even though the useful heat production from the nuclear power plant is only a small fraction of the nuclear electricity production.
If nuclear is not included as CHP, the CHP production accounts for 16% of electricity production.

The electricity distribution losses of 9.3 % are higher than the EU average (2003 IEA).



Renewable Energy

The Lithuanian renewable energy is biomass, hydro, and biogas at 2 wastewater plants.

The largest use of renewable energy is in the form of biomass, of which the production increased by 10 % during the period 1998-2003. Since 1994, waste wood and wood chips are used to burn in the district heating boilers with higher capacity (bigger than 1 MW), and since 1996, straw-firing boilers started to be used, which burn about 7,500 t straw annually. (2003 Eurostat, 2003 IEA).
In 2002, big investment was made in geothermal energy, and 47 small (less than 10-MW) hydro plants were built. The biodiesel production started in 2004 (5,000 t). (Barometer) The production capacity of bioethanol is 8,000 t/year, and of biodiesel, 12,000 t/year, according to the Biofuel Program (2004 August). (LTMIN)

There is still room for increases in biomass and there is a good potential for hydro, wind and geothermal. Biogas resources include wastewater treatment plants, manure of domestic animals, and organic waste from food processing. Solar systems could meet 15%-20% of energy demand for space-heating of buildings.

Renewable Energy Promotion and Policies

Towards the EU oblilgation, Lithuania has a national target of generating 12% of its TPES by 2010, and 7% of electricity output by 2010 from renewable energy (compared with 7.3 and 3 % respectively in 2003), as well as a target of 5.75 % renewable energy in transport, also to be reached by 2010.

To increase awareness, there is a national Energy Agency operating under the Ministry of Economy in the capital Vilnius that was established in 1993. there are also two regional SAVE agencies, one in Kaunas (established in 2003) and another in Visaginas (established in 2004). (ManageEnergy)

The main driver of the development of renewable energy is national energy policy (EU 2004, LTMIN):

Law on Energy of the Republic of Lithuania in May, 2002, stipulating 3rd-party financing, capital grants, guaranteed prices and feed-in tariff, but with no guaranteed time. Of the average energy prices set in February, 2002, the highest is for wind, 7.5 €ckWh; followed by hydro, 6.9 €ckWh; and biomass, 6.9 €ckWh. The prices are set by the National Control Commission for Prices and Energy.

National Energy Strategy, adopted in October 2002. The objective is to meet the 12% EU target of TPES by 2010. Measures include drawing up and updating programmes; encouragement through use of organisational, economic and financial measures; support for enterprises; and implementation of projects for the use of wind, water and solar energy as well as for the consumption of other renewable and waste energy resources. The state will back the implementation of these projects and provide conditions for EU structural and other support funds to be used for achieving the above goals.

The National Energy Efficiency Programme (NEEP), effective since 1992, was revised and adopted in 2001 for the period of 2001 to 2005. *Resolution No. 1474 of December, 2001:* Procedure for promotion of purchasing of electricity generated from renewable and waste energy resources.
- drafting legislation for its implementation and regulatory documents;
- renovating buildings and updating their energy facilities;
- usage of renewable, local and secondary energy resources;
- increasing energy efficiency in production processes;
- information dissemination and counselling activities.

Law on Biofuel, Biofuels for Transport and Bio-oils, 1999, amended in 2000 and secondary legislation: Governmental Resolution No 1056 of 26 August, 2004 on the Approval of the Programme for the Promotion of the Production and Use of Biofuel in the period 2004-2010. By 2010, the production of biodiesel should be increased to 40,000 t/year, while production of bioethanol should be raised to 20,000 t/year. There is excise duty relief for biofuels. There is also a mandatory target beginning in December, 2005 to mix biofuels in petrol and diesel.

Barriers to the development of renewable energy include a general lack of knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. In addition, there is no guaranteed time for the amount of the feed-in tariff.

Geographical Distribution of Renewable Energy

Biomass installations are located throughout the country where waste wood from the wood industry and straw are available. Windpower resources are primarily in the western coastal region. Geothermal resources are in the western region. Hydro resources are in the Nemunas river, which flows from Belarus through the country to the Baltic Sea..

National Allocation Plan for EU Emissions Trading.

The first National Allocation Plan (NAP) was notified to the Commission in May, 2004. Lithuania submitted additional information amending and completing the notified plan by letters in September and November, 2004.
The European Commission accepted the plan in December, 2004, and the plan was then enforced for the 93 installations covered.
In December 2004, Lithuania reduced its cap from 42.5 to 36.8 $MtCO_2$ for the first 3-year period. In the period of 2005-2007, the NAP covers the emissions of 12.2 $MtCO_2$ annually, and the energy production share is about 7.3 $MtCO_2$ annually. About 1.5% of the total allocation is to be auctioned. Reservation for new entrants is 5%. (IEA 2005 and EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: Solar, Wind, Biofuels, Biomass 2005. EurObserv'er, Systemes Solaire, and EUFORES.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

LTMIN: Ministry of Economy of the Republic of Lithuania, and National Energy Agency http://www.ukmin.lt/index.php/en/energy/Renewable/.

Ministry of Environment http://www.am.lt.

LUXEMBOURG

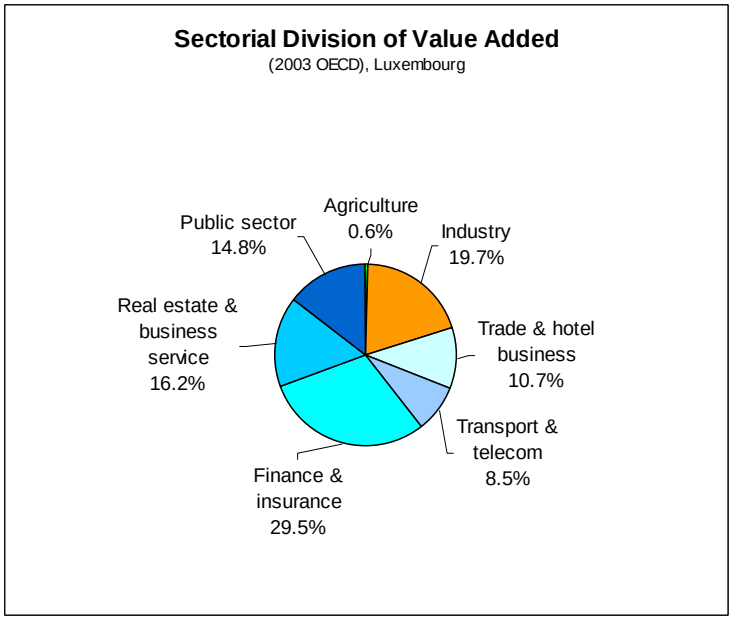
Population:
0.5 million (2004)

GDP:
26 billion € (2004) =
57,573 €/capita

Greenhouse-gas emissions:
11.3 million tons CO_2 equivalent (2003) =
25.0 tons/capita

Economic Sectors
Private service sectors contribute 68% of the value added of Luxembourg, which includes an extremely large finance and insurance sector (30%). It is around 6 times higher than the EU average. The public sector is small (15%). Agriculture is without importance and the contribution of the industry sector is small.

The Luxembourgian GDP per capita is extremely high, 2.5 times above the average in the EU, while the GDP growth rate is 4.5% in 2004, nearly the double of the EU average.
The economy is in very good shape, with an unemployment rate of 4.8%, one of the lowest in the EU; a surplus on state finances (0.2 % of GDP in 2004); and a positive current account balance in its foreign exchange (8.2% of GDP in 2003), which is the highest in the EU. (Eurostat 2005).



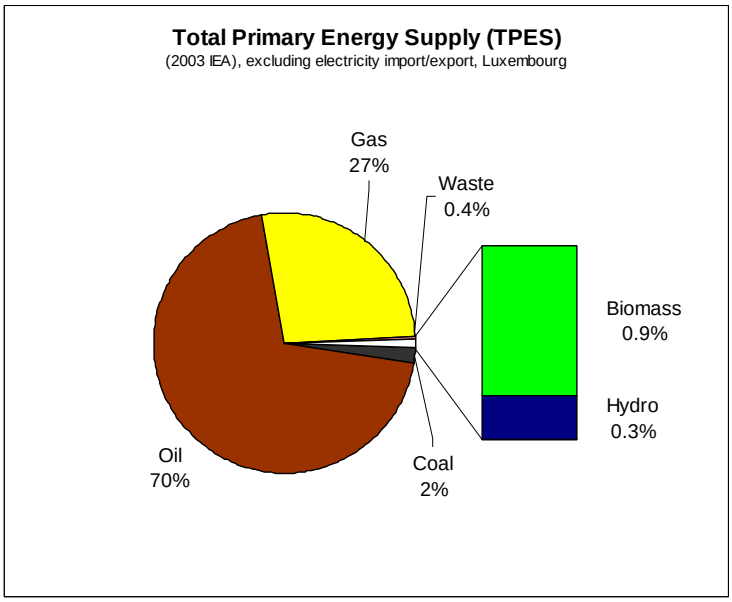
Energy Supply and Demand

The energy supply of Luxembourg is highly dominated by imported oil that contributes 70% of the total primary energy supply (TPES), followed by gas (27%), and coal (2%).

There is no domestic production of any fossil fuels (2003-IEA).
The TPES was 163 PJ in 2003, not including electricity imports. It increased by 5% in 2003.
In the supply structure, oil is dominant, covering 68% of total final consumption (TFC), followed by gas, covering 16%, and electricity, covering 13%. (TFC, 2003-IEA).

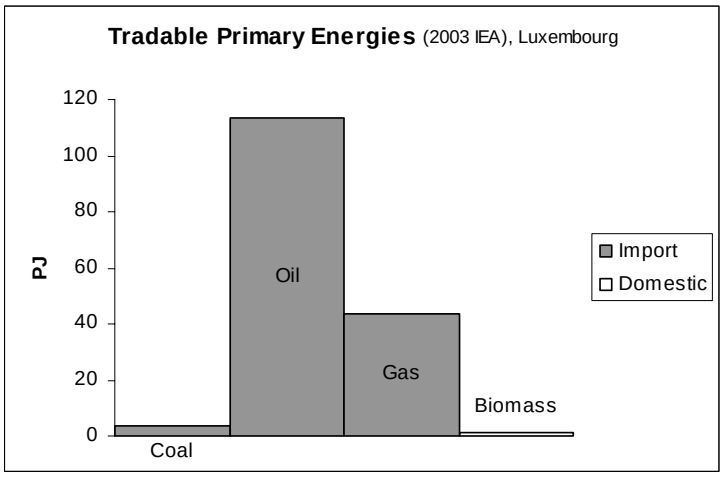
Luxembourg has imported electricity in recent years; 60% of consumption was imported in 2003. (2003-IEA).

The district heating is half of the average of the EU, supplying 1% of TFC.



The demand structure is dominated by transport, industry and residential consumption. Among industrial sectors, iron and steel is the largest energy consumer. It accounts for 42% of industrial energy consumption, followed by machinery (8%), chemicals (7%), and non-metallic minerals (6%) (2003 IEA).

Transport includes aviation, which represents about 17% of transport energy use.
Others/non-specified is mainly agriculture and non-energy oil use.



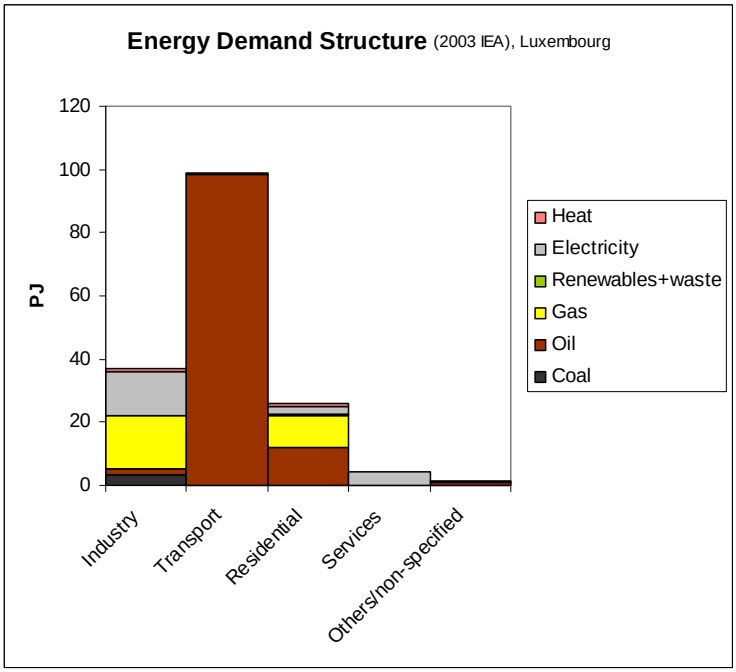
Electric Power Supply

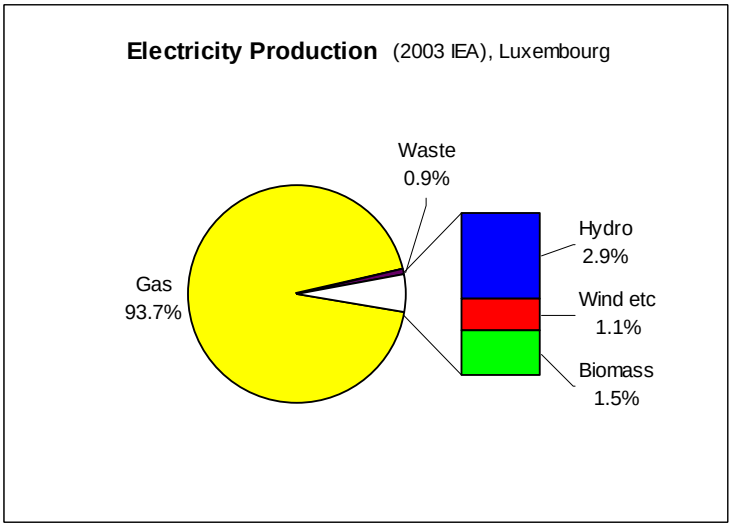
The power supply structure of Luxembourg is dominated by gas-power stations that supply 94% of electricity production, followed by hydro (3%) and biomass (2003 IEA).
The total production was 2.78 TWh in 2003. (IEA).

The efficiency of the power sector is reasonable and the losses in the electricity and CHP sector are 0.8 times the useful production of electricity and heat delivered to the grids, according to IEA methodology.

Included in losses is the power sector's own consumption of 13% of electricity production.

13% of the power production is from CHP plants.





Renewable Energy

The Luxembourg renewable energy is mainly generated from biomass, renewable municipal waste, and hydro.

The largest use of renewable energy is in the form of biomass, of which solid biomass is most important ,with biogas as a minor but growing component. (In 2003, energy from biogas comprised 21% of the total energy produced from biomass.) Since 1995, the production of energy from solid biomass has been stable, whereas the production of energy from biogas took off in 2000 and has increased since then.

The second-largest component is energy production from renewable municipal waste. This production has been stable since 1990 with a small increase since 2000.

The third most important renewable energy is hydro. The production has been stable since 1990 with large yearly fluctuations due to variations in rainfall.

The biomass is all being used for residential and in electricity plants.

A remarkable observation is that Luxembourg has by far the highest photovoltaic power per capita in the European Union (58,1 MWp/capita, end of 2004). Second place goes to Germany with 9.6 MWp/capita (end of 2004). Luxembourg's windpower capacity was 35 MW in 2005.

Renewable Energy Promotion and Policies

In Luxembourg, renewable energy is mainly promoted with information, feed-in tariffs and subsidies.

Towards the EU obligation, Luxembourg has a national target of generating 5.7% of its electricity from renewable energy (compared with 2.1% in 2003), to be reached by 2010.

The national coordination of renewable-energy development is carried out by the Energy Agency of Luxembourg (AEL).
Some local agencies are also involved in disseminating information about renewable energy. One of them has received EU support for its operations, mostly during its establishment and first years of operation (ManageEnergy).

Feed-in tariffs have been relatively low, 2.5 €c/kWh for most renewables. High tariffs (45-55 €c/kWh) for PV in 2003 started some development, but this incentive system ended at the end of 2004. However, the new Luxembourg Minister of Environment made a new commitment to renewable energies in 2005. Feed-in tariffs are now (2006):
-56 €c/kWh for PV;
-10.3 €c/kWh for windpower, biogas plants and hydro below 500 kWelectric; this tariff is reduced by 2.5 €c/kWh after 10 years.

Subsidies of up to 50% are given to renewable-energy investments, with the highest rate reserved for solar thermal, and 30% for biomass heating.

The main drivers of the development of renewable energy are national policies. In recent years, rising prices of imported energies have given an additional impetus to investments in renewables.

The main barrier has been low prices given for renewable electricity. The new higher feed-in tariffs might change that.

Geographical Distribution of Renewable Energy

As it is a small country, there is no major geographical variations; but windpower is limited to relatively few windy sites.

National Allocation Plan for EU Emissions Trading.

The first National Allocation Plan (NAP) was notified to the Commission in March, 2004. The European Commission accepted the plan in October, 2004, and it was then enforced for the 19 installations covered.
In 2005-2007, the NAP covers the emissions of 3.51 $MtCO_2$ annually, equivalent to 26% of total GHG emissions. (IEA 2005 and EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

AEL: Energy Agency of Luxembourg, website, www.ael.lu.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

MALTA

Population:
0.40 million (2004)

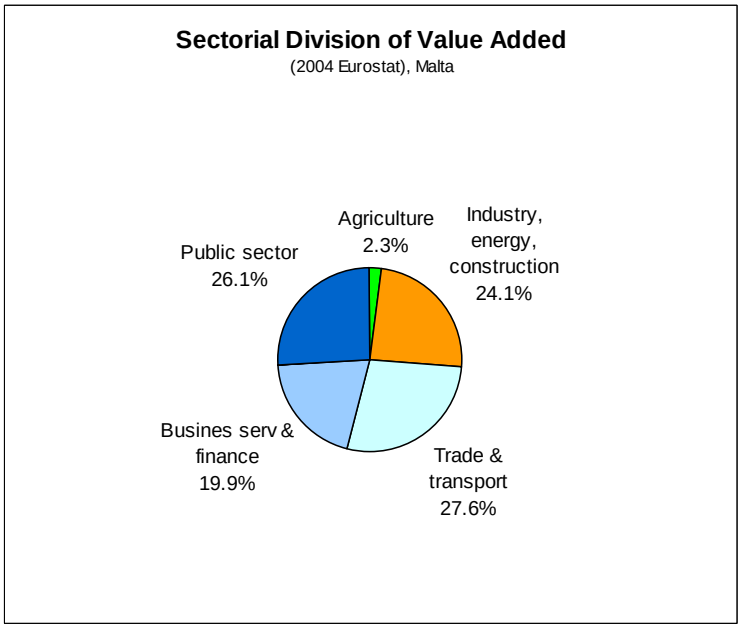
GDP:
4 billion € (2004) = 10,003 €/capita

Greenhouse-gas emissions:
2.9 million tons CO_2 equivalent (2003) = 7.3 tons/capita

Economic Sectors
Private service sectors contribute almost half of the gross value added, including a large tourist sector. The public-sector contribution is above the EU average, while that of the industry sector is relatively small.

The economy of Malta has some financial problems, with a deficit on state finances for a number of years (-5.1% of GDP in 2004) and a negative current account balance in its foreign exchange that also has lasted for a number of years (-5.7% of GDP in 2003) (Eurostat 2005). The unemployment rate of 7.7% is slightly below the EU average.

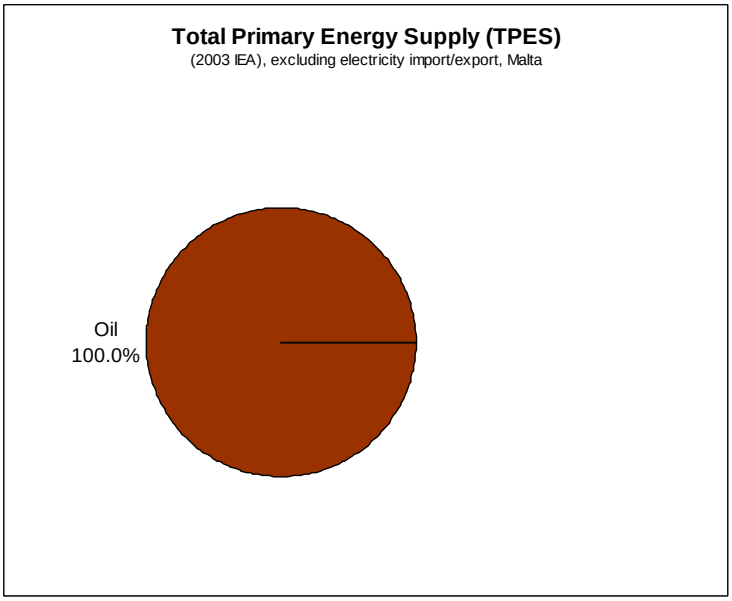
Geographically, Malta is a small and densely populated island nation. The strategically located island has been ruled and fought over by various powers over the centuries. Malta is the smallest EU country in terms of both population and area.
Malta's major resources are limestone, a favourable geographic location, and a productive labour force. Malta produces only about 20% of its food needs, has limited freshwater supplies, and has no domestic energy sources except solar. The economy is dependent on foreign trade (serving as a freight trans-shipment point), manufacturing (especially electronics and textiles), and tourism. Malta has many museums, shops, beaches, and leisure activities in a densely packed area. It is a well known, popular vacation destination among Europeans.



Energy Supply and Demand

The energy supply comprises only oil that is imported as ready products. There is no domestic production of fossil fuels.

The TPES was 37 PJ in 2003, increasing by 14% from 2002. In the final supply structure, oil also dominates at 67%, with electricity produced from oil covering the remaining 33% (TFC, 2003-IEA).



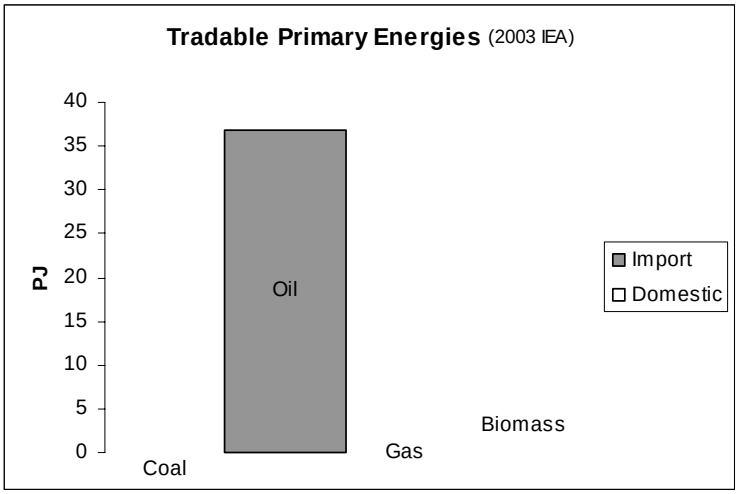
The demand structure is dominated by transport at 58% of TFC, followed by residential energy use (17%), the service sector (11%), and industry (10%) (2003 IEA).

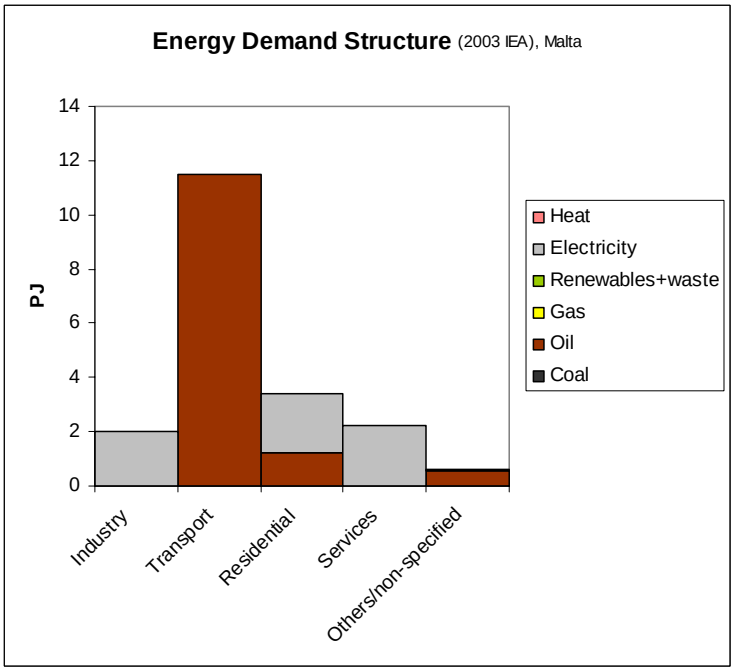
Transport includes aviation, which represents about 29% of transport energy use.

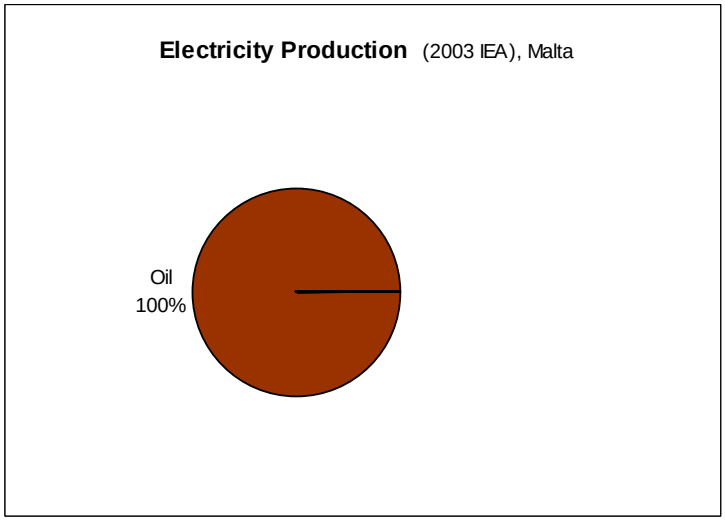
Electric Power Supply

The power is produced by oil-fired power stations that supplied 2.2 TWh in 2003, an increase of 9% from 2002. (2003 IEA).

The efficiency of the power sector is low, as co-generation of heat and electricity is not used.
The losses in the power sector are 2.7 times the useful production of electricity.
Included in losses is the power sector's own electricity consumption along with network losses, together comprising 19% of production. (2003 IEA).







Renewable Energy

The current use of renewable energy is confined to some fairly limited solar developments. In 2004, capacity was installed for 4215 m^2 of solar heating, increasing the total collector surface area to 15,350 m^2. An additional 9 kW has been installed; the increase in 2004 was less than 1 kW (Barometer).
Malta is endowed with good potentials for increased use of solar energy, for heating as well as for electricity and cooling. It also has potentials for wind power; but the development is limited by little available land and difficult circumstances for offshore installations with deep seas surrounding the islands. Further, it has a biomass energy potential and a potential for wave energy.

Renewable Energy Promotion and Policies

Towards the EU obligation, Malta has a national target of generating 5% of its electricity from renewable energy (compared with less than 0.1% in 2003), to be reached by 2010. To fulfill the electricity target, Malta would have to produce 112 GWh (with 2003 power consumption), equal to the production from 45 MW of windturbines (with the assumption of 2500 annual equivalent full-load hours) or 90 MW of solar PV (with the assumption of 1250 annual equivalent full load hours).
Malta has a target for biofuels in transport of 0.3% for 2005.
Information on renewable energy is distributed by the Malta Renewable Energy and Energy Efficiency Association (MEEREA), a private organisation without much public support that relies to a large extent on volunteer help.

Support for renewable energy on Malta consists of a reduction of VAT on solar installations from the normal 15% to 5%.

Biofuels are exempted from vehicle fuel tax.

Several barriers have inhibited the development of renewable energy. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Lack of energy policy with priorities for renewable energy.
- Passive to negative attitude from the Maltese power company.
- Very limited support for renewable energy.

Geographical Distribution of Renewable Energy
The solar, biomass, and windpower potentials are distributed throughout the island.

National Allocation Plan for EU Emissions Trading.
The first National Allocation Plan (NAP) was submitted to the European Commission in October, 2004.
The European Commission accepted the plan in December, 2004, and the plan was then enforced for the 2 installations covered.
In 2005-2007, the NAP covers the emissions of 2.9 $MtCO_2$ annually. This is equal to the Business-as-Usual predictions of the installations covered. During 2005-07, a credit of 6.54 $MtCO_2$ is given to the energy sectors (IEA 2005), while a large share, 2.29 $MtCO_2$, is given to new entrants.

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.
Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

Barometer: 2005. EurObserv'er, Systemes Solaire, and EUFORES.

MEEREA: Information from http://www.geocities.com/meereamalta/.

Information on biofuels from Premia, December 2005, presented at the conference Clean Vehicles and Fuels, Nov. 2005, Stockholm, www.premia-eu.org.

NETHERLANDS

Population:
16.3 million (2004)

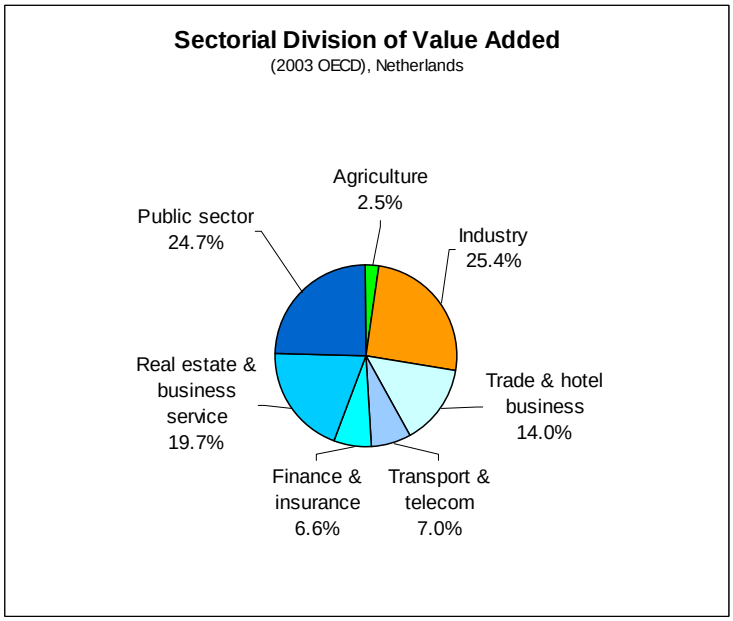
GDP:
489 billion € (2004)
= 30,078 €/capita

Greenhouse-gas emissions:
214.8 million tons CO_2 equivalent (2003) =
13.2 tons/capita

Economic Sectors
Private service sectors contribute 48 % of the value added of Netherlands. The majority of the sectors is close to the EU average. The public sector is relatively big, while the agriculture sector is slightly above the EU average.

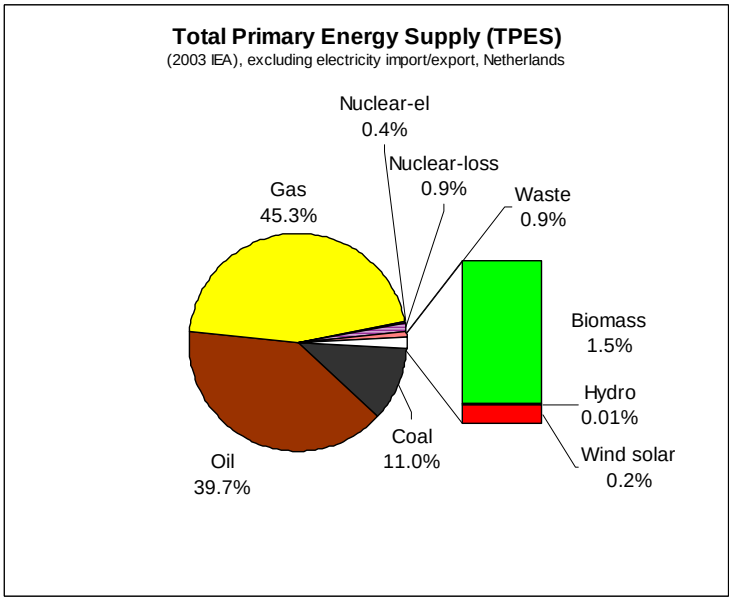
The GDP per capita is 34% above average in the EU. The GDP growth rate is 1.7% in 2004, which is below the EU average. The 4.6% unemployment rate is among the lowest in the EU. The economy is stable, with a deficit on state finances (2.1% of GDP in 2004) and a positive current account balance in its foreign exchange (3.3% of GDP in 2003) (Eurostat 2005).

Leading industries include metals, foods, beverages, tobacco, chemicals, petroleum products, and electronics. The country functions as a gateway for the traffic of goods between western Europe and the rest of the world. The country's ports are some of the most modern in the world, and they can easily be reached by the biggest oceangoing ships. Rotterdam is also the world's leading oil-refining center. Dutch dairy farming is highly developed. The Netherlands has almost half of the total European horticultural area under glass. Well known companies are Royal Philips Electronics, Royal Dutch Shell Co. (petroleum products); ING and, ABN AMRO (finance).
Geographically, the western part is the centre of industry, especially in the services sector. The natural gas fields are in the northeast, in the North Sea, in an area larger than the country itself.

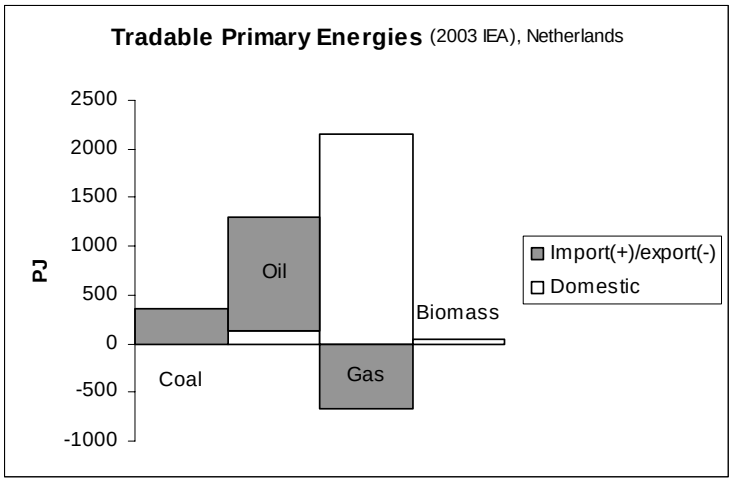


Energy Supply and Demand

The energy supply of Netherlands is dominated by domestic gas that contributes 45% of the total primary energy supply (TPES), followed by oil (40%) and coal (11%).
The domestic production of gas exceeds gas use by 45%, while the domestic production of oil is 10% of the oil use. There is no domestic production of coal (2003-IEA).
The TPES was 3278 PJ in 2003, not including electricity imports. It increased by 3% in 2003.

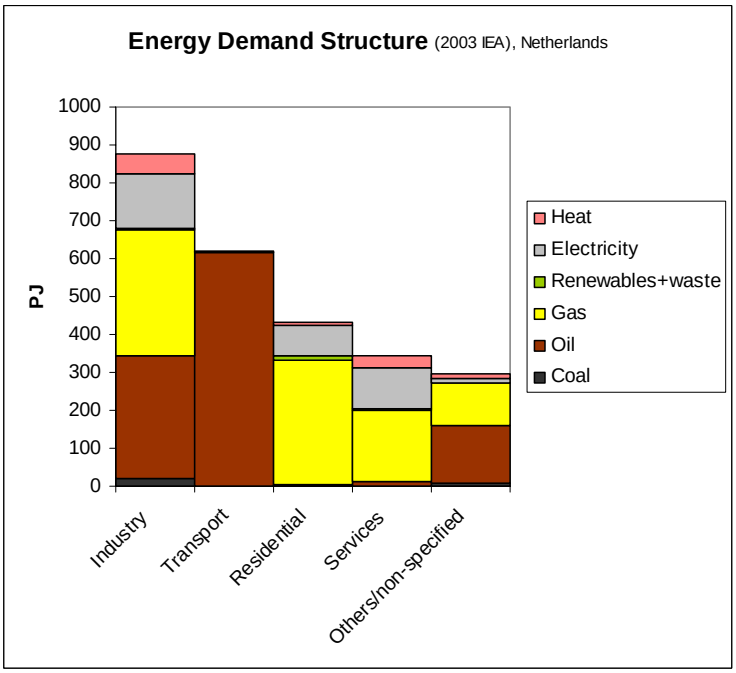


In the supply structure, oil is dominant, covering 43% of total final consumption (TFC), followed by gas, covering 38%, and electricity, covering 14%. (TFC, 2003-IEA).
Netherlands has imported electricity in recent years, 19% in 2003 (2003-IEA).
The district heating is above average in the EU, supplying 4% of TFC.



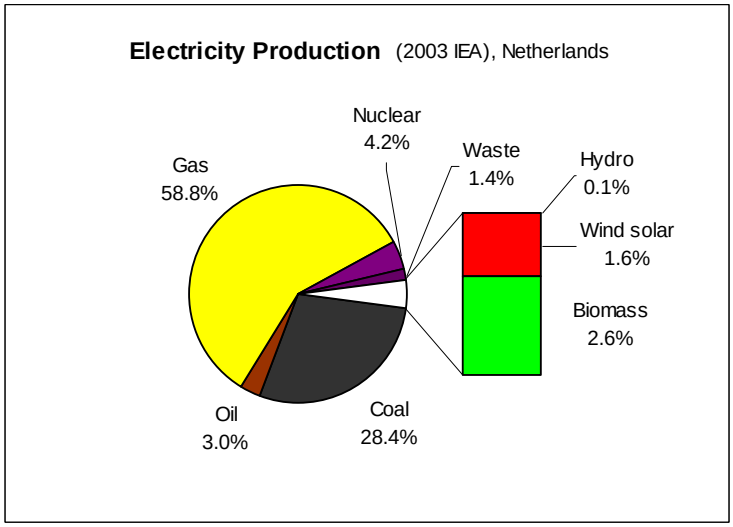
The demand structure is dominated by industry, followed by transport and residential consumption. Among industrial sectors, the chemical industry is the largest energy consumer. It accounts for 65% of industrial energy consumption, followed by food and tobacco (10%) and iron and steel (5%) (2003 IEA).

Transport includes aviation, which represents about 11% of transport energy use.
Others/non-specified is primarily agriculture and non-energy oil use.



Electric Power Supply
The power supply structure of Netherlands is dominated by gas power stations that supply 59% of its electricity production, followed by coal (28%), nuclear (4%), and oil (3%) (2003 IEA).
The total production was 97 TWh in 2003 (IEA).

The efficiency of the power sector is fairly high, as cogeneration of heat and electricity is used substantially, and the losses in the electricity and CHP sector are 1.1 times the useful production of electricity and heat delivered to the grids, according to IEA methodology.
Included in losses is the power sector's own consumption of 9 % of electricity production.
The electricity distribution losses of 5% are below the EU average (2003 IEA).



Renewable Energy

The renewable energy in the Netherlands is mainly generated from biomass, from renewable municipal waste and, to a lesser degree, from windpower.

The largest use of renewable energy is in the form of biomass (2003), of which solid biomass is the most important (80%), supplemented with biogas (20%). The production of biomass energy has doubled since 1990.

The second most important is production of energy from renewable municipal waste. This production has almost doubled between 1990 and 1999 and has been stable between 1999 and 2003. Most of the renewable municipal wastes and biomass is used in CHP Plants.

The production of energy from windpower has taken off since 1990. It covered 8% of the total renewable energy production in 2003 and it is increasing. In 2004, the Netherlands was the fifth country in the European Union to pass the 1,000 MW mark for windpower (1,077 MW). In 2005 the capacity increased to 1,219 MW.

Even though solar thermal does not contribute much to the total production of renewable energy, it is worth notice that there has been a considerable development within this sector in the Netherlands since 1990. In 2004, the Netherlands ranked fifth among the European Union countries with respect to accumulated capacity of thermal solar collectors (503,829 m2).

There are large additional potentials for windpower, in particular for off-shore windpower, and for biomass.

Renewable Energy Promotion and Policies

In the Netherlands, renewable energy is mainly promoted with feed-in tariffs, subsidies, and tax exemptions. Within the EU, the Netherlands has a national target of generating 9.0% of its electricity from renewable energy (compared with 4.3% in 2003) to be reached by 2010. The installation rates for renewable energy have been a bit too small to reach the targets, but the rates are increasing. Netherlands has a target of 2% of renewable energy (biofuels) in transport to be reached by 2006.

National coordination of renewable-energy development is carried out by SenterNovem, Netherlands Agency for Energy & Environment.
Three local energy agencies have received EU support for their operation, mostly during their establishment and first years of operation. (ManageEnergy).

The feed-in tariff is guaranteed for 10 years, and the rates in 2006 are:
-Wind offshore, PV, small scale bioenergy, small hydro: 9.7 €c/kWh.
-Wind onshore, 7.7 €c/kWh, to be reduced to 6.5 €c/kWh for new installations after 1/7-2006.
-Biomass, general, 7.0 €c/kWh, to be reduced to 6.6 €c/kWh for new installations after 1/7-2006.

Investments in windpower and certain other technologies can be partly deducted form profit tax, resulting in an effective investment subsidy of about 13% (2005).
Tax incentive promotes low-interest loans for environmental initiatives including renewable energy at 1%-2% reductions in interest rates.

The main drivers for the development of renewable energy are national policies and increasing prices of imported energies, mainly oil.

A number of barriers have slowed the development of renewable energy. This includes:
- very long administrative procedures for windpower,
- price uncertainties prior to 2003, before the current feed-in tariff system was in place,
- short period for feed-in tariffs (10 years).

Geographical Distribution of Renewable Energy

There is no distinct pattern of distribution of renewable energy within the Netherlands. The high population density does make it difficult to find windpower sites in the western part of the country.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was admitted to the European Commission in April, 2004. The European Commission accepted the plan in July 2004, and the plan was then enforced for the 333 installations covered. In March 2005 the plan was amended with exclusion of one installation.
In 2005-2007, the NAP covers emissions of 95.3 $MtCO_2$ annually, equivalent to 44% of total GHG emissions. Credits of 13.3 $MtCO_2$ annually are given to the energy sectors. (EU NAP and IEA 2005)

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: 2005. EurObserv'er, Systemes Solaire, and EUFORES.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

Information on biofuels from Premia, December 2005, presented at the conference Clean Vehicles and Fuels, Nov. 2005, Stockholm, www.premia-eu.org.

POLAND

Population:
38 million (2004)

GDP:
195 billion € (2004)
= 5,106 €/capita

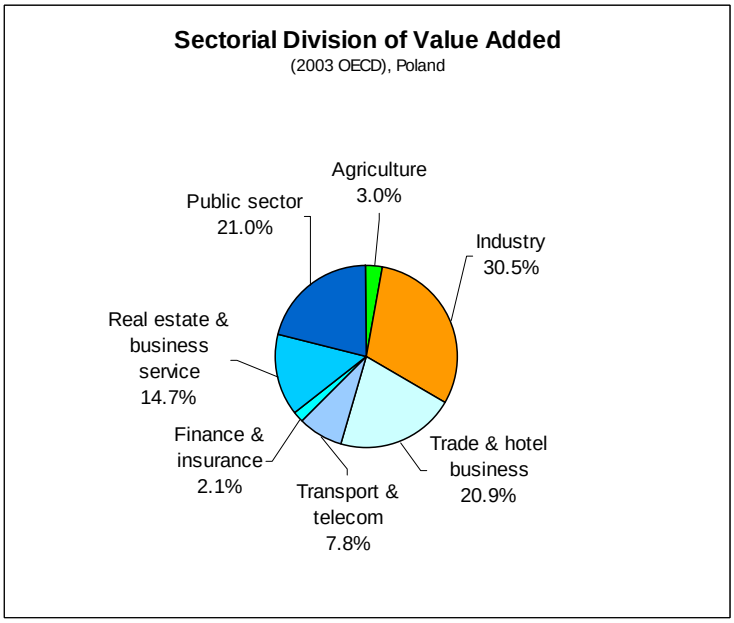
Greenhouse-gas emissions:
384.0 million tons CO_2 equivalent (2003) =
10.1 tons/capita

Economic Sectors
The service sectors contribute less of the value added of Poland than the EU average (66%); agriculture (3%) and industry (30%) contribute relatively more.

The economy of this new EU country has shown an increase in GDP, with a growth significantly above the EU average (5.3 % in 2004).
The Polish GDP per capita is among the lowest in EU, 23% of the average.

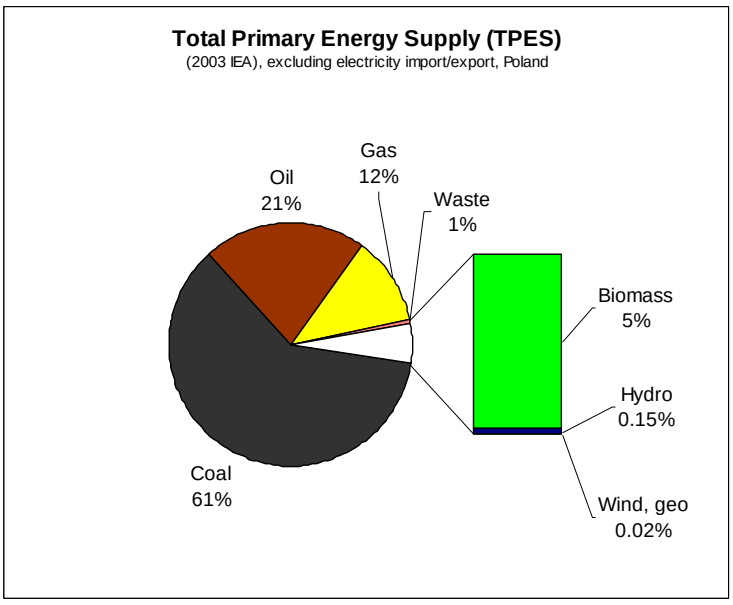
Poland has an extremely high unemployment rate of 18.8%, the highest in the EU. The economy is further troubled with a deficit on state finances (-3.9% of GDP in 2004) and a negative current account balance in its foreign exchange (-2.0% of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer countries, Poland receives support from EU structural funds.

Industries include machine-building, iron and steel, coal mining, chemicals, shipbuilding, food processing, glass, beverages, and textiles.



Energy Supply and Demand

The Polish energy supply is dominated by domestic coal that contributes 61% of the total primary energy supply (TPES), followed by oil (21%), gas (12%), and biomass (5%).
The domestic production of coal excesses the coal use by 23%. The domestic production of gas is 32% of the gas use and oil production is 4% of the oil use (2003-IEA).
The TPES was 3905 PJ in 2003, not including electricity exports. The TPES increased by 5.2% in 2003.



In the supply structure, oil is dominant, covering 31% of total final consumption (TFC), while the rest is shared among gas, heat, electricity, and wood. (TFC, 2003-IEA).

Poland has exported electricity in recent years, 8.2% in 2003 (2003-IEA).

District heating is very much used, supplying 12% of TFC.

The demand structure is dominated by industrial and residential consumption. Among industrial sectors, the chemical and petrochemical industries are the largest energy consumers. They account for 35% of industrial energy consumption, followed by iron and steel (14%), non-metallic minerals (12%), and food and tobacco (11%) (2003 IEA).

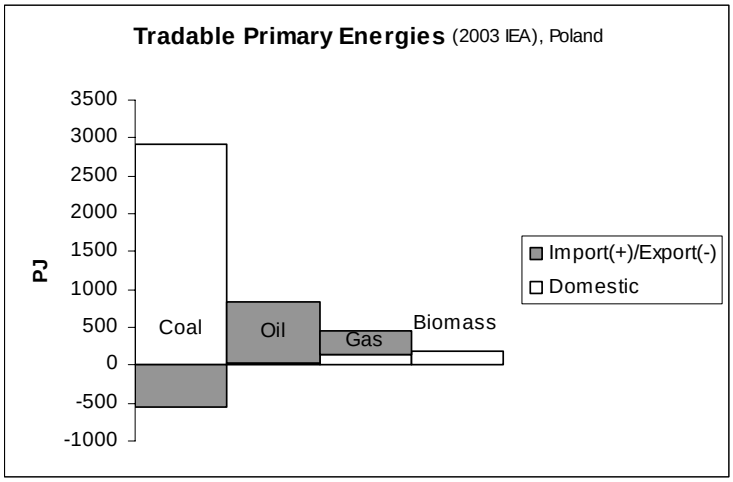
Transport includes aviation, which represents about 2.7% of transport energy use.
Others/non-specified is primarily agriculture, along with non-energy oil use, and non-specified energy use.

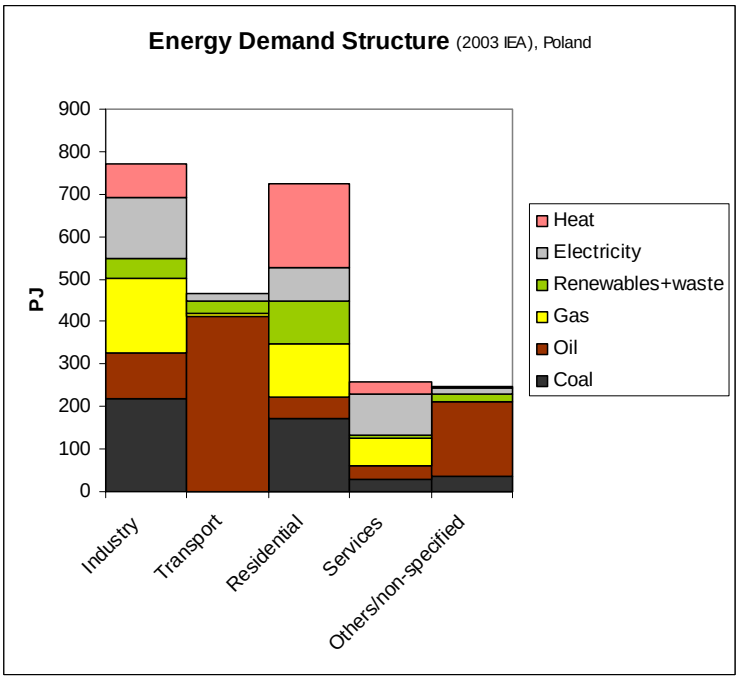
Electric Power Supply
The power supply structure of Poland is extremely dominated by coal power stations that supply 95% of electricity production (2003 IEA).
More than half of the capacity was built in the 1970's and modernisation will require significant investments.

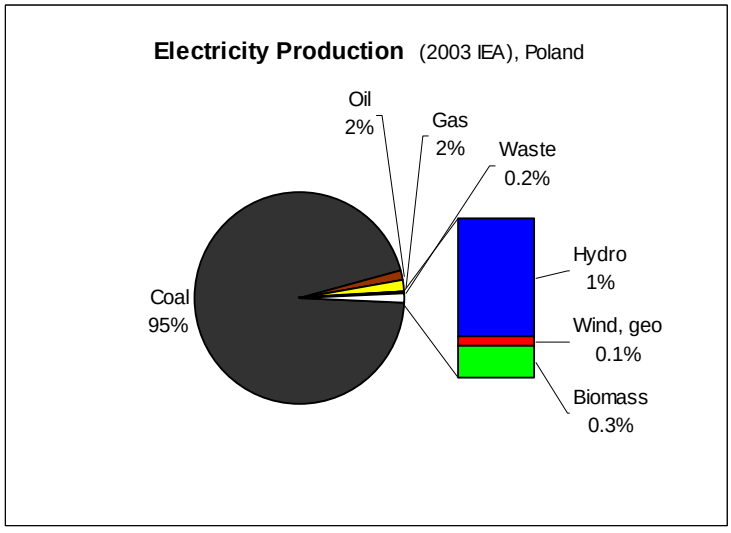
The total production was 150 TWh in 2003 (IEA).

The efficiency of the power sector is about average for EU countries, with losses in the electricity and CHP sector that are 1.4 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 18% of electricity production.

The electricity distribution losses of 12% are well above the EU average (2003 IEA).







Renewable Energy

In Poland, renewable energy is mainly generated from biomass and, to a lesser degree, hydro.

Biomass is the most used source of renewables in Poland. In 2003, it contributed 5 % of TPES and covered about 98 % of all renewable-energy use (2003). Solid biomass composes the largest part (83% of biomass), with liquid biomass (16%) and biogas (1%) as minor parts. The production has increased since 1990 with respect to both solid biomass and biogas. Liquid biomass has taken off rather significantly only after 2000.
More than half of the biomass use is for residential energy demand. The industrial sectors also use some, in particular paper and pulp as well as wood and wood products. CHP plants and heat plants also consume a minor part of the biomass production. Biomass contributes 0.3 % of the electricity production, but this fraction increased 9 times between 2000 and 2003 (URE).

Biogas from wastewater and from agricultural activities and landfill gas are used, but there is still a large unused potential.

Poland is the 4th biggest producer of bioethanol after Spain, France and Sweden. Poland produced 60,000 tons in 2003, which decreased to 35,000 tons in 2004. Investors have big plans in this area (Warsaw Business Journal 2005).

In Poland, biomass is a good alternative to replace or reduce use of coal. Considering the age and the decreased efficiency of many existing heating and CHP plants, conversion to biomass boilers is a good alternative. It is expected that the major part of the renewable-energy target up to 2010 will be met by small wood boilers, wood and straw heating plants, wood-fired CHP plants, and increased use of biogas.

The other important renewable energy is hydro. The production has been stable since 1990, with large yearly fluctuations due to variations in rainfall. The unused hydro potential is limited.

Even though windpower only accounts for a very small proportion of Poland's renewable energy supply, Poland has the largest windpower capacity among the new EU countries. Windpower capacity increased from 63 MW to 73 MW in 2005.

Solar thermal is also used in Poland; collector surface increased to 95,000 m^2 in 2004.

Renewable Energy Promotion and Policies
Within the EU, Poland has a national target of generating 7.5% of its electricity from renewable energy by 2010 (compared with 1.5% in 2003). The Polish renewable-energy targets for TPES are 7.5 % by 2010 and 14 % by 2020.

Regarding biofuels, there is a target of 1.5% by 2006 for renewable energy in transport.

The national coordination of renewable-energy development is shared between the ministries, the Energy Regulatory Office (URE), and the below-mentioned energy agencies.

Concerning information, there are 3 national agencies in Warsaw that are also involved in coordination: NAPE - National Energy Conservation Agency, KAPE SA - The Polish National Energy Conservation Agency, Association of Polish Energy Actors at Local and Regional Level - EC Baltic Renewable Energy Centre. Regional agencies operate in all regions. At least four regional agencies receive or have received EU support for start-up and operation. (ManageEnergy)

The main drivers for the development of renewable energy are national policies, and lately also increasing oil and gas prices, as well as concern over security of supply.
The Development Strategy of Renewable Energy Sector was adopted by the Parliament of the Republic of Poland in August 2001. According to the strategy, the renewable-energy targets for TPES are 7.5 % by 2010 and 14 % by 2020. (Ministry of Environment)
In 2004, purchase obligations and a quota system were introduced by the Energy Law and relevant Decree of Minister of Economy, Labour and Social Policy (2003 May 30). The aim is to realise the Polish indicative (voluntary), agreed-upon target.

The regulation above concerns the obligation to purchase electricity and heat from renewable energy sources. The regulation requires that electricity suppliers maintain a portfolio of renewables with an annually increased percent starting from 2.4 % in 2001 up to 7.5% in 2010. They can either invest in renewable-electricity production themselves or buy renewable electricity. The regulation does not indicate either from which specific sources the suppliers are to purchase renewable electricity, or at what price. Therefore, the price is found by means of negotiations between the renewable-energy producer and the supplier, or within open tendering on energy supply.
Barriers to the development of renewable electricity are:

- Targets (2.4-7.5%) have not been reinforced effectively;
- Lack of easy access to information on potential, design, consulting, and procedures;
- Lack of education and training programmes;
- Insufficient number of domestic companies involved in the manufacturing of renewable-energy equipment on a larger scale;
- Lack of proven methods of avoiding conflicts with nature- and landscape-protection objectives (environmental impact assessment);
- The traditional old established custom of using coal as a main fuel;
- Subsidies for coal use in the energy sector.

There are environmental funds supporting renewables with grants and soft loans.
In addition, EU structural funds can support renewable energy.

Since 1997, discussions have been in progress on tax exemptions for biofuel mixed with petrol. Legislation was passed in 2003 and in 2004 that gave tax reductions for petrol with 5% ethanol. Legal uncertainties have made the law less efficient, but there is a biofuel business in Poland with production of bioethanol.

Geographical Distribution of Renewable Energy
While biomass and solar installations are located throughout the country, windpower resources are abundant in the northwest along the Baltic coast and in the southern mountainous region.

National Allocation Plan for EU Emissions Trading.
The first National Allocation Plan (NAP) was registered by the European Commission in September, 2004. The European Commission accepted the plan in March, 2005 under condition of certain amendments. The Polish government accepted the amendments, and enforced the plan December 2005 for the installations covered. In 2005-07, the NAP covers the emissions of 239.1 $MtCO_2$ annually, equivalent to about 62% of total GHG emissions. Credits of 206 $MtCO_2$ are given to the electricity and heat sectors (EU press release and EU NAP).

Sources and information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: Solar Thermal, Wood Barometer 2005. EurObserv'er, Systemes Solaire, and EUFORES.

European Wind Energy Association Press release, February 1, 2006: European Record for Windpower.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

Polish Ministry of Economy, Labour and Social Policy www.mos.gov.pl.

Polish Ministry of the Environment www.mos.gov.pl .

URE: The Energy Regulatory Office (URE in Polish or ERO in English) Activity Report 2005 of the President of the URE, www.ure.gov.pl.

KAPE, www.kape.gov.pl.

ECBREC, www.ibmer.waw.pl/ecbrec.

PORTUGAL

Population:
10.5 million (2004)

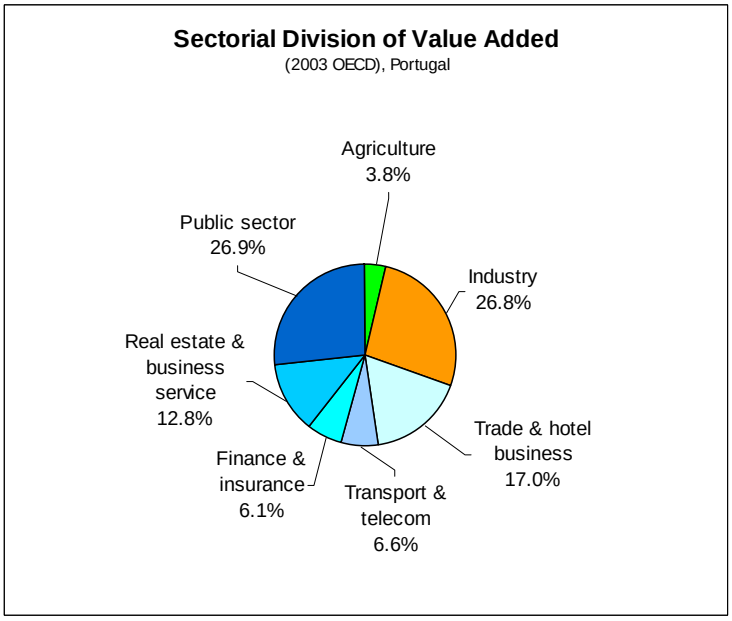
GDP:
142 billion € (2004)
= 13,556 €/capita

Greenhouse-gas emissions:
81.2 million tons CO_2 equivalent (2003) =
7.8 tons/capita

Economic Sectors
Private service sectors contribute 43% of the value added of Portugal, which includes relatively small real estate and service sectors. The public sector is relatively big compared with the average for the EU. Agriculture contributes 4% and industry contributes 29%, both of which are above the EU average.

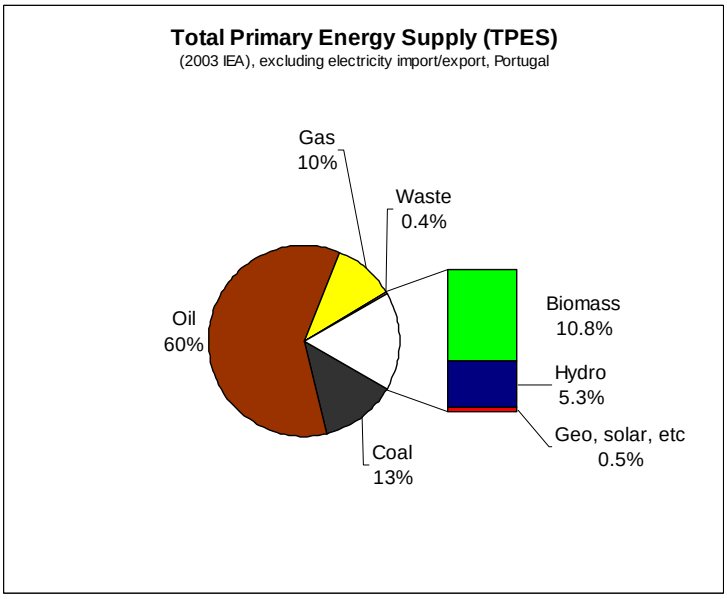
The Portuguese GDP per capita is 60% of the EU average, whereas the GDP growth rate of 1.2% in 2004 was slightly above average for the EU.
The unemployment rate of 6.7 % is below the EU average. The economy is troubled, with a deficit on state finances (-3.0% of GDP in 2004) and a negative current account balance in its foreign exchange (-5.7% of GDP in 2003) (Eurostat 2005).
As one of the EU countries with lower GDP, Portugal receives EU support in the form of structural funds.

Leading industries are oil refining, chemicals, cement, steel, shipbuilding, automobile assembly, electronics, wood-pulp and cork production, and fish and beverage processing, textiles, footwear, furniture, wine, processed food. Portugal is the world's largest exporter of tomato paste and a leading exporter of wines.
Geographically, two regions account for 75% of Portugal's industrial capacity: the Lisbon region in the south tends more toward heavy industry, and the Porto region in the north, toward light industry.



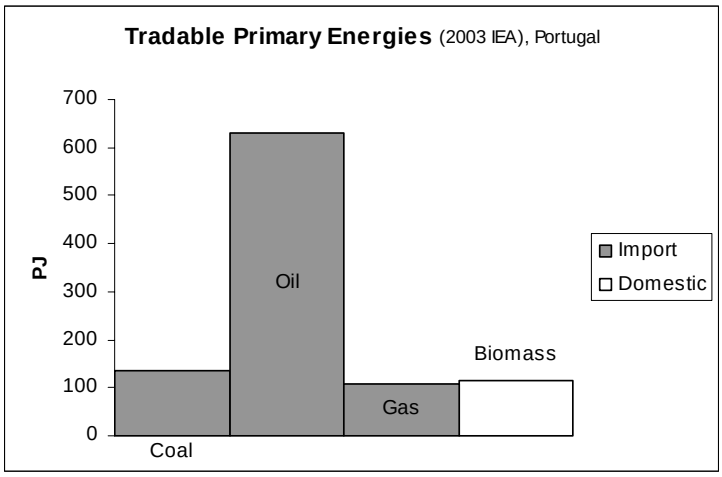
Energy Supply and Demand
The Portuguese energy supply is dominated by imported oil that contributes 60% of the total primary energy supply (TPES), followed by coal (13%), biomass (11%), and gas (11%).
Portugal does not produce fossil fuels (2003-IEA).
The TPES was 1055 PJ in 2003, not including electricity imports. It decreased by 3% in 2003 after a steady increase for a number of years.
In the supply structure, oil is dominant, covering 63% of total final consumption (TFC), followed by electricity, covering 18%, and gas, covering 6%. (TFC, 2003-IEA).

Portugal has imported electricity in recent years, 6% in 2003 (2003-IEA).
District heating is not much used, supplying 1% of TFC.



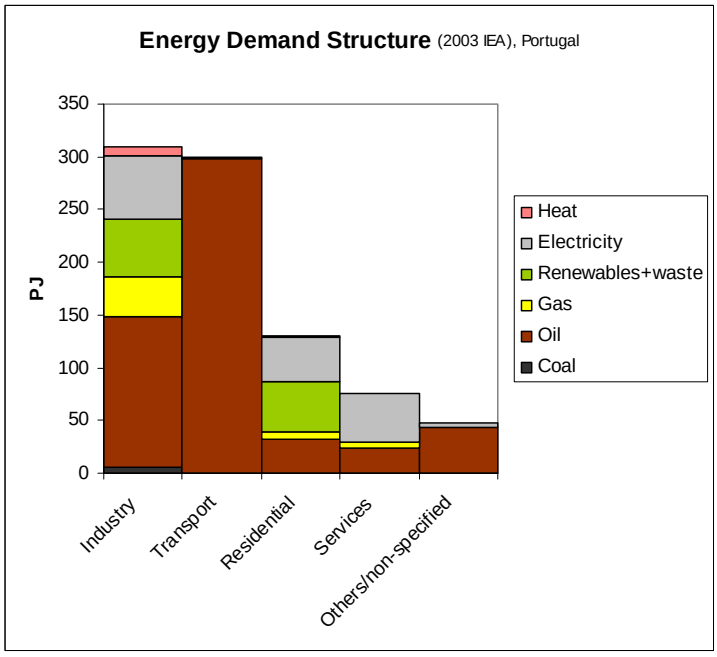
The demand structure is dominated by industry and transport consumption. Among industrial sectors, the chemical and petrochemical industry is the largest energy consumer. It account for 30% of industrial energy consumption, followed by non-metallic minerals (16%), paper and pulp (16%), textile (7%) and food and tobacco (7%) (2003 IEA).

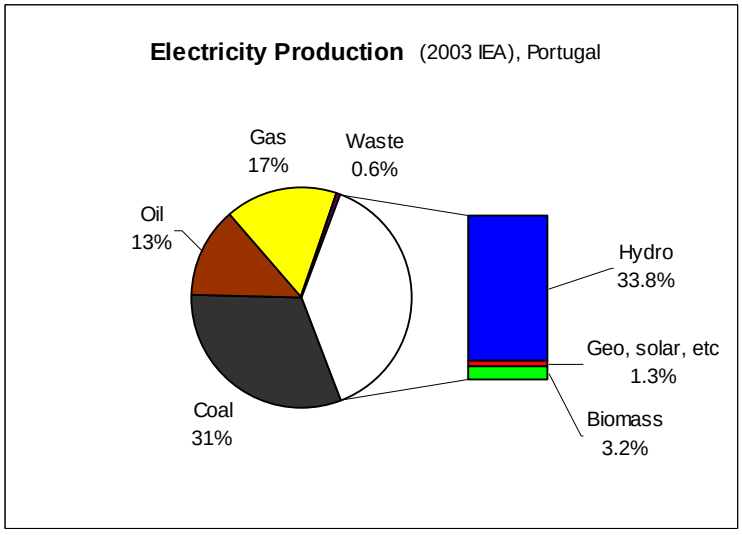
Transport includes aviation, which represents about 11% of transport energy use.
Others/non-specified is primarily non-energy oil use and agriculture.



Electric Power Supply
Portugal's power supply structure is dominated by hydro power stations that supply 34% of electricity production, followed by coal (31%), gas (17%), and oil (13%) (2003 IEA).
The total production was 283 TWh in 2003 (IEA).

The efficiency of the power sector is high, as the power plants are efficient, and cogeneration of heat and electricity is somewhat used. The losses in the electricity and CHP sector are 0.9 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 5% of electricity production. 11% of the power production is from CHP plants.
The 2003 electricity distribution losses of 9% were above the EU average (2003 IEA).





Renewable Energy

The renewable energy in Portugal is mainly generated from biomass and hydro. All other forms of renewable energy only add minor contributions.

The largest use of renewable energy is in the form of biomass (2003), of which solid biomass is most important, comprising 97% of the country's biomass. Since 1990, its production has been more or less stable, with a small increase since 2002. The largest user of biomass energy is the industrial sector (concentrated in paper, pulp and printing and in non-metallic minerals). The residential sector is of almost equal importance and uses 40% of the entire biomass supply. 37% of the total energy residential energy use comes from biomass.

Among the countries in the European Union, Portugal had the fifth-highest consumption of primary energy from wood energy per capita in 2004. The wood energy part of the total primary supply energy was 10% in 2004 (no. 5 in the EU after Finland, Sweden, Latvia, and Austria).

The second most important renewable energy in Portugal is hydro. In spite of yearly fluctuations due to variations in rainfall, there has been an overall increase since 1998.

Even though wind energy only accounted for 1% of Portugal's renewable-energy production in 2003, it is a sector that is developing rapidly. In 2004, Portugal installed 224.4MV and in 2005, an impressive 500 MW, in both years almost doubling the capacity.

Portugal is endowed with good potentials for increased use of renewable energy, for windpower, solar, and biomass. In the future, wave-power can also contribute to the energy mix.

Renewable Energy Promotion and Policies

In Portugal, renewable energy is mainly promoted with information, feed-in tariffs, and subsidies.
Within the EU, Portugal has a national target of generating 39.0 % of its electricity from renewable energy (compared with 38 % in 2003) to be reached by 2010. Portugal has also a target of 1.15% biofuel in transport by 2005.

National coordination of renewable-energy development is carried out by the Portuguese Energy Agency ADENE, www.adene.pt.
Six regional energy agencies and eight local energy agencies have received EU support for their operation, mostly during their establishment and first years of operation. (ManageEnergy).

The most important support mechanism is feed-in tariffs. New tariffs from 2005 are:
- windpower 7.6 €c/kWh for the first 33,000 full-load hours[1] or 15 years, whatever comes first.
- PV 31.7 – 44.4 €c/kWh for 15 years, the high tariff applies for installations below 5 kW.

In addition, small hydro is supported with a feed-in tariff.

Investment subsidies on the order of 40% have been given to electricity-producing renewable electricity and to installations for biofuels for transport.

Tax exemption of vehicle fuel tax for biofuels helps development of the biofuels market. The tax exemption is only available for a certain biofuels quota each year (target of 1.15% in 2005).

The main drivers for the development of renewable energy are national policies. In recent years, increasing prices of imported energies have given an additional impetus to investment in renewables.

A number of barriers have slowed the development of renewable energy. The barriers can be grouped into a number of categories:

[1] Full-load hours is the equivalent hours with full load production for a given energy production. As an example, a 1 MW windturbine has reached 33,000 full load hours when it has produced 33,000 MWh (33 GWh).

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Administrative barriers, in particular to larger installations. The gradual lifting of the barriers is an explanation for the rapid development of windpower in recent years.
- Low fossil-fuel prices with little internalisation of external costs of fossil fuels via taxes.

Geographical Distribution of Renewable Energy
Renewable energy sources and installations are distributed throughout the country.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was submitted to the European Commission in June, 2004.
The European Commission accepted the plan in October, 2004, and it was then enforced for the 239 installations covered.
In 2005-2007, the NAP covers the emissions of 38.1 $MtCO_2$ annual average, equivalent to 48% of total GHG emissions in 2003. Compared with 2002, this is equal to 9% reduction for electricity plants, but 25% increase for the (relatively smaller) CHP sector and 6% increase for refining. Annual credits of 26 $MtCO_2$ on average are given to the energy sectors for 2005-2007 (EU NAP and IEA 2005).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

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EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

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European Wind Energy Association Press release, February 1, 2006: European Record for Windpower.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

SLOVAKIA

Population:
5.38 million (2004)

GDP:
33 billion € (2004) =
6,134 €/capita

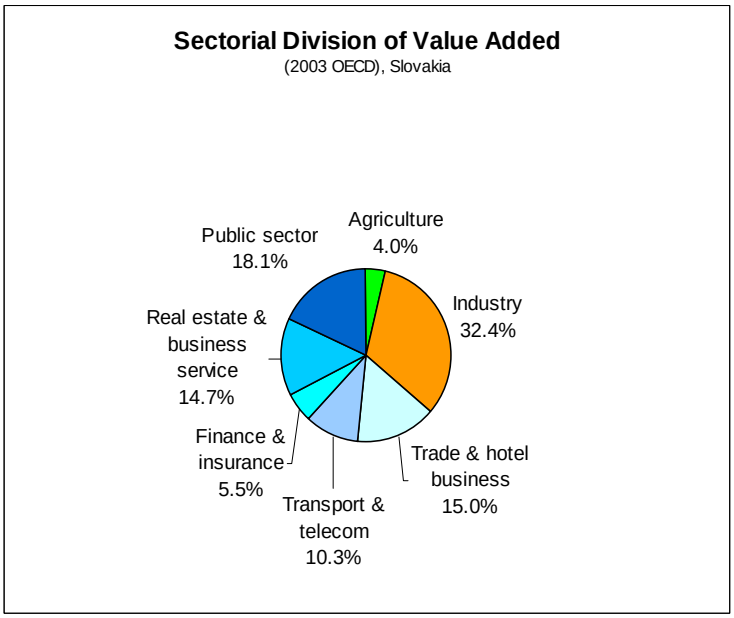
Greenhouse-gas emissions:
37.2 million tons CO_2 equivalent (2003) =
6.9 tons/capita

Economic Sectors
The service sectors contribute 63% of the value added of the Slovak Republic, an amount that is smaller than the EU average; the industry share is 32.4 %, which is relatively higher than the EU average.

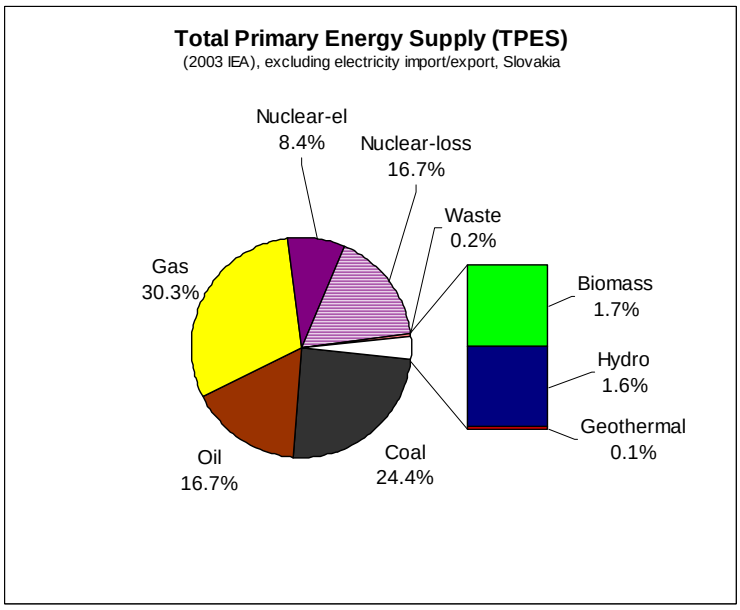
One of the new EU countries, Slovakia has an economy with a steady increase of GDP. The growth is higher than the EU average (4.5-5.5 % in 2003-04), while the GDP/capita is only 27% of the EU average.

The unemployment has declined considerably from 18.2 % in 2004 to 11.5% in January 2006.
The Slovak deficit in state finances has decreased (to -3.1 % of GDP in 2004) and the negative current account balance in its foreign exchange suddenly improved from -8 % of GDP in 2001-02 to -0.9 % of GDP in 2003) (Eurostat 2005). The reason for this was huge cuts in governmental expenditures in all sectors. As one of the newer and poorer EU countries, Slovakia receives support from EU structural funds.

The industries include metal products; food and beverages; chemicals; machinery; paper and printing; transport vehicles; textiles; electrical and optical apparatus; and rubber products. Foreign investment flows presumably into automotive industry. In 2007, when Volkswagen, Peugeot and Kia will be producing at full capacity, Slovakia will became a world leader in car production per capita (almost 1 million cars produced annually).
Since 1998, the government has created good conditions for continual economic growth, with labour market liberalization and a 19% flat tax rate.
Geographically, the industry is located in the western part of Slovakia.



Energy Supply and Demand
The Slovak energy supply is dominated by imported fossil fuels and nuclear fuels, while renewable energy is playing a smaller role at 3.4% of the total primary energy supply (TPES).
In the supply structure, gas is now the biggest source, covering 35% of total final consumption, followed by oil, covering 25%, and electricity covering 17% of TFC. (TFC, 2003-IEA).
The district heating is widely used, supplying 9.2% of TFC.



Generally, the energy consumption has grown slightly in recent years and stands at 798 PJ in 2003. It was 755 PJ in 1993. A smaller part of the fossil-fuel use is of domestic origin: 18% of total primary coal supply, 3 % of gas, and 2% of oil. Nevertheless, the energy intensity is 70% higher than the EU average and the primary energy consumption per person is 90% of the EU average.

The demand structure is dominated by industry (42%), followed by residential (25%) and transport (20%) consumption. Among the industrial sectors, the chemical and petrochemical and the iron & steel industries are the largest energy consumers. They account for, respectively, 27% and 25 % of the industrial energy consumption, followed by non-metallic minerals (10%) and paper and pulp industry (10%) (2003 IEA).

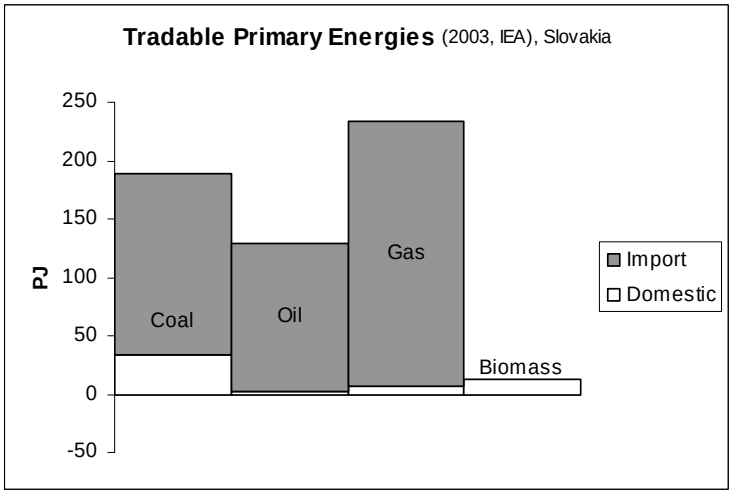
Transport includes aviation, which represents about 1.8 % of transport energy use.
Others/non-specified are agriculture and non-energy oil use.

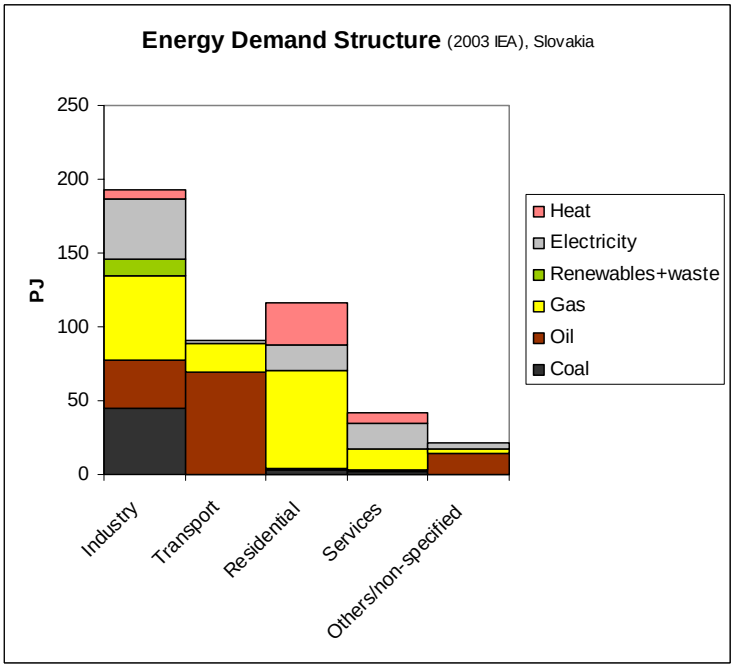
Electric Power Supply
The Slovak power supply structure is dominated by nuclear power that supplies 55.5% of electricity production, followed by coal (23,1%), hydro (13,5 %), and gas (7,9 %).

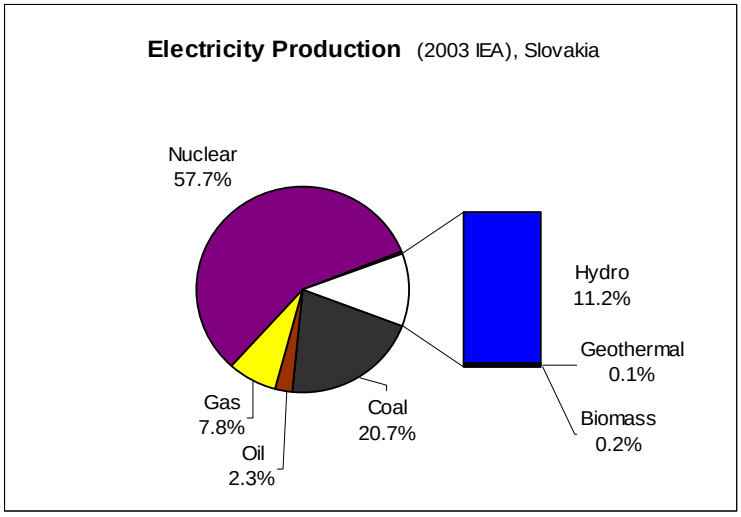
The total production was 30.6 TWh in 2004.

The efficiency of the power sector is about EU-average. Cogeneration of heat and electricity is widely used, and the losses in the electricity and CHP sector are 1.6 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 12.4 % of electricity production.

85% of the power production is reported as being from CHP plants. This is because the Slovak authorities report the country's 2 nuclear power plants as CHP plants, even though the useful heat production from the nuclear power plants is only a small fraction of the nuclear electricity production. If nuclear is not included as CHP, the CHP production is 28% of electricity production. The electricity distribution losses of 7.3 % are close to the EU average (2003 IEA).







Renewable Energy
The main renewable energy sources are biomass (1.9 PJ in 2004) and hydropower (1.3 PJ), with small amounts of energy coming from geothermal sources. The share of renewables has not changed during the past few years. In the renewable electricity sector the total production reached 3,581 GWh, which represents 11.6 % of all power consumed in Slovakia in 2003. The majority was generated in hydropower plants - 3,480 GWh (excl. pump hydro); 84 GWh were produced through biomass (mostly co-firing with coal). In the year 2005, there was one windpark with 4 wind mills in operation in Cerova. This facility with total installed capacity of 2.6 MW was expected to produce 4 GWh of electricity in 2005.

There is quite large capacity of pump-storage hydropower plants, 880 MW, in operation now. In general, the potential of hydropower is still not fully used and preferably small hydropower plants with less than 50% of used potential seem to be very attractive in the future.

The development of renewables is very slow and the real growth is only in the biomass sector, which is used for heating purposes. Here, more and more people are cancelling their natural-gas pipeline connections and converting their boilers to wood-firing ones.

Renewable Energy Promotion and Policies
Despite original (2004) strong commitment to increase the share of renewable electricity up to 31% in 2010 (doubling the current figure), the Slovak government decided to drop this EU-driven target to almost no increase at all (19% in 2010). Until now, there was no special legislative support for renewables, in contrast to the Czech Republic, where progressive law is in force. Nevertheless, there is a law on energy with preferential treatment of renewable energy sources when the production facilities are connected to the grid. In general, the financial support is now concentrated in EU Structural Funds, which are available for Slovak subjects (public and private). With almost 25 projects financed in the year 2005, this mechanism seems to be the leading force. Most projects were oriented toward utilization of biomass for heating purposes (municipalities), but the large part of funds went to co-firing of biomass and coal.

The renewables are practically not promoted by any kind of information campaign in Slovakia. Few NGOs are filling the gap. Tax exemptions for renewable energy sources were also cancelled after the adoption of a flat tax rate of 19% in 2004. There is also no driving force to increase the share of renewables in transportation. The utilisation of biodiesel, which was supported in previous years, is now almost nonexistent, with a large part of the production being exported outside Slovakia. In general the national policy towards renewables is created by the Ministry of Economy, which prepares the energy-policy plans for Slovakia.

The only driver towards development of renewables seems to be continually rising energy prices, mainly natural gas and electricity.

The real barriers (in contrast with the neighbouring Czech Republic) are feed-in tariffs offered to power producers by three regional power-distributing companies. The average level for feed-in tariffs for all kinds of renewable sources in the year 2005 was low, 0.05 €/kWh. This leads to long payback times of the investment and to a lack of interest on the investor side. In the case of an average small hydropower plant, the payback time is usually 15 years or more. Lack of information and even of interest among public subjects (municipalities) is slowing down the development.

Geographical Distribution of Renewable Energy
The largest hydro power plants are located on the river Vah and Danube (Gabcikovo). Biomass is used for heating purposes, mainly in the countryside.

National Allocation Plan for EU Emissions Trading
The first National Allocation Plan (NAP) was published in June, 2004. After the review, the European Commission identified over-allocation and demanded reduction cuts by 5 $MtCO_2$ (-14%), which were accepted by the government. The Slovak government decided to allocate emission quotas to the selected 27 larger and 175 smaller installations according to their past emissions. The NAP covers emissions equivalent to 52% of total greenhouse-gas emissions. In the period of 2005-2007, out of 29.6 $MtCO_2$ allocated annually, almost 20 $MtCO_2$ goes to the energy sector.

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

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IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Energy policy of the Slovak Republic, Ministry of Economy, 2005.

SLOVENIA

Population:
2.0 million (2004)

GDP:
26 billion € (2004) = 13,023 €/capita

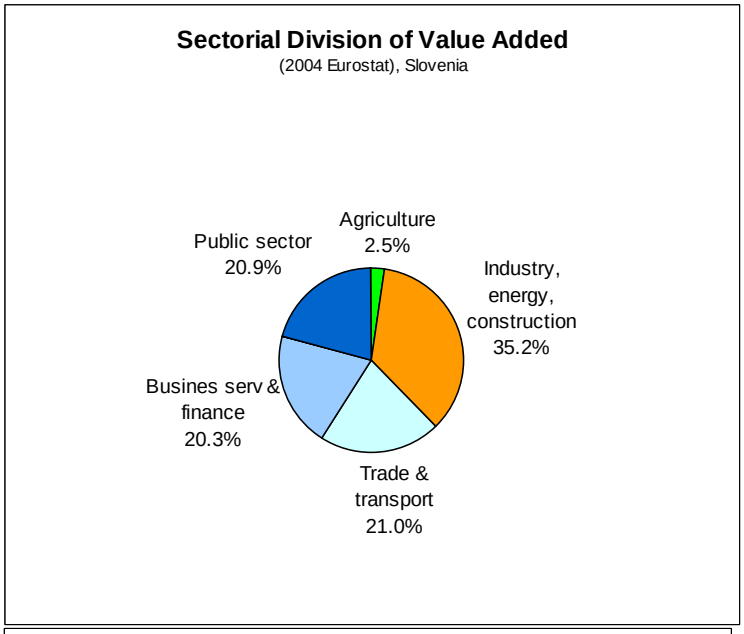
Greenhouse-gas emissions:
51.7 million tons CO_2 equivalent (2003) = 25.9 tons/capita

Economic Sectors
The service sectors contribute 62% of the value added of Slovenia, which is less than the EU average. Agriculture (2.5%) contributes slightly more that the EU average, and industry (35%) contributes much more.

Industries include ferrous metallurgy and aluminium products, lead- and zinc smelting, electronics, trucks, electric power equipment, wood products, textiles, chemicals, and machine tools. Companies include Krka (food products); Pivovarna Union (food products); and Gorenje (appliances, white goods).

The Slovenian GDP per capita is 58% of the average of the EU; however, it is the highest among the new EU countries in the continent. The GDP growth rate is 4.2% in 2004, which is significantly above the average of the EU.

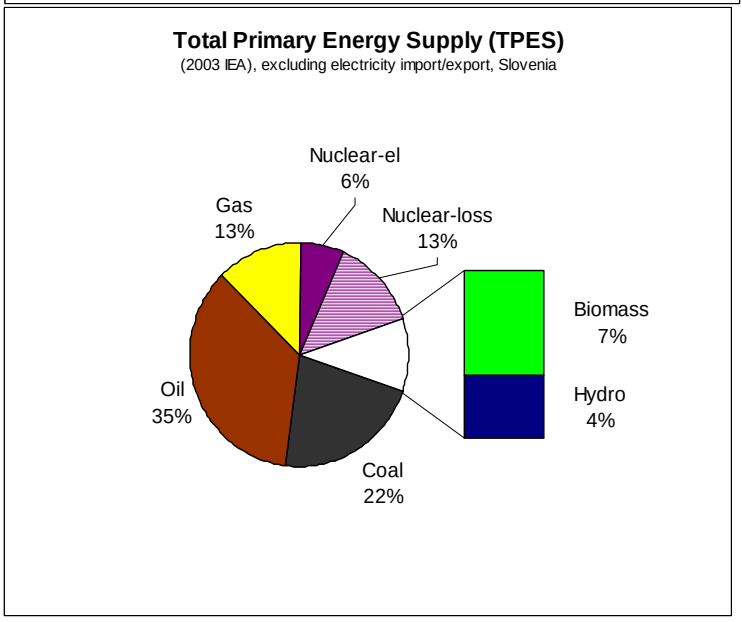
The economy is stable, with a relatively low unemployment of 6.0%, but with a deficit on state finances (-2.1% of GDP in 2004) and a small negative current account balance in its foreign exchange (-0.4% of GDP in 2003) (Eurostat 2005).
As one of the newer and poorer EU countries, Slovenia receives support from EU structural funds.



Energy Supply and Demand

The Slovenian energy supply is dominated by imported oil that contributes 35% of the total primary energy supply (TPES), followed by coal (22%), nuclear (19%), gas (13%) and renewable energy (11%).
The domestic production of coal covers 78% of the coal use, while there is no domestic production of other fossil fuels (2003-IEA).
The TPES was 289 PJ in 2003, not including electricity imports. It increased by 4.2% in 2003.
In the supply structure, oil is dominant, covering 49% of total final consumption (TFC), followed by electricity, covering 21%, and gas, covering 15%. (TFC, 2003-IEA).

Slovenia has imported electricity in recent years, 1.3% in 2003 (2003-IEA).
The district heating usage is above the average of the EU, supplying 3.8% of TFC.

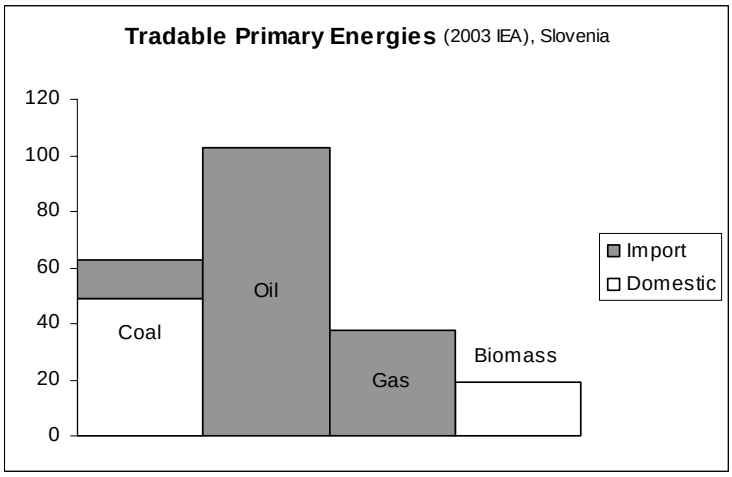


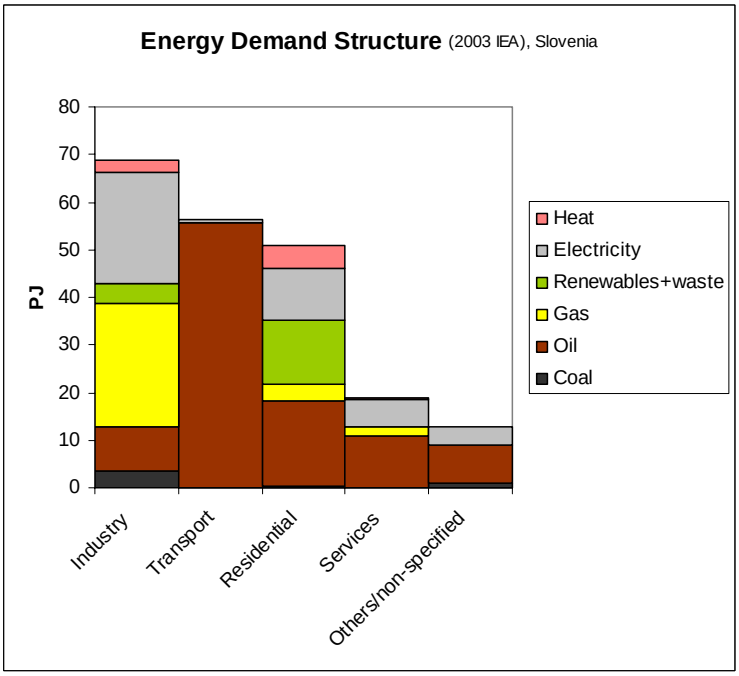
The demand structure is dominated by industry, transport, and residential consumption. Among industrial sectors, the chemical and petrochemical industry is the largest energy consumer. It accounts for 18% of industrial energy consumption, followed by paper pulp and print (14%), non-metallic minerals (13%) and non-ferrous metals (10%) (2003 IEA).

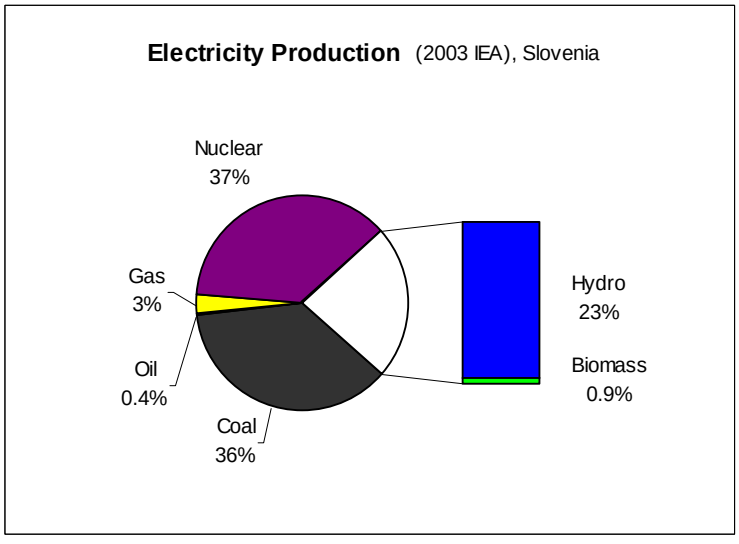
Transport includes aviation, which represents about 10% of transport energy use.
Others/non-specified are primarily non-energy oil use as well as agriculture, and includes also non-specified energy use.

Electric Power Supply
The power supply structure of Slovenia is mainly based on nuclear, coal and hydropower stations that supply, respectively, 37%, 36% and 23% of electricity production (2003 IEA).
The total production was 14 TWh in 2003. (IEA).

The efficiency of the power sector is around EU average; the losses in the electricity and CHP sector are 1.5 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 7.7 % of electricity production. 35% of the power production is from CHP plants. The electricity distribution losses of 4.5% are well below the EU average (2003 IEA).







Renewable Energy

The Slovenian renewable-energy use is mainly from biomass and hydro.

The largest use of renewable energy is in the form of biomass, of which solid biomass composes the most important part and biogas only a minor part (just 1.3%of total biomass in 2003). The production is increasing. More than half of the uses of biomass energy are residential and ¼ of the residential energy used is from biomass. The industrial sector also uses biomass, in particular the paper and pulp industry and the wood and wood products industry. CHP plants and heat plants together consume a minor part of the biomass production.
Part of the residential biomass use is traditional. A change is taking place from traditional wood stoves to more modern, user-friendly wood stoves and boilers.

The second most important renewable energy is hydro. The production has been stable since 1990, with large yearly fluctuations due to variations in rainfall.

Biofuel production started on a small scale in 2005.

Renewable Energy Promotion and Policies
In Slovenia, renewable energy is mainly promoted with feed-in tariffs.
Towards the EU obligation, Slovenia has a national target of generating 33.6% of its electricity from renewable energy (compared with 23.4% in 2003), as well as a target of 5.7% renewable energy in transport, both to be reached by 2010. The installation rates for renewable energy are not enough to reach the target. Slovenia is the only one of the new EU member countries that have difficulties in meeting its greenhouse-gas reduction target within the Kyoto Protocol.

The national coordination of renewable-energy development is carried out by the Department for Energy Efficiency and Renewables under the Ministry for Spatial Planning and Environment (MSPE).
The Slovenian E-forum works to disseminate information and to promote renewable energy as a NGO.

Feed-in tariffs are available for electricity from small hydro, biomass, windpower, geothermal, and solar; currently there is no windpower or geothermal energy and the PV capacity is on the order of only 100 kW. Feed-in tariffs are:

- PV below 36 kW: 37.36 €c/kWh, above 36 kW: 6.44 €c/kWh;
- Biomass below 1 MW 6.95 €c/kWh, above 1 MW: 6.74 €c/kWh;
- Hydropower below 1 MW, 6.15 €c/kWh, above 1 MW 5.93 €c/kWh;
- Windpower below 1 MW: 6.06 €c/kWh, above 1 MW: 5.85 €c/kWh;
- Geothermal: 5.85 €c/kWh.

Contracts that guarantee the feed-in tariffs are given for only ten years.

A CO_2 tax of 15 €/ton of CO_2 increases the competitiveness of renewable energy versus fossil fuels.

The drivers for the development of renewable energy are national policies, a tradition of using biomass, and, in recent years, increasing prices of fossil fuels.

A number of barriers have slowed the development of renewable energy, resulting in underdevelopment of many fields including windpower and biomass. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Long and lengthy administrative procedures to obtain permissions for renewable-energy plants, although amendments of laws in 2004 improved the situation.
- Relatively short period for feed-in tariffs (10 years).
- Some protests against windpower.
- Few local initiatives for renewable energy, which make local protests stronger.

Geographical Distribution of Renewable Energy

While biomass and installations are located throughout the country, the windpower potential is in just a few locations, mainly in the southern part of the country. For a small country, there is a remarkable difference in solar radiation in different parts of the country, with substantially more insolation in the south of the country.

National Allocation Plan for EU Emissions Trading

The first National Allocation Plan (NAP) was notified to the Commission in April, 2004. The European Commission accepted the plan in July, 2004, and the plan was then enforced for the 98 installations covered.
In 2005-07, the NAP covers the emissions of 8.77 $MtCO_2$ annually, equivalent to 55% of total GHG emissions. This is equal to 92% (on average) of projected emissions of the installations covered. Credits of 6.14 $MtCO_2$ annually are given to the energy sectors (IEA 2005 and EU NAP)

Sources and information:

2003 IEA: International Energy Agency, Energy Balances for Non-OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

Eurostat 2005: Europe in Figures – Eurostat Yearbook 2005, Eurostat, European Commission, Luxembourg.

EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer 2005. Wood Barometer, EurObserv'er, Systemes Solaire, and EUFORES.

ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

MSPE: Ministry for Spatial Planning and Environment, www.gov.si/aure.

Sustainable Energy News no. 51, 2005: Slovenia: Something is going on.., article by Andrej Klemenc, Slovenian E-Forum.

SPAIN

Population:
42.3 million (2004)

GDP:
838 billion € (2004)
= 19,790 €/capita

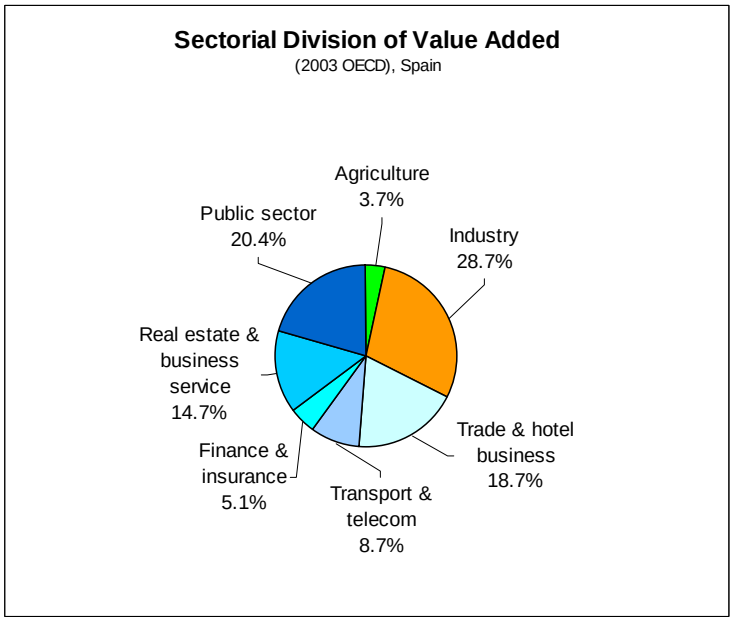
Greenhouse-gas emissions:
402.3 million tons CO_2 equivalent (2003) =
9.5 tons/capita

Economic Sectors

Private service sectors contribute 48% of the value added of Spain, which includes a relatively large trade and hotels business sector. The public sector is relatively small, while agriculture contributes 4%, which is higher than EU average.

The Spanish economy contributes 8% to the EU GDP. The GDP per capita is 88% of the average in the EU, while the GDP growth rate was 3.1% in 2004, which is above the EU average.
The economy is troubled, with high unemployment at 11%, a small deficit on state finances (-0.1% of GDP in 2004) and a negative current account balance in its foreign exchange (-2.8% of GDP in 2003) (Eurostat 2005).
As one of the EU countries with a lower GDP, Spain receives EU support in the form of structural funds for the poorer parts of the country.

Industries include textiles and footwear, food and wine, metals and metal products, chemicals, shipbuilding, automobiles, machine tools, clay and refractory products, pharmaceuticals, and medical equipment. Prominent Spanish companies include: Acerinox (primary metals); Industria de Disano Textil (clothing); Repsol-YPF (petroleum products); Compania Española de Petroleos (petroleum products); Elaro Puleva (food products).

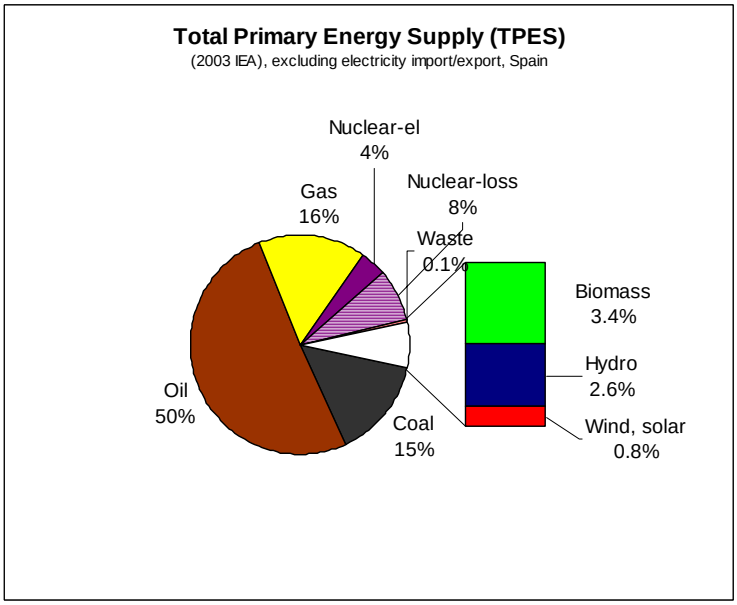


Energy Supply and Demand

The Spanish energy supply is dominated by imported oil that contributes 50% of the total primary energy supply (TPES), followed by gas (36%) and coal (8%).
The domestic production of coal was 35% of the coal supply (2003-IEA) and is declining with phase-out of subsidies.

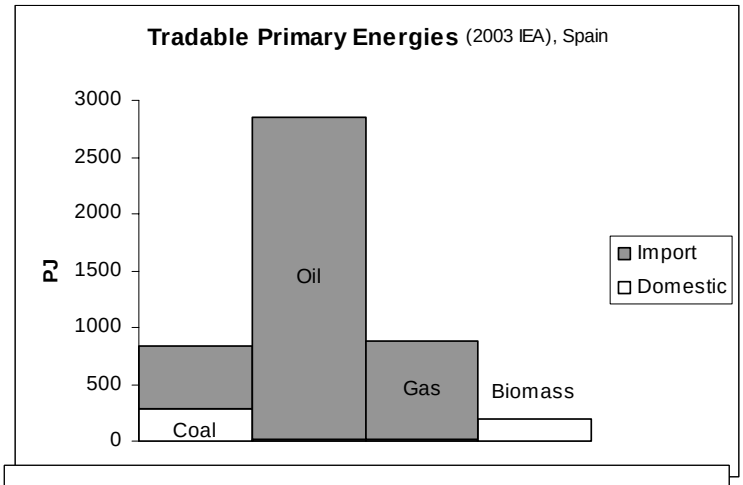
The TPES was 5696 PJ in 2003, not including electricity import. It increased 3.4% in 2003.
In the supply structure, oil is dominant, covering 60% of total final consumption (TFC), followed by electricity covering 19% and gas covering 16%. (TFC, 2003-IEA).

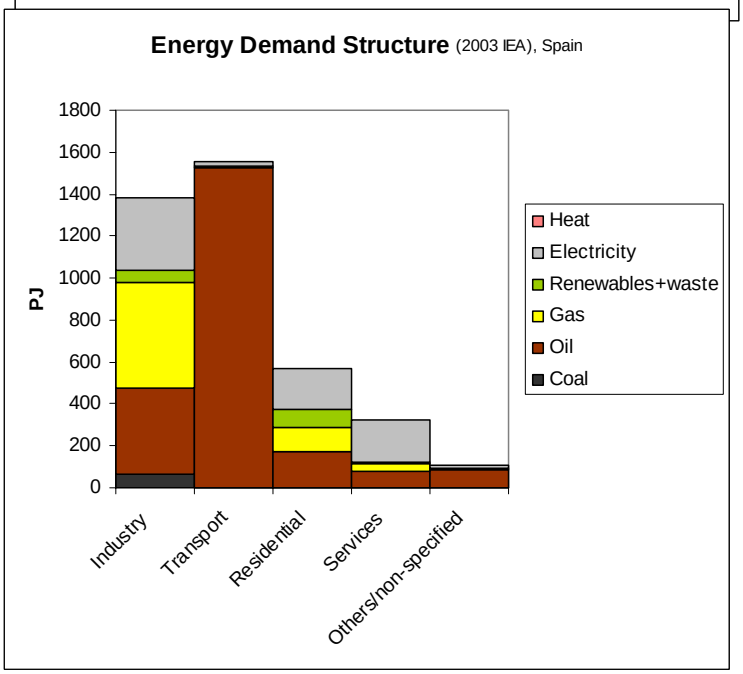
Spain has imported small amounts of electricity in recent years, 1% in 2003 (2003-IEA). District heating is used very little.



The demand structure is dominated by transport and industry consumption. Among industrial sectors, the chemical industry is the largest energy consumer. It accounts for 25% of industrial energy consumption, followed by non-metallic minerals (22%), iron and steel (12%) and food and tobacco (9%) (2003 IEA).

Transport includes aviation, which represents about 12% of transport energy use.
Others/non-specified is primarily non-energy oil use and agriculture.





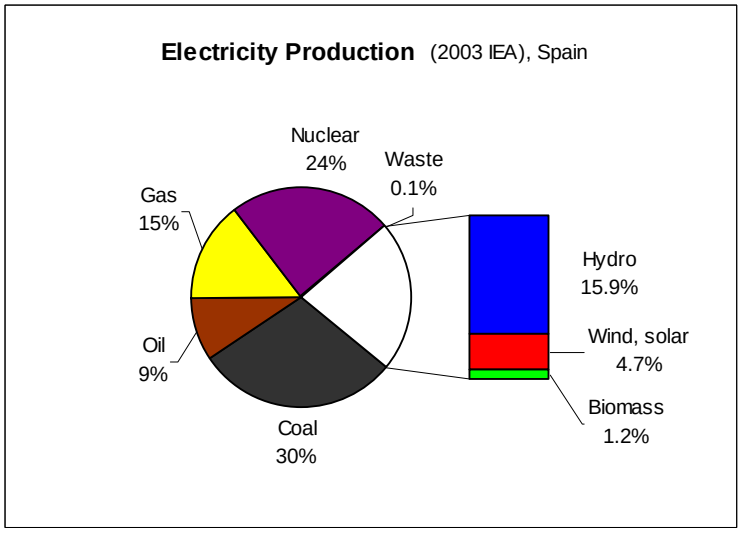
Electric Power Supply

Spain's power-supply structure is dominated by coal power stations that supply 30% of its electricity, followed by nuclear (24%), hydro (16%), and gas (15%) (2003 IEA).
The total production was 283 TWh (2003 IEA).

The efficiency of the power sector is average and the losses in the electricity and CHP sector are 1.4 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is own consumption of electricity in the power sector of 7 % of production.

12% of the power production is from CHP plants.

The electricity distribution losses of 9% are above the EU average (2003 IEA).



Renewable Energy

Spanish renewable energy is mainly generated from biomass, hydro, and, increasingly, windpower.

The largest use of renewable energy is in the form of biomass (2003), of which solid biomass is most important at 88%; liquid biomass and biogas together comprise 12%.

Since 1990, production has been more or less stable, with a small increase since 2000. The main uses for biomass energy are residential, with almost 42% of biomass supply, followed by the industrial sector (where the main users are paper, pulp and printing products, wood and wood products, and food and tobacco products), and electricity plants. 15% of the total energy for residential use comes from biomass.

The second most important renewable energy is hydro. The production has been stable since 1990, with large yearly fluctuations due to variations in rainfall.

Since 1995, wind power has increased from almost nothing to 10,027 MW of installed capacity by the end of 2005. This rise in production has put Spain in the forefront in adopting this technology. Today, Spain holds the second-largest windpower market among the European countries.

Even though bioethanol only makes up a small portion of Spain's renewable energy supply, Spain is the leading country in the European Union in terms of bioethanol output, with a total of 194.000 tons in 2004 (160.000 tons in 2003). In 2004, this was 60% of the total European production. The success of this production is mainly due to Spain's choice not to tax ethanol. With the planning of several large production units, output is expected to increase significantly during the next few years.

The solar market is still small, contributing only 0.5% of Spain's renewable-energy production. In 2004, Spain installed 90,000 m^2 of solar thermal collectors; this market is increasing fast. Spain also increased its PV capacity by 11.8 MW PV in 2004, giving it the third-largest PV market in Europe.

Spain is endowed with good potentials for increased use of renewable energy, for windpower, biomass, solar, and, in the future, also for wave power.

Renewable Energy Promotion and Policies

In Spain, renewable energy is mainly promoted with information, feed-in tariffs, subsidies, and building regulations for solar thermal.
Within the EU, Spain has a national target of generating 29.4% of its electricity from renewable energy (compared with 22% in 2003) to be reached by 2010. The installation rates for renewable energy are close to meeting the target. Spain had a target of 2% renewable energy (biofuels) in transport for 2005, compared with 1.3% in 2004.

National coordination of renewable-energy development is carried out by the Spanish Energy Agency (IDEA). Sixteen regional energy agencies and at least thirteen local energy agencies are involved in information dissemination and in the promotion of renewable energy. Of these, at least 19 receive or have received EU support for their operation, mostly during their establishment and first years of operation (ManageEnergy).

The main support mechanism is feed-in tariffs, where renewable-energy producers can choose between a fixed tariff or the spot market electricity price plus a bonus. The feed-in tariffs for windpower, biomass and small hydro are 90% of a reference tariff (about 7 €c/kWh), while the premium is 40% of the reference tariff (about 3 €c/kWh). The feed-in tariffs are reduced after some time:
- windpower tariff is reduced after 5 years (to 85% of reference) and after 15 years (to 80% of reference); for small groups below 5 MW, the tariff is only reduced after 15 years.
- geothermal electricity tariff is reduced after 20 years to 80% of reference.
- small hydro below 10 MW, tariff reduced after 25 years to 80% of reference value, for hydro 10-25 MW, the reduction takes place after 15 years.
- biomass tariffs are reduced to 80% of the reference tariff after 20 years.

Increasing spot market prices for electricity has made the choice of premium very profitable in 2005 for windpower owners that have chosen this tariff.

For PV, special high tariffs apply of 575% of the reference tariff (about 45 €c/kWh) for installations below 100 kW and of 300% of the reference tariff (about 23 €c/kWh) for larger installations. Both tariffs are reduced after 25 years and the low tariff is also available for solar thermal electric plants.

Tax deductions of 10% of investments are available for companies investing in solar and biomass installations, including biofuels installations. Biofuels are supported by a tax exemption from vehicle tax fuel.
Low-interest loans have also been used to support renewable-energy installations.

With the new building regulations entering into force in 2006, all new and renovated buildings must have solar thermal installations unless it can be proven that this is not cost-effective in the specific case. This favourable legislation is expected to lead to installation of more than 150,000 m^2/ year of solar thermal heating, substantially above previous levels.

The main drivers for the development of renewable energy are national policies. In recent years, increasing prices of imported energies have given an additional impetus to investment in renewables.

A number of barriers have slowed the development of renewable energy. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- Difficulty of obtaining permission for small investors and cooperatives to install windturbines and other larger renewable installations.
- In certain areas, protests against windturbines (but insignificant protests in other parts of Spain).
- Low fossil-fuel prices with little internalisation of external costs via energy taxes.

Geographical Distribution of Renewable Energy
Windpower is mainly installed in northern regions of Spain. Solar and biomass have potential throughout the country, but the best solar potentials are in the dry central parts and in the south. Some of these parts have enough clear sunshine for solar thermal electric installations.

National Allocation Plan for EU Emissions Trading.
The first National Allocation Plan (NAP) was notified to the EU Commission in July, 2004.The European Commission accepted the plan in December, 2004 under condition of smaller amendments, and it was then enforced for the 819 installations covered. It was enforced with the Spanish Law 1/2005, March 2005.
In 2005-2007, the NAP covers the emissions of 174 $MtCO_2$ annually, equivalent to 42% of total GHG emissions in 2003. Credits of 100 $MtCO_2$ annually are given to the electricity sectors, including special allocations of 12 $MtCO_2$ reserved for cogeneration of heat and electricity. (EU NAP and IEA 2005).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

OECD 2005: OECD in Figures, Statistics of the member countries. 2005 Edition.

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EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

EU NAP: EU Commission Climate Change homepage on Emissions trading - National Allocation Plans.

Barometer: EurObserv'er, Systemes Solaire, and EUFORES.

IDEA: Spanish Energy Agency IDAE www.idae.es .

Spanish Government, http://noticias.juridicas.com/base_datos/Admin/rd436-2004.html.

European Wind Energy Association Press release, February 1, 2006: European Record for Windpower.

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Overview and Analysis of National Reports on the Biofuel Directive, Report no. ECN-C-05-042, ECN, Netherlands, 2005.

SWEDEN

Population:
9.0 million (2004)

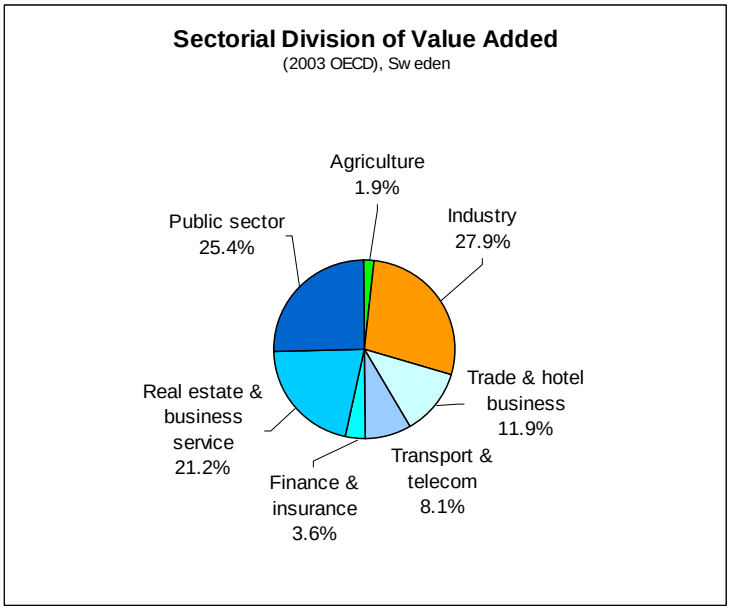
GDP:
279 billion € (2004)
= 31,084 €/capita

Greenhouse-gas emissions:
70.6 million tons CO_2 equivalent (2003) =
7.9 tons/capita

Economic Sectors
Private service sectors contribute 45% of the value added of Sweden, which includes a relatively large real-estate and business-service sector. The public sector (25%) is relatively large compared with the EU average.

The Swedish GDP per capita is 38 % above the average for the EU, while the GDP growth rate is 3.7 in 2004, also above the EU average. The economy is generally in good shape, with an unemployment rate below the average for the EU (6.3% in 2004), a surplus on state finances (1.6% of GDP in 2004), and a positive current account balance in its foreign exchange (6.4% of GDP in 2003) (Eurostat 2005).

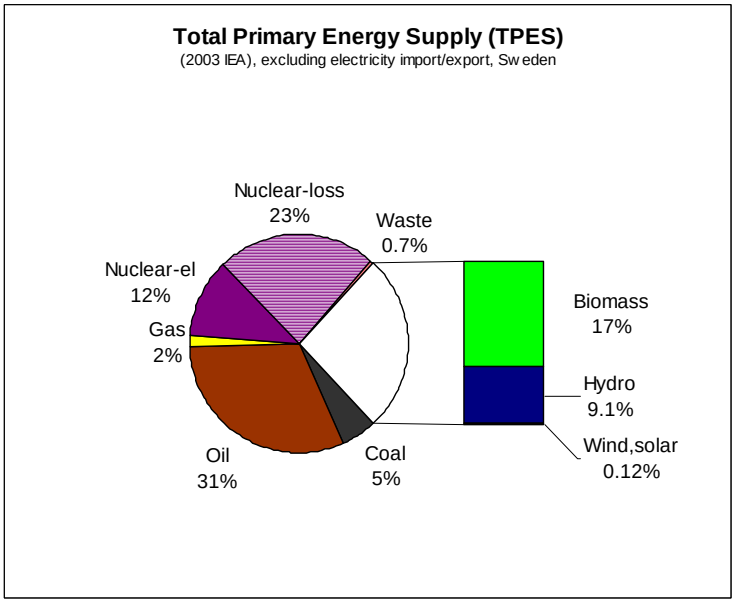
Leading industries are iron and steel, precision equipment (bearings, radio and telephone parts, armaments), wood pulp and paper products, processed foods, and motor vehicles. Prominent Swedish companies include Saab (autos, aerospace and defence); Volvo (motor vehicles); Electrolux (electrical equipment and appliances); IKEA (retail consumer goods); L. M. Ericsson (telecommunication electronics); Svenska Cellulosa (paper); Holmen (paper); and ABB Ltd. (heavy industrial and power equipment).



Energy Supply and Demand
The Swedish energy supply is mainly based on renewable energy, oil, and nuclear, which contribute, respectively, 26%, 31% and 31% of the total primary energy supply (TPES).
The domestic production of coal is 13% of the coal use, while there is no domestic production of other fossil fuels (2003-IEA).

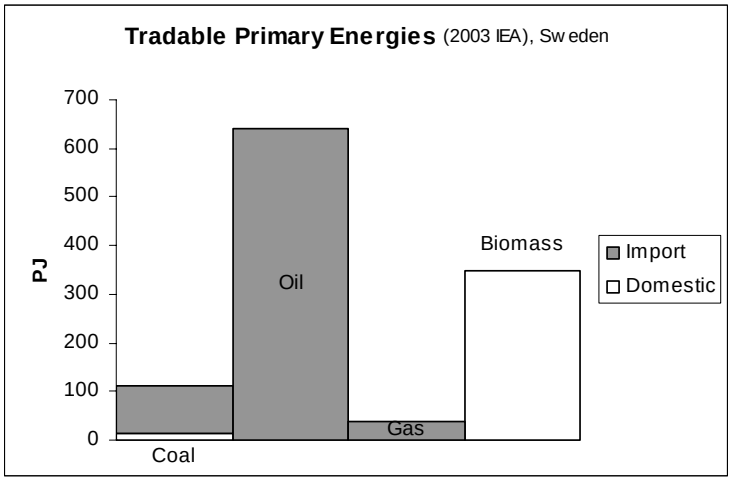
The TPES was 2070 PJ in 2003, not including electricity imports. It decreased by 2.5% in 2002-2003, mainly because of a decrease in hydro production, which was offset with electricity imports.
In the supply structure, oil and electricity are dominant, covering, respectively, 40% and 31% of total final consumption (TFC), followed by gas, covering 2%. (TFC, 2003-IEA).

Sweden has imported electricity in recent years, 10% in 2003 (2003-IEA).
The district heating is used in a level far above EU average, supplying 11% of TFC.

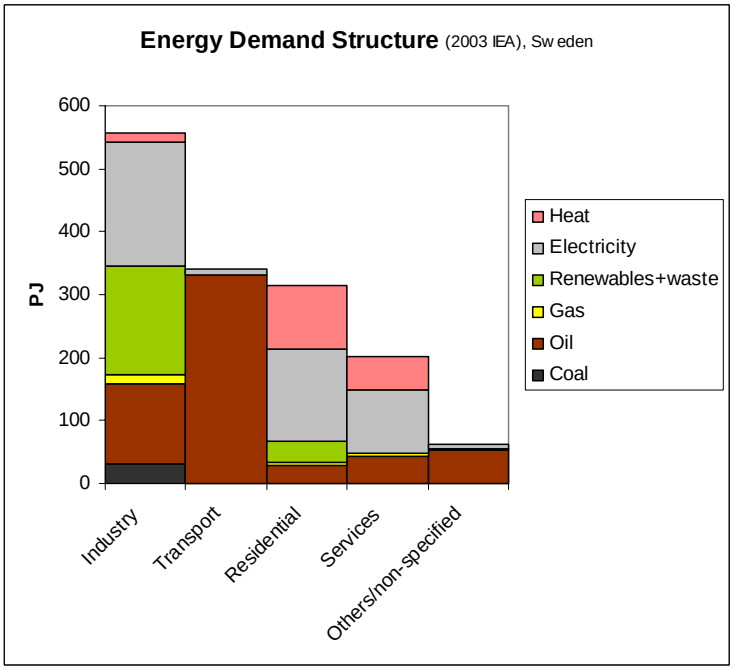


The demand structure is dominated by industry, followed by transport and residential consumption. Among industrial sectors, the paper and pulp is the largest energy consumer. It accounts for 46% of industrial energy consumption, followed by chemical and petrochemical industry (16%), iron and steel (9%), and wood (5%) (2003 IEA).

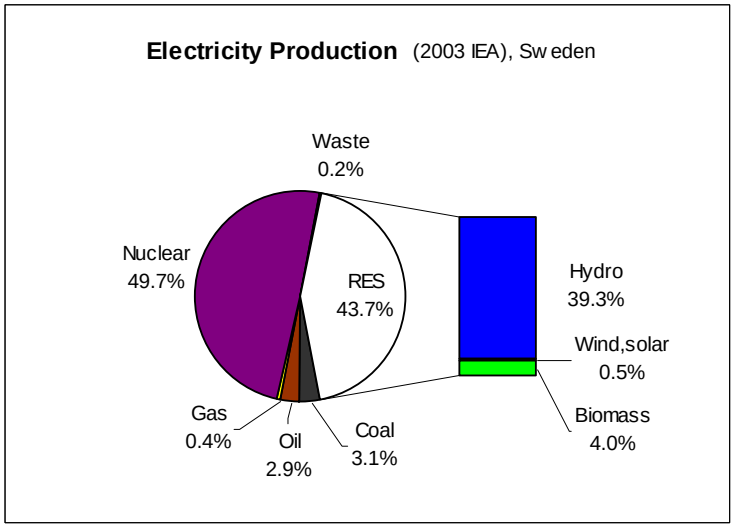
Transport includes aviation, which represents about 9% of transport energy use.
Others/non-specified is primarily non-energy oil use and includes also agriculture and non-specified energy use.



Electric Power Supply
The power supply structure of Sweden is dominated by nuclear and hydro power stations that supply, respectively, 50% and 39% of electricity production, followed by biomass, oil, and coal (2003 IEA). In years with higher hydro production, renewable energy contributes more than nuclear to electricity (5% more in 2002). The total electricity production was 136 TWh in 2003 and 147 TWh in 2002 (IEA).



The efficiency of the power sector is reasonably high with IEA methodology because a large part of the power is from hydro and a part of the rest is from cogeneration of heat and electricity.
The losses in the electricity and CHP sector are 1.0 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Most of the losses are in nuclear power plants, and they also include the power sector's own consumption of 4 % of electricity production.
10% of the power production is from CHP plants.
The electricity distribution losses of 8% are close to the EU average (2003 IEA).



Renewable Energy

The renewable energy in Sweden is mainly generated from biomass and hydro and, to a lesser degree, from renewable municipal waste and from ambient heat used in heat pumps.

The largest use of renewable energy is in the form of biomass (2003), of which solid biomass is by far the most important (98.6%), supplemented with a small amount of biogas (1.4%). There has been an increase in production almost every year since 1990 (an increase of 56% from 1990-2003). Some 42% of the energy produced from biomass is consumed by industry, in particular the paper and pulp sector, which uses wood residues and black liquor, a residue from the pulp industry. This sector is by far the largest industrial sector in Sweden and 60% of the total primary energy used in this sector comes from biomass. Another major consumer of biomass energy is CHP plants and heat plants that consume 42% of the energy produced by biomass. Finally, the residential sector also consumes a good share of the energy produced by biomass (10%).
Sweden is the second-largest producer of primary energy from wood energy in the European Union and also ranks second in the EU in per-capita production of primary energy from wood energy in 2004 (0.92 TOE/capita). There are several causes for this significant development. The rise in oil prices was amplified even more by the tax on carbon that has made wood pellets (for small boilers) and wood chips (mainly for larger boilers) very competitive. In addition, several cities have built CHP plants to provide heat and electricity to the city based on wood, and Sweden is leading in wood-fired CHP in the 10-100 MWelectric size.

The second most important renewable energy is hydro. Production has been stable since 1990 with large yearly variations due to variations in rainfall.

Although use of ambient heat in heat pumps produces less than 10% of the amount of energy that is generated from hydro and less than 5% of that generated from biomass, it is the third most important source of renewable energy in Sweden, and is a growing sector.

Of less significance but increasing steadily each year is the production of energy from renewable municipal waste.

Even though its production of bioethanol is small (52,000 tonnes in 2004), Sweden is the third-largest producer of bioethanol in the European Union. Much of the produced bioethanol, together with imported bioethanol, is mixed in petrol in the ratio of 5%; the mixture is sold throughout most of Sweden for ordinary cars. Sweden is also leading in biogas for transport, but the volume is still small.

There are large potentials for increase in windpower, as well as in use of solid biomass and biogas.

Renewable Energy Promotion and Policies

In Sweden, renewable energy is mainly promoted with electricity certificates, obligations to buy renewable electricity, tax reductions, and information. Subsidies are also used.
Within the EU, Sweden has a national target of generating 60% of its electricity from renewable energy (compared with 44% in 2003 and 48% in 2002), to be reached by 2010. In recent years the installation rates for renewable energy have not been sufficient to reach this target. As there is little room for increase in the hydro production, non-hydro renewables will have to be increased from 3% to about 15% of electricity production by 2010 to reach the target. A biofuels target for 2005 was 3%, compared with 1.3% biofuel use in transport in 2004.

The main support system for electricity is a green certificate system. Electricity consumers are under obligation to buy a certain quantity of green electricity, which in turn creates a demand for certificates. The amount of renewable electricity, excluding hydro above 1.5 MW, should rise from 7.3% in 2003 to 16.9% in 2010, following the above target. The price for the renewable certificates is expected to be in the range of 1.3-1.6 €cent/kWh. The uncertainty of the certificate price combined with the uncertainty of the electricity price on the power pool results in unattractive uncertainties for investors. Current considerations of allowing imports of certificates, e.g., from Norway have only increased these uncertainties.

A transition scheme provides additional support for windpower until 2007.

Tax incentives are currently the most important tool in support of renewable energy. Sweden has taxes on fossil fuels and electricity, partly as a CO_2 tax of 610 Skr/ton of CO_2, (about 60 €/ton of CO_2). There are no energy taxes on renewable energy.
There are also reduced taxes for cars using biofuels.

Sweden has introduced procurement of renewable energy, whereby public institutions and others buy renewable energy and biofuel vehicles. This creates volume in the market and more attractive prices.

In addition there is a 15% subsidy on windmill investments.

The national coordination of the renewable energy development is carried out by STEM, the Swedish Energy Agency, www.stem.se.

Information dissemination and promotion of renewable energy is done by 12 regional energy agencies, of which eleven are or have been supported by the EU for their operations, mostly during their establishment and first years of operation (ManagEnergy)

The main drivers for the development of renewable energy are national policies and increasing prices of imported energies.

A number of barriers have slowed the development of renewable energy. The main barrier to development is that the support mechanisms for renewable electricity are not strong enough and are too uncertain to drive the development. A change in the support system for renewable electricity in 2003 has caused some uncertainty.

Geographical Distribution of Renewable Energy
Biomass is used throughout the country, while the largest hydropower plants are in the north of the country and electricity is sent from north to south in Sweden.

National Allocation Plan for EU Emissions Trading.
The first National Allocation Plan (NAP) was notified to the Commission in April, 2004.
The European Commission accepted the plan in July, 2004, and the plan was then enforced for the 499 installations covered. In 2005-07, the NAP covers the emissions of 22.9 $MtCO_2$ annually, equivalent to 31% of total GHG emissions. Annual credits of 14 $MtCO_2$ on average are given to the energy sectors (IEA 2005 and EU NAP).

Sources and Information:

2003 IEA: International Energy Agency, Energy Balances for OECD Countries, 2005 Edition (2003 data). Figures converted from Mtoe to PJ and graphs made by authors.

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EU 2004: The share of renewable energy in the EU, Country Profiles. Overview of Renewable Energy Sources in the Enlarged European Union. COM(2004)366 final. Commission Staff Working Document. European Commission, Bruxelles, 2004.

IEA 2005: Renewable Energy – Market and Policy Trends in IEA Countries. International Energy Agency, 2005.

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ManageEnergy, Energy Agency Map, EU DG TREN, Directorate General for Energy and Transport.

Overview and analysis of National Reports on the EU Biofuel Directive. ECN-C-05-042, 2005.

UNITED KINGDOM

Population:
59.67 million (2004)

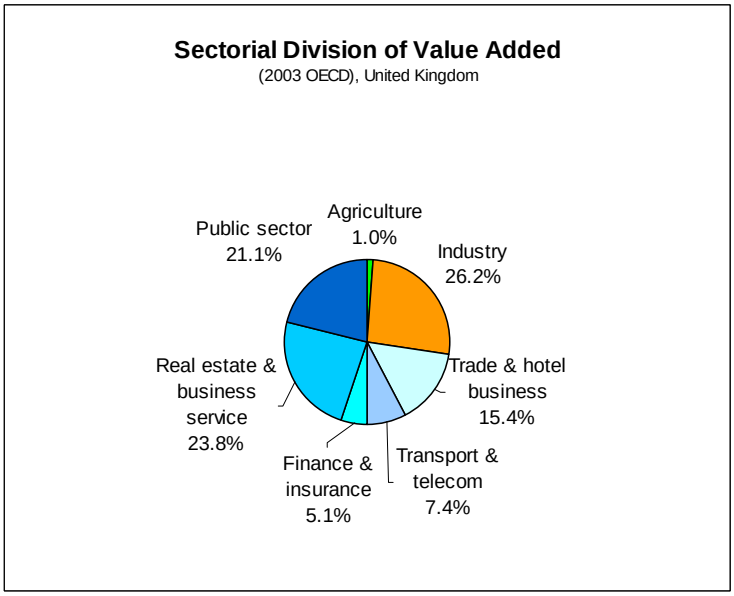
GDP:
1,715 billion €
(2004) =
28,740 €/capita

Greenhouse-gas emissions:
651.1 million tons CO_2 equivalent
(2003) =
10.9 tons/capita

Economic Sectors
Private service sectors contribute more than half of the value added of the UK. Agriculture contributes only 1 % of the value added, which is one of the lowest values in the EU.

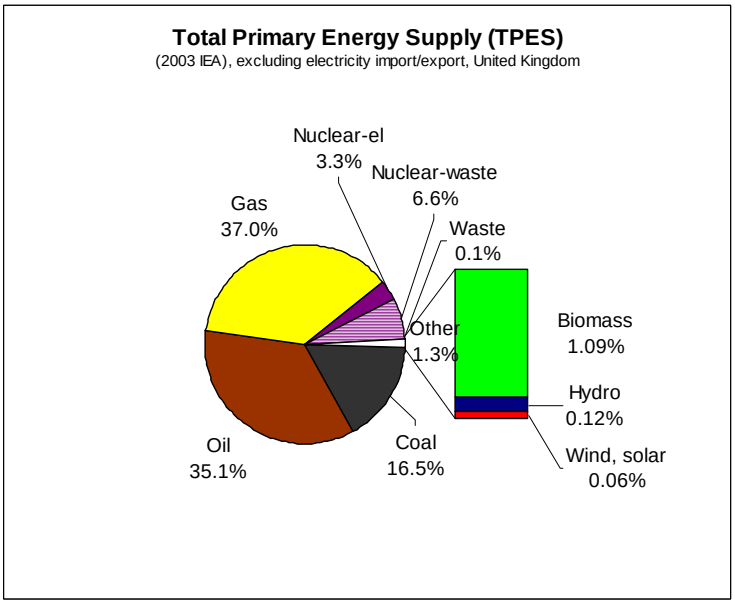
The UK economy is the second-largest in the EU. It contributed 17% to the EU GDP. The GDP per capita is 28% above the average of the EU. The UK has the lowest unemployment rate in the EU (4.7 % in 2004), smaller balance problems with deficit of state finances (-3.1% of GDP in 2004), and a slightly negative current account balance in its foreign exchange (-1.7% of GDP in 2003) (Eurostat 2005).

Geographically the heavy industries, steelworks, chemical industries, coal-fired power stations and heavy engineering including shipbuilding are concentrated in northern and central England, South Wales, and industrialised parts of southern Scotland and Northern Ireland. These are areas where coal and iron ore were originally mined. Banking, finance, IT companies and the head offices of service-sector industries are mostly based in London and southeastern England. Arable agriculture is mainly in eastern parts of the UK where it is drier and soils are of better quality. Tourism is important in London and many scenic rural and mountain areas, plus some coastal resorts.



Energy Supply and Demand
The UK energy supply is dominated by gas and oil which contributes, respectively, 35 and 37 % of the total primary energy supply (TPES), followed by coal (16%).
Domestic production of oil and gas has covered the demand in the recent years and UK has been a small exporter of them. This is changing now, and in 2004 UK became net importer of gas. Total indigenous UK production of natural gas in the third quarter of 2005 was 14.2% lower than in the corresponding quarter a year earlier.
The UK still has domestic coal production but 56 % of coal supply is imported

The UK had a steady increase of 1%-3 % electricity production in recent years; in 2003 it increased by 3 % to 395 TWh. (2003-IEA). District heating is used, but it is only 1.1 % of TFC.



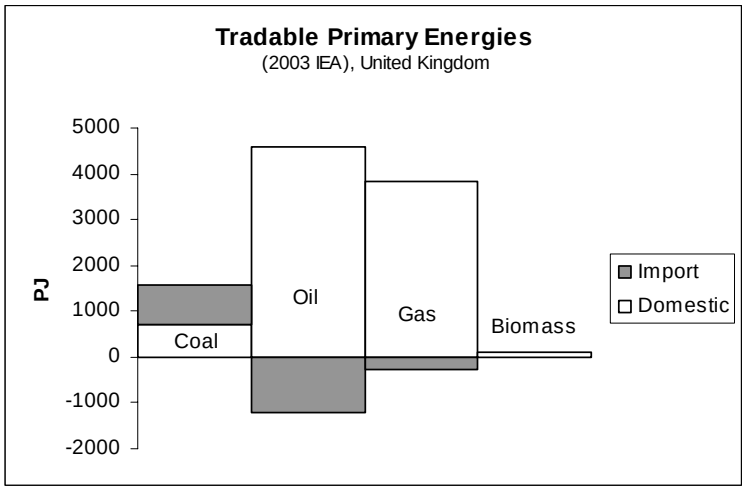
The TPES was 9,572 PJ in 2003, not including electricity imports from France.
It has remained stable since 1999, combining a slow decrease of the industrial energy consumption and a slow increase in transport energy consumption.

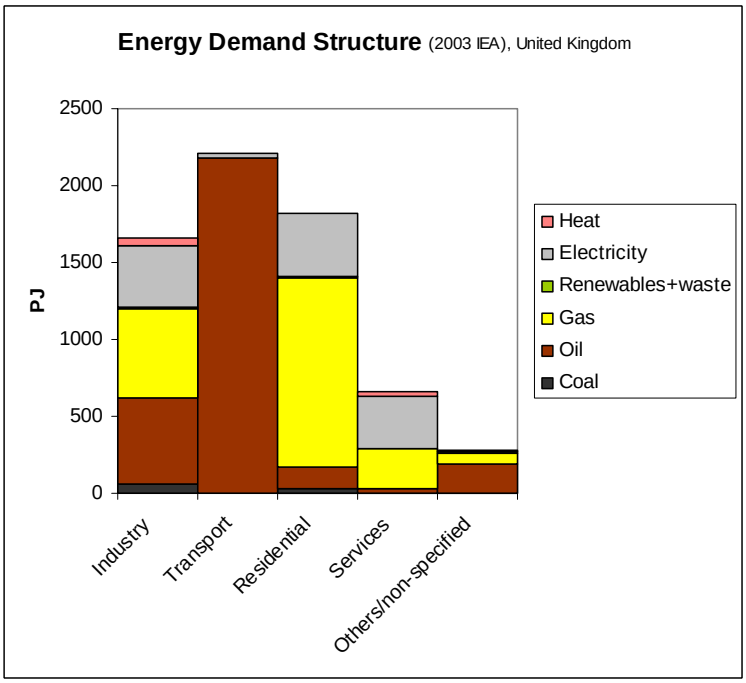
In the demand structure the largest sector is transport (33% of TFC) followed by residential (27%) and industry (25%). Among industrial sectors the chemical and petrochemical is the largest energy consumer, accounting for 35% of the industrial energy consumption. This is followed by machinery and transport equipment (10%), food and tobacco (8.8%), iron and steel (7.6%), and paper and pulp (6%) (2003 IEA).

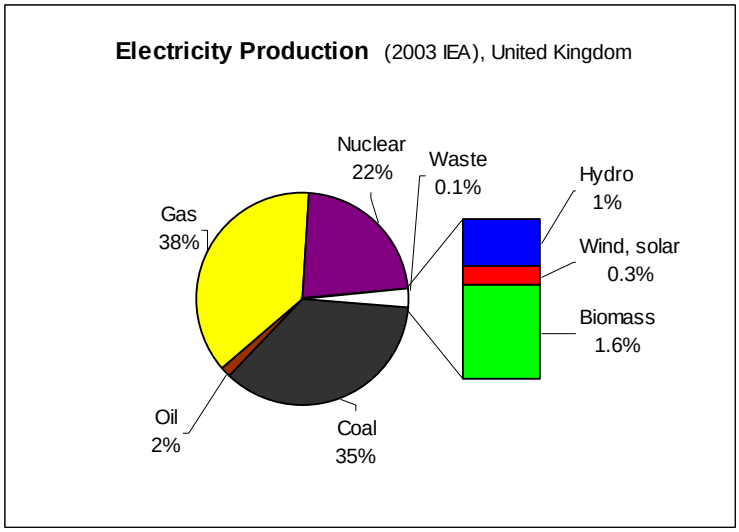
Transport includes aviation, which represents about 21 % of transport energy use.
The others/non-specified is primarily non-energy oil use, and includes also agriculture, and non-specified energy use.

Electric Power Supply
The UK power supply structure is dominated by gas (37%), coal (35%), and nuclear (22%) power stations. (2003 IEA). Since 1991 the share of coal decreased from more than 60% to 35% while that of gas increased from almost nothing to 38%.

The efficiency of the power sector is low, as cogeneration of heat and electricity is not usual and losses in the electricity and CHP sector are 1.7 times the useful production of electricity and heat delivered to the grids, according to IEA methodology. Included in losses is the power sector's own consumption of 7.5 % of electricity production. 6% of the power production is from CHP plants, most of which are on-site generators for industry.
The electricity distribution losses of 7.5 % are close to the EU average (2003 IEA).







Renewable Energy

Biogas and landfill gas - The UK is the European leader in biogas in the form of landfill gas, which is widely used in the UK. There is some production of biogas from sewerage works and one centralised biogas plant at Holdsworthy in Devon, which is supplied with animal slurry from local farms. In most cases the gas is used to generate electricity, which qualifies for financial support of currently £50 /MWh through Renewables Obligation Certificates (ROC's), plus the traded market value of electricity, approximately £30/MWh base load price. The electricity base load price has doubled since 2002 [£1 Sterling = €1.5 euro)
Landfill gas production increased almost 6 times during the period 1990-2003; there is still room for further development and for increases in efficiency. Most new UK landfill sites are constructed to enable the methane generated to be collected and used for electricity generation after the site has been capped. However, there is a growing shortage of landfill sites, which are not welcomed by local people as they can have a damaging effect on the local environment, e.g., through contamination of groundwater.

Biomass - Second-largest in the use of renewable energy is biomass (wood fuel and, to a lesser extent, energy crops), the use of which more than tripled during the period 1990-2003, but which still only represents 1% of TPES. This includes wood fuel for domestic heating (wood-burning stoves, etc., which are popular in rural areas) and, since 2002, price support for electricity generated from co-firing biomass in existing coal-fired power stations. There is an increasing number of biomass district heating schemes supported by UK Government funding, mainly based on wood chips from sawmills and forestry operations. There is a very small market for wood pellets in the UK, with 3 manufacturers supplying the market plus some pellets imported from France, Austria and Northern Ireland.

Wind Energy - In 2004, onshore and offshore wind energy together accounted for 0.49% of electricity generated in the United Kingdom, up from 0.32% in 2003. During 2004, renewable energy sources accounted for 3.58% of the electricity generated in the UK, up from 2.67% in 2003. By the end of 2005, the UK has an installed capacity of 1337 MW windpower.
The UK target is to produce 10% of electricity from renewable energy sources by 2010, backed by the Renewables Obligation, a market-based penalty and reward system described in more detail in the main UK section of this report. The current assessment is that 4% of UK electricity could be generated by onshore wind farms by 2010, plus a further 3% from offshore wind farms. There are regional differences due to variations in the wind energy resource, for example, wind energy provided 2.4 % of Scotland's electricity generation in 2004, compared to 0.49% for the UK as a whole. Scotland benefits from 25% of Europe's wind energy resource and has a target to produce 20% of electricity consumed in Scotland from renewable energy by 2010.

Solar energy - There has been a low uptake of solar thermal in the UK, approximately 20,000 m2 per year in 2003 and 2004.The total installed area in December, 2005 was approximately 250,000m^2, partly due to lack of a good solar resource, especially in winter months, and to a lack of significant government funding to help kick-start the industry.
Solar photovoltaic installations totalled 1.9MWp in the UK in 2004. The total area of PV installed in the UK at the end of 2004 was 7.8 MWp. Solar PV has been supported since 2002 by 50% capital grants for installations on houses and public buildings with an initial budget of £20m over 3 years. There is no premium price for solar PV exported to the grid other than the Renewable Obligation Certificate price offered to all renewables generators at the same rate. However, after grant and sale of ROC's, a PV system in the UK will have a 40-year simple payback time at 2005 electricity prices, hence the relatively low uptake.

Renewable Energy Promotion and Policies
In the UK, renewable energy is mainly promoted with information along with a complex mixture of subsidies and market-based obligations to buy renewable electricity. Within the EU, the UK has a national target of generating 10% of its electricity from renewable energy (compared with 2.67 % in 2003), as well as a target of 5.75% biofuels for transport, both to be reached by 2010. In November, 2005, the UK Government announced a Biofuels Obligation on transport fuel suppliers, with certificates to prove compliance and penalties for failure to supply the target percentage of biofuels in any year, similar to the Renewables Obligation Certificates (ROC's) for the electricity market.

The original UK target was to provide 10% of electricity demand from new renewable energy sources, but the 10% by 2010 target has been changed to include existing older large hydroelectricity installations, mainly in Scotland, which supply 1.5 % of UK electricity demand.

The promotion and national co-ordination of renewable energy development are carried out by the national UK Government, through the Department of Trade and Industry (DTI), the Department of the Environment, Farming and Rural Affairs (DEFRA) and the Office of the Deputy Prime Minister (ODPM). In practice, funding for local promotion of renewable energy is devolved to regional governments in Wales and the English regions. The Energy Saving Trust with funding from the DTI manages a network of 52 regional Energy Efficiency Advice Centres, mainly promoting energy saving to the household and small business sectors, but currently in the process of reorganisation into 26 larger regional Sustainable Energy Centres, which will include renewable energy and sustainable transport local advice. In addition, there are several local Energy Agencies in the UK, most established under the European SAVE II programme, which provided a contribution towards core funding for 3 years. Energy Advice Centres and Energy Agencies can be either linked to Local Authorities or independent organisations and are usually not -for- profit companies. They are considered very successful as a means of providing advice at a local level, delivering national projects on a regional basis, developing links and providing independent advice to local organisations such as schools, social housing providers, Local Authorities and nature conservation bodies. Many of these Energy Advice Centres develop projects and secure funding for local demonstration projects, often with international partners through EU funding.

There are several financial support measures that operate throughout most of the UK, such as Renewables Obligation Certificates for renewable electricity, 30% grants towards the capital cost of biomass heating and CHP equipment, grants for farmers for 50% of the establishment costs of energy crops such as willow and miscanthus (elephant grass), tapering financial support to set up biomass energy supply networks and businesses (£3m total budget for the UK over 3 years), capital grants towards the cost of offshore wind energy projects (£60m initial budget, half of which was provided by revenue from the National Lottery), support for other marine renewables and a reduction in road fuel duty of £0.20/litre for eligible biofuels.

There is some financial support for householders, schools, environmental and community organisations to install renewable-energy systems, (except PV) with a total budget for England and Wales of £10m over 3 years, likely to be extended for a further period after April 2006.
Photovoltaic installations qualified for 50% capital grants with a budget of £20m over 3 years.

There is a partial vehicle fuel tax exemption for biofuels.

The main drivers for the development of renewable energy are national policies and, increasingly, EU policies and international agreements such the Kyoto Accord. In recent years, rising prices of imported energies have given an additional impetus to investments in renewables, along with widespread public concern over the potential negative impacts of climate change.

A number of barriers have slowed the development of renewable energy. The barriers can be grouped into a number of categories:

- Little knowledge of the new technologies and low awareness of the benefits of changing to renewable energies. This is a general issue for introduction of new technologies.
- A centralised electricity grid and supply network, which although liberalised and theoretically open to competition is controlled by a small number of multinational players who have no commercial interest in connecting independent or local renewable energy generators.
- There has been a long running and hostile campaign against wind energy in the UK, which has caused planning delays and often polarised opinion in rural areas where wind farms are proposed. Local people are concerned about the visual appearance of wind turbines, possible noise, house price devaluation etc. There is also opposition because of the financial support provided to large outside companies developing the wind farms and few local benefits. However the results over 50 independent public opinion polls show that typically 75% of people living within 3 miles of wind turbines like them and would favour more wind energy developments. (reference: Sustainable Development Commission “Wind Power- Your Questions Answered” www.sd-commission.org.uk.)

Geographical Distribution of Renewable Energy

Biomass and solar installations are located throughout the country, although since 2002 biomass production has been concentrated near existing coal-fired power stations where biomass is co-fired with coal in order to gain Renewables Obligation Certificates. Hydropower and onshore windpower have mainly been developed in Scotland and the western half of the UK where the best wind speeds are found (higher than an average 6m/s). Some wind-energy sites in Scotland have mean wind speeds in excess of 8m/s and can produce electricity at approximately £0.02/kWh (3 euro cents/kWh), more cheaply than combined-cycle gas turbines.

The UK government has selected areas off the coasts of northwestern and eastern England for large-scale offshore windfarm developments. Most regions of the UK now have plans and targets for development of local renewable energy capacity in line with the national target of 10% of electricity demand from renewable energy by 2010.

National Allocation Plan for EU Emissions Trading

For the period 2005-2007, the first National Allocation Plan (NAP) was submitted to the European Commission in May, 2004. The European Commission approved the first NAP in July, 2004 on conditions of some technical amendments. A new NAP was submitted in November, 2004 and a revision was submitted in February, 2005 including an increase in allocations of 18.9 $MtCO_2$. The European Commission rejected the second plan in April, 2005.

In spite of the rejection, the UK government published the final version of the NAP in May, 2005.

In November, 2005 the European Court nullified the Commission's decision of rejection of the UK NAP.

In 2005-07, the NAP covers the emissions of 252 $MtCO_2$ annual average, equivalent to 38 % of total GHG emissions. This is estimated to be 8% below the projected emissions of the 1,978 installations covered. Allocations of 176 $MtCO_2$ are given to the energy sectors, including off-shore emissions and allocations to new entrants. (DEFRA 2005)

The National Allocation Plan for EU Emissions trading and the potential impact of the Emissions Trading market on UK renewable energy development is discussed in more detail in the main section of the UK report.

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