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Energy statistics to support EU policies and solutions

2007 edition

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Foreword

Energy has become an item of top priority on the political agenda. The increase in energy prices, the interruption of Russian natural gas imports in early 2006, the impact of energy market liberalisation, the impact of energy consumption on the environment and the entry in force of the Kyoto protocol have all made the energy situation a focal point of attention.

Not surprisingly, the general public is increasingly concerned with the EU energy situation. Both politicians and European citizens are reflecting on the best road forward to ensure a stable and environmentally friendly supply of energy for the future.

There is a clear need for a comprehensive informative overview of the EU situation which this publication aims to fulfil. It endeavours to answer a broad range of questions relating to both the energy situation and EU policy using the latest official statistical data available at Eurostat.

We hope that this publication will contribute to a wider understanding of the EU energy situation, energy policy, and in particular help to face challenges in the field of energy statistics.

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1.1 Energy profiles

Introduction

With 25 Member States (27 from 2007) the European Union encompasses a wealth of diversity which is far more than cultural; the economic situation in each of the Member States shows considerable differences.

Consequently, in this publication on energy we give a short description not only on the energy situation of the EU as a whole, but also of the individual members. We hope that this may offer the reader an insight into the specificities of Member States, and therewith also into the challenge of building EU energy policies to suit all, and on which we will concentrate in the next chapter.

Data used for the country overviews are Eurostat 2004 data, unless stated otherwise; we used many national sources both for data and for policies and wherever applicable these sources will be referenced.

1.1.1 Energy profile of the EU-25

The opening of energy markets across the EU during the past 10-15 years marks a transition from a heterogeneous collection of national energy systems to an integrated system in which supply and demand can be more efficiently balanced for the benefit of the whole Community. Innovative energy efficiency programs have contributed to reductions in energy intensity and stimulated the development of new products and services. The liberalisation of energy markets in combination with strategies and targets for environmental sustainability are key tools in the energy transition that is underway in the EU.

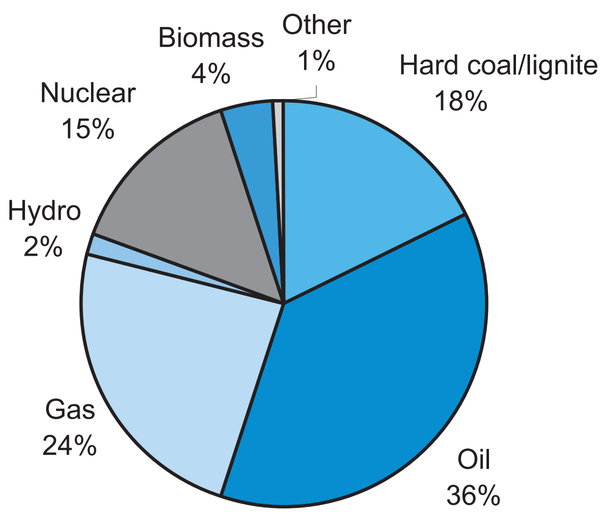
The current energy structure within the EU remains heavily dependent on fossil fuels, including a significant amount of imported oil and gas. A reduction in the reliance on imported fossil fuels is a vital element in the transition to a sustainable and secure energy system; this transition is already reflected in the policy instruments and patterns of investment of recent years, with the strong emphasis on low carbon energy sources, particularly natural gas, biomass, and wind. The EU leadership role on renewables and climate change is also helping to transform global markets and policies.

Primary energy system

The EU is dependent on fossil fuels for 79% of its gross inland consumption, with much of the remainder consisting of nuclear and biomass (Figure 1.1.1). Although some sources, particularly wind, have grown at very high rates in recent years, they still represent only a small share of primary supply, due to the dominance of oil for transport, and of coal and gas in the power sector. The very substantial growth of natural gas consumption, the plateau in coal consumption and the rise of new renewable forms of energy are among the major structural changes in supply during the past 10-15 years.

The dependence on imported fossil fuels is greatest in the case of oil; domestic sources accounted for only 20% of oil consumption in 2004. 46% of natural gas consumption came from domestic sources, while this was the case for 61% of solid fuels. Of the domestic production of solid fuels, 62% was hard coal and 38% lignite. Net imports of all energy sources amounted to 52% of total gross inland consumption in 2004.

Figure 1.1.1: Gross inland consumption by fuel



Electric power sector

Demand and generation of electricity within the EU were roughly in balance, with only a very small net export of 422 GWh.

The growing concern over environmental impacts, particularly climate change, along with the market opening in the power sector have contributed to a number of shifts in the sources of supply during the past 10-15 years. Until the past 5-10 years, wind capacity was insignificant, but as of 2004 it represented about 5% of total capacity. The capacity of thermal, hydro, and nuclear-which had long provided the foundation for EU power supply-all decreased in share (Figure 1.1.2).

The supply mix has become more diverse; in 1990, two sources-solid fuels and nuclear-accounted for about 70% of power generation, whereas by 2004, these two sources supplied only 60%. Natural gas has become the main fuel of choice at the margin; the share of natural gas in power production increased from 7% to 20% between 1990 and 2004 (Figure 1.1.3). Due to robust electricity demand during much of this period, all fuels except oil registered an absolute increase; the use of oil for power generation has been reducing gradually ever since the oil crises of the 1970s.

Figure 1.1.3: Electric power generation by source (GWh)

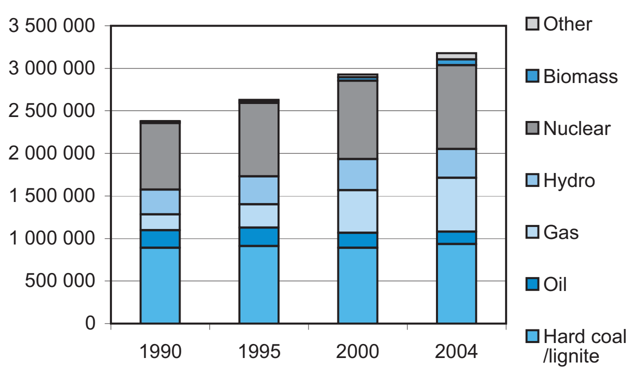
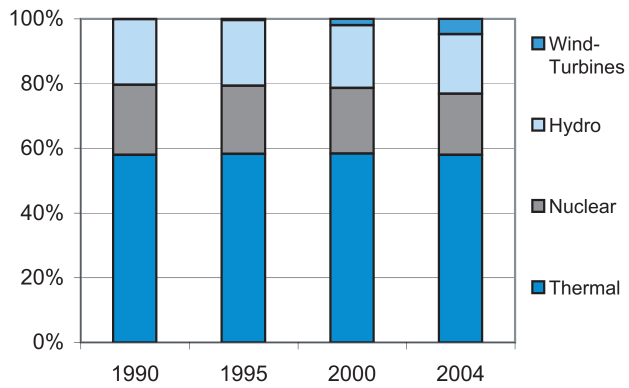
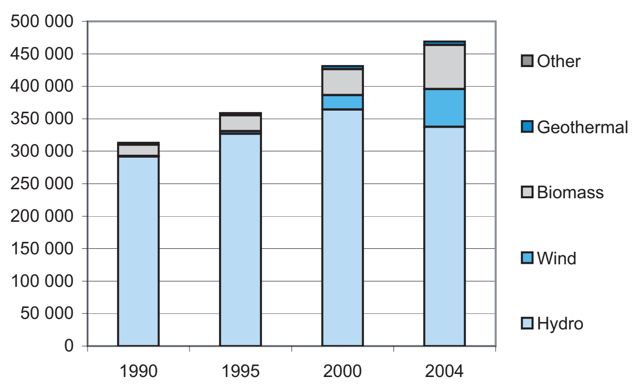


Figure 1.1.2: Net installed capacity of electricity generating plants, in MW



Before the 1990s, the overwhelming majority of renewable energy in the power sector was hydro-based; large hydropower plants that were built several decades ago provided the only major contribution to electricity generation. Some countries had initiated bioenergy programmes in the 1980s, but their total contribution remained small. In the 1990s, several renewable technologies were mature and policy support mechanisms had evolved sufficiently so that major commercial investment could accelerate considerably. A renewables revolution was launched in the EU, with wind and biomass leading the way. The share of wind, biomass, and geothermal electricity increased by a factor of four from 1990 to 2004 (Figure 1.1.4). The share of hydro among all renewables decreased from 93% to 72% over this period, whereas the share of wind increased from almost nil to 12% and the share of biomass increased from 5% to 14%.

Figure 1.1.4: Electricity generation from renewables (GWh)



Natural gas

The expansion of natural gas markets has brought major changes in the structure of EU energy systems. As a relatively clean fuel, it has contributed to lower greenhouse gas emissions as well as reductions in other environmental impacts associated with oil and coal. The maturity of technology for natural gas infrastructure-including terminals for liquefied natural gas-facilitated rapid market development throughout the EU. The opening of the gas and electricity markets has helped to facilitate competition between fuel types as well as among suppliers for a given fuel type. End-use market shares for gas are significant across all sectors; industry, households, service sector, electric power stations, and chemical feedstocks are all major end-users (Figure 1.1.5).

In terms of dependence on imports, natural gas has increased the dependence slightly, since more than half of gas is imported. Russia is the main source of imported natural gas, followed by Norway and Algeria. As the gas grids become more and more connected, it should become easier to balance supply and demand across the EU. However, some countries are still dependent for their entire gas supply on a single supplier country-Russia. The supply routes and policies of transit countries can therefore become critical in avoiding supply disruptions.

Biofuels for transport

Yet another transformation is taking place with the expanded use of liquid biofuels in the transport sector, albeit starting only in the past few years. Production and use of biofuels increased by more than 3-fold between 2000 and 2004; much of this is biodiesel produced in Germany, France, and Italy, which together accounted for 90% of total EU production.

Production of bio-ethanol in the EU has increased by more than 3-fold since 2000 (Figure 1.1.6). The situation with bio-ethanol is different than bio-diesel, since production of bio-ethanol within the EU is much more expensive in comparison to developing countries that can make ethanol from sugar cane, which is currently the lowest cost feedstock. Consequently, the EU is a very small producer in terms of total global production, which is dominated by Brazil and the U.S. Consumption in the EU has been increasing much faster than production; most of the ethanol currently used is thus imported. In the future, ethanol could be produced from lignocellulose, which would greatly expand the availability of biomass feedstocks; EU-level research is directed at commercialisation of such "next-generation" technology (1). Three pilot plants have been established for ethanol from lignocellulosic biomass, one each in Denmark, Spain, and Sweden (2).

Figure 1.1.5: Natural gas use by sector

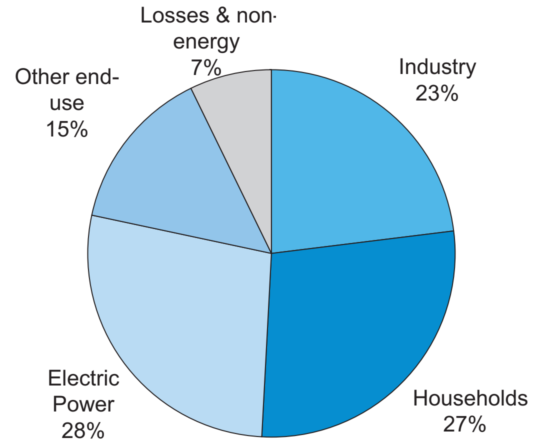
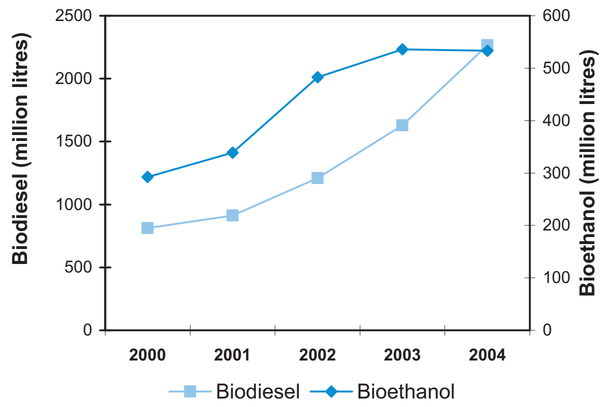


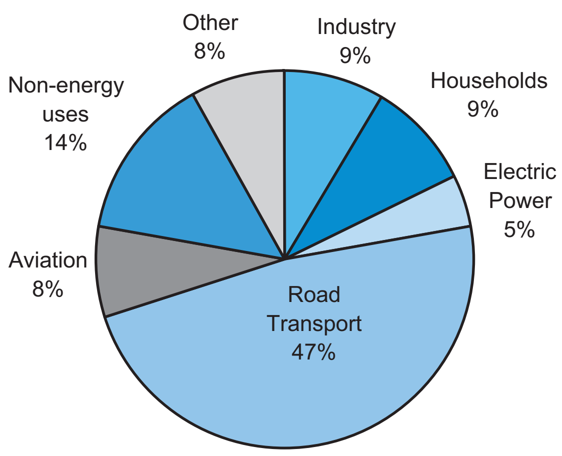
Figure 1.1.6: EU-15 biofuels productions



Petroleum products

Much of the imported oil ends up as transport fuels for road transport and aviation, which together accounted for about 55% of the consumption of petroleum products in 2004 (Figure 1.1.7). Transport has also been the main source of growth with respect to oil consumption, as oil use in the other end-use sectors has generally been declining. Non-energy uses accounted for about 14% of the total; such uses are sometimes referred to as "noble" uses of petroleum, since alternatives are often non-existent or costly, although such a characterisation is becoming less relevant with the availability of bio-plastics and other petroleum substitutes. It is also important to note that nearly 25% of oil use is in sectors where other alternatives may be available-namely in households, power production, and in industry. EU policies for reducing oil dependence therefore address the non-transport sectors as well; substitution for oil in non-transport uses may be easier and less costly than substitutions in transport.

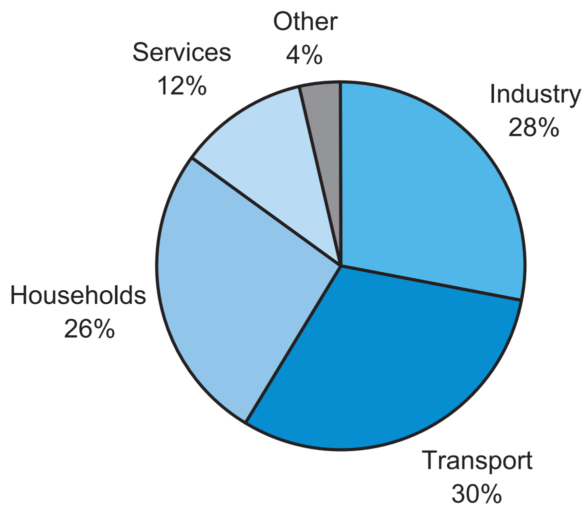
Figure 1.1.7: Petroleum products use by sector



Structure of energy demand

Final energy consumption is dominated by industry, transport, and households, which together accounted for over 80% in 2004 (Figure 1.1.8). Within the transport sector, the overwhelming majority - about 83% - of energy use is for road transport. However, aviation, currently at 13%, has been growing rapidly, and has contributed to increased greenhouse gas emissions. The ‘other’ category includes the relatively small amount of energy use in the agricultural sector, which amounted to about 2.5% of total final consumption in 2004.

Figure 1.1.8: Final energy consumption by sector



Electricity consumption is dominated by industry, which accounted for 41% of the total; households accounted for 29% and the service sector accounted for 27%. The fact that electricity consumption in industry still far exceeds the consumption in the service sector suggests the continued importance of the industrial segment of the economy, in spite of the increasing importance across the EU of a services-oriented economy. Industrial sector energy consumption is dominated by a few energy-intensive sectors, namely iron & steel, chemicals, engineering products, and building materials. The energy intensity of these sectors will be under closer scrutiny in the future, due to concerns about competitiveness as well as greenhouse gas emissions. These sectors already participate in the EU emissions trading scheme (ETS) and have been undergoing a process of restructuring towards lower carbon burdens and more streamlined and energy-efficient processes.

EU-25 - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	**Total all products**	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	882 301	118 602	71 868	134 260	2 167	192 232	-	254 361	-	108 811	-	-
Recovered products	7 484	1 282	-	2 190	748	-	-	-	3 264	-	-	-
Imports	1 363 138	149 602	719	638 337	261 047	288 096	-	-	-	1 496	4	23 837
Stock change	-1 717	-568	1 537	-2 593	2 019	-2 114	-	-	0	2	-	-
Exports	455 922	30 591	499	89 614	249 593	60 633	-	-	-	1 116	3	23 873
Bunkers	48 404	-	-	-	48 404	-	-	-	-	-	-	-
Gross inland consumption	1 746 880	238 328	73 626	682 579	-32 017	417 581	-	254 361	3 264	109 194	0	-36
Transformation input	1 469 027	220 163	72 631	730 864	29 069	121 639	8 619	254 361	2 472	29 207	-	-
of which: Public thermal power stations	*24%*	*67%*	*94%*	-	*74%*	*78%*	*56%*	-	*34%*	*55%*	-	-
Autoprod. therm. power st.	*3%*	*4%*	*2%*	-	*19%*	*16%*	*41%*	-	*60%*	*34%*	-	-
Nuclear power stations	*17%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*3%*	*21%*	*0%*	-	*1%*	*0%*	-	-	-	-	-	-
Refineries	*50%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	1 073 091	34 003	2 873	-	721 304	-	22 423	-	-	-	53 151	239 337
of which: Public thermal power stations	*15%*	-	-	-	-	-	-	-	-	-	*55%*	*56%*
Autoprod. therm. power st.	*2%*	-	-	-	-	-	-	-	-	-	*5%*	*8%*
Nuclear power stations	*8%*	-	-	-	-	-	-	-	-	-	*0.2%*	*35%*
Coke-oven plants	*4%*	*99%*	-	-	-	-	*35%*	-	-	-	-	-
Refineries	*67%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	3 551	-	-	47 433	-43 823	-	-	-	-	-31 225	-	31 166
Consumption of the energy branch	87 170	692	302	17	41 198	13 335	4 348	-	9	99	2 387	24 782
of which: Prod. and distrib. of electr.	*16%*	-	-	-	*0.1%*	*0.2%*	-	-	-	-	*7%*	*54%*
Oil refineries	*54%*	-	-	-	*99%*	*19%*	-	-	*59%*	-	*14%*	*13%*
Distribution losses	25 223	-	-	-	-	2 899	667	-	-	-	4 016	17 642
Available for final consumption	1 242 102	51 475	3 565	-868	575 198	279 708	8 788	-	783	48 663	46 748	228 042
Final non-energy consumption	101 147	1 251	134	-	86 267	13 462	33	-	-	-	-	-
Final energy consumption	1 141 968	49 387	3 208	12	488 069	268 067	8 864	-	783	48 657	46 917	228 004
Industry	319 211	39 775	1 928	12	51 584	95 838	8 779	-	745	15 940	10 950	93 661
of which: Iron & steel industry	*19%*	*68%*	*1%*	-	*5%*	*11%*	*96%*	-	*5%*	*0%*	*3%*	*11%*
Chemical industry	*18%*	*8%*	*9%*	-	*20%*	*22%*	*1%*	-	*41%*	*1%*	*45%*	*18%*
Glass, pottery & building mat.	*13%*	*11%*	*56%*	-	*22%*	*17%*	*1%*	-	*32%*	*5%*	*2%*	*7%*
Paper and printing	*11%*	*3%*	*17%*	-	*4%*	*10%*	*0%*	-	*1%*	*66%*	*5%*	*13%*
Transport	350 239	-	-	-	341 835	461	-	-	-	1 850	-	6 093
of which: Road transport	*83%*	-	-	-	*84%*	*100%*	-	-	-	*100%*	-	-
Air transport	*13%*	-	-	-	*14%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	472 517	9 612	1 280	-	94 650	171 768	85	-	38	30 867	35 967	128 250
of which: Households	*64%*	*75%*	*74%*	-	*58%*	*68%*	*77%*	-	-	*89%*	*79%*	*51%*
Statistical difference	-1 013	837	224	-880	861	-1 822	-109	-	0	6	-169	38

References

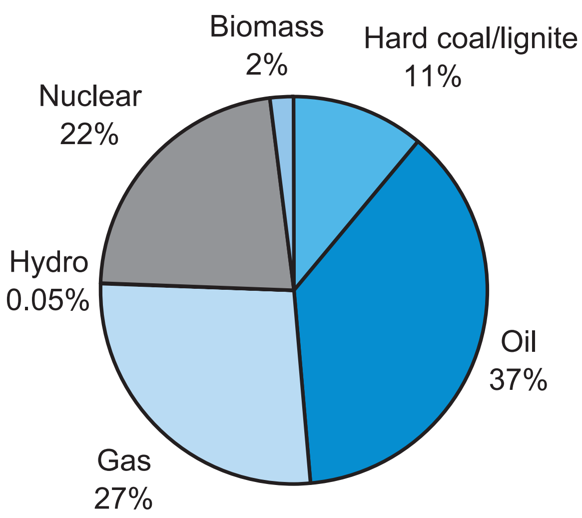
(1) NILE (2006) "New Improvements for Lignocellulosic Ethanol," Integrated Project supported by the 6th Framework Programme, http://www.nile-bioethanol.org/.

(2) EC, 2006 "An EU Strategy for Biofuels," COM(2006) 34 final, Communication from the Commission, Brussels, 8.2.2006.

1.1.2 Belgium

Belgium has few of its own mineral energy resources and is almost fully dependent on imported energy sources. The gross inland consumption included 75% fossil fuels and 22% nuclear in 2004 (Figure 1.1.9). Energy intensity in Belgium is slightly over the EU average despite aging building stock, the presence of some energy-intensive industries, and the considerable growth in transport. The strategic importance of several cities in Belgium as major hubs for commerce and energy trade has been a major contributor to the increased energy for transport.

Figure 1.1.9: **Gross inland consumption by fuel**



Regional political economy

Belgium, in the midst of very developed urban and industrial areas, has three regions-Flanders, Wallonia, and Brussels. A high population density (especially Brussels and Flanders), an intense international trade, and a sprawled settlement of housing, commercial and industrial activities have created intensive traffic flows. Traffic is dominated by road transport, although there is also a dense network of railroads and inland waterways running into the Netherlands, Germany and France. Antwerp is a major logistic crossroads in the range of North Sea ports and is the home port for a large oil-based industry (refineries, petrochemicals).

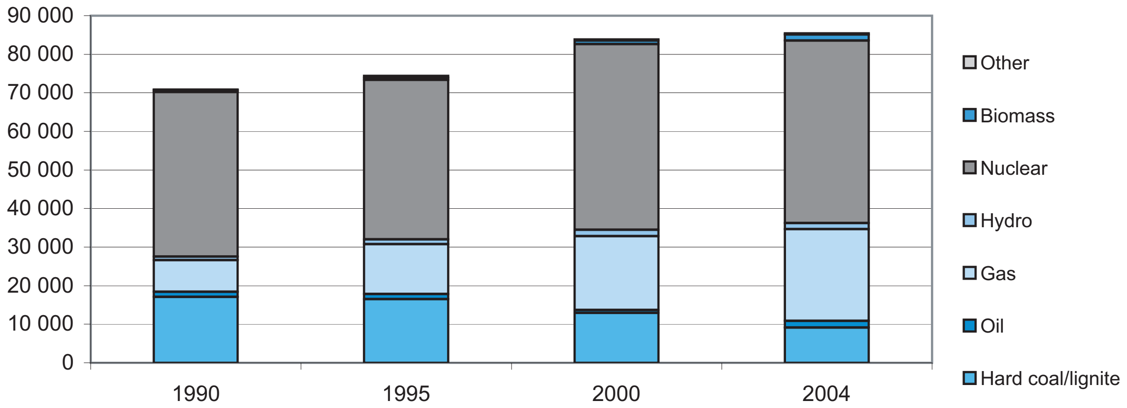
Electric power sector

In a first round of liberalisation, the EU Directives on the internal power market were implemented and transposed into Belgian federal law in early 1999 for the industrial sector. In a second round for the electricity distribution, Flanders anticipated the implementation of the total opening of the electricity market already in 2003, while Brussels and the Walloon region will complete the process in 2007, date foreseen by the Directive.

Four regulatory committees were established: CREG (federal), VREG (Flanders), CWAPE (Wallonia) and BIM-IBGE (Brussels). The networks of electricity and gas are owned by local utilities, about 20% of which are public, while 80% have a mixed ownership structure. There has already been some market restructuring and foreign investment in the Flemish market.

The fuel mix has shifted somewhat during the last 10-15 years. Although nuclear power continues to dominate, its share has dropped from 60% to 55% of generation between 1990 and 2004, while gas has become a significant contributor, with 25% of generation in 2004 compared to 8% in 1990. Coal has decreased from 24% to 11% over the same period. A small amount of renewables have entered the mix, although only amounting to some 4%. The overall trend is towards diversification in the fuel mix, albeit mainly to gas thus far (Figure 1.1.10).

Figure 1.1.10: **Electric power generation by source (GWh)**



Nuclear power

Nuclear power was envisioned in the 1960s as the key to meeting growing energy demand; seven reactors were commissioned during the period 1974-1986. After the Chernobyl accident, there was growing opposition to nuclear power, and further expansion was halted a few years later. Legislation enacted in 2003 went further, by ruling that between 2015 and 2025, all nuclear plants that have exceeded the lifetime of 40 years should be closed. The Belgian decision in the wake of Chernobyl is somewhat similar to the Swedish reaction after the Three Mile Island accident (see section on Sweden). As in other EU countries, nuclear power today is being discussed again, due to concerns about climate change, energy security, and increasing electricity prices.

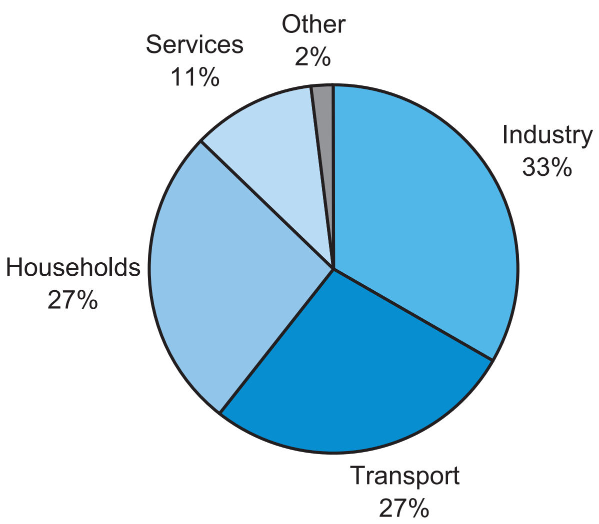
Fossil fuel dependency

Domestic coal and imported oil provided much of the commercial energy resources in Belgium for several decades. In the 1980s, domestic coal was no longer competitive with imported coal, oil and natural gas. Domestic coal mining ended in 1989 and coal is now imported from all over the world for power generation, for steel-making, and for some smaller industrial uses.

The harbour of Antwerp developed as a major refinery centre, exporting petroleum products and supplying feedstocks to the new oil-based industries in the maritime development areas in the region. Oil was used for central heating in buildings, even in urban areas. 17% of the petroleum products available for final consumption also go in non-energy use for the petrochemical sector. The high dependence on oil proved to be costly during the oil price shocks of the 1970s, in 1990-91, and during the past few years. A significant amount of oil is still used today for heating and other uses in buildings, amounting to about 27% of final uses of oil in 2004, however a replacement with natural gas is now progressing.

Bruges' North Sea port has developed into the top European port for natural gas, and handled 1.9 million tonnes in 2005 ([1]). Natural gas is imported mainly from the Netherlands, Norway and Algeria. Gas arrives through the sea pipe that extends 830 km from Norway and from the UK interconnector in Bacton. The port also has LNG facilities, which handle gas from Algeria, the Middle East, and other regions of supply. Retail delivery was traditionally covered by the network and supply companies that also deliver electric power. With the market liberalisation and separation of ownership, there has been some restructuring as well as challenges by foreign companies for market shares.

Figure 1.1.11: Final energy consumption by sector



Renewable energy

Renewable electricity generation is supported by Tradable Green Certificate (TGC) systems. The Flemish TGC system has mainly promoted investments in wind power and biomass. An increasing share of biomass is imported biomass waste from abroad. Programmes for promoting bio-fuels in transportation have also been initiated; the option is now available for a 5% bio-fuel share in automotive fuels.

Combined heat & power (CHP) has expanded somewhat since the mid-1990s, mainly as gas turbine plants on industrial sites. Except for some small hydro in the Walloon region and micro hydro in Flanders, most renewable energy would be from biomass and wind.

Energy Demand

Industry remains the largest final energy end-user, although transport and households are quite close behind (Figure 1.1.11). The relatively high share of households in energy consumption can be explained by a high population density, an ageing building stock and the lack of district heating, which would generally provide more efficient energy options for an urban and densely populated country. Energy efficiency in buildings is a key area for future improvements, through implementation of the EU Energy Performance of Buildings Directive ([2]), which falls under the responsibility of the regional governments.

Industry's share in total end-use has been declining, partly by changes in the industrial structure and partly by realising efficiency measures more than the other sectors. The traditional heavy industries remain the largest consumers: iron & steel, chemicals, and non-ferrous minerals (e.g. cement) industrial energy end-use in 2004.

Eighty percent of the energy consumption in the transport sector is attributed to road transport. Traffic has grown faster than efficiency improvements in vehicle technology.

Belgium - Summary energy balance, 2004

expressed in 1000 TOE

	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	13 159	-	-	-	-	-	-	12 204	-	955	-	-
Recovered products	180	95	-	-	6	-	-	-	79	-	-	-
Imports	76 111	7 047	104	35 511	17 432	14 559	-	-	-	206	-	1 253
Stock change	-116	-178	-	4	47	11	-	-	-	-	-	-
Exports	26 802	977	-	3 098	22 143	-	-	-	-	-	-	584
Bunkers	7 706	-	-	-	7 706	-	-	-	-	-	-	-
Gross inland consumption	54 826	5 986	104	32 417	-12 363	14 570	-	12 204	79	1 161	-	669
Transformation input	64 335	5 545	-	40 985	432	3 908	554	12 204	68	638	-	-
of which: Public thermal power stations	*12%*	*37%*	-	-	*100%*	*96%*	*100%*	-	*100%*	*86%*	-	-
Autoprod. therm. power st.	*0%*	*1%*	-	-	-	*4%*	-	-	-	*9%*	-	-
Nuclear power stations	*19%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*4%*	*46%*	-	-	-	-	-	-	-	-	-	-
Refineries	*64%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	51 785	2 025	-	-	40 664	-	1 396	-	-	-	502	7 197
of which: Public thermal power stations	*7%*	-	-	-	-	-	-	-	-	-	*100%*	*42%*
Autoprod. therm. power st.	*0%*	-	-	-	-	-	-	-	-	-	-	*2%*
Nuclear power stations	*8%*	-	-	-	-	-	-	-	-	-	-	*57%*
Coke-oven plants	*5%*	*100%*	-	-	-	-	*34%*	-	-	-	-	-
Refineries	*79%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	2 522	-	-	8 513	-5 990	-	-	-	-	-38	-	38
Consumption of the energy branch	2 288	-	-	-	1 365	60	221	-	-	-	-	642
of which: Prod. and distrib. of electr.	*15%*	-	-	-	-	-	-	-	-	-	-	*52%*
Oil refineries	*69%*	-	-	-	*98%*	*3%*	-	-	-	-	-	*38%*
Distribution losses	371	-	-	-	-	-	-	-	-	-	40	331
Available for final consumption	42 139	2 467	104	-55	20 514	10 602	621	-	10	484	462	6 931
Final non-energy consumption	4 314	-	-	-	3 461	853	-	-	-	-	-	-
Final energy consumption	37 416	2 223	103	-	16 624	9 958	620	-	10	484	462	6 931
Industry	12 444	2 038	101	-	1 089	4 425	620	-	6	291	402	3 471
of which: Iron & steel industry	*31%*	*88%*	-	-	*3%*	*17%*	*100%*	-	-	-	*4%*	*17%*
Chemical industry	*26%*	*0%*	-	-	*13%*	*39%*	-	-	*100%*	-	*32%*	*33%*
Glass, pottery & building mat.	*11%*	*6%*	*70%*	-	*26%*	*14%*	-	-	-	-	-	*6%*
Paper and printing	*5%*	*2%*	-	-	*4%*	*3%*	-	-	-	*66%*	-	*6%*
Transport	10 201	-	-	-	10 071	-	-	-	-	-	-	129
of which: Road transport	*83%*	-	-	-	*84%*	-	-	-	-	-	-	-
Air transport	*14%*	-	-	-	*14%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	14 772	185	2	-	5 464	5 533	-	-	4	194	60	3 331
of which: Households	*68%*	*80%*	*100%*	-	*66%*	*68%*	-	-	-	*98%*	*25%*	*69%*
Statistical difference	409	244	1	-55	428	-209	0	-	-	0	-	0

References

(1) Port of Zeebrugge, http://www.zeebruggeport.be/.

(2) Directive 2002/91/EC of the European Parliament and of the Council on the energy performance of buildings, of 16 December 2002, see http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_001/l_00120030104en00650071.pdf.

1.1.3 Czech Republic

As with other transition countries in Central and Eastern Europe, the transformation in the Czech economy since 1990 has been accompanied by a transformation in the energy system. Although coal continues to be the main source for electric power, the shares of low carbon sources in the supply mix have increased considerably, with added capacity for nuclear, hydro, and natural gas. On the demand side, energy intensity decreased by 23% from 1991 to 2004 due mainly to structural changes in energy-intensive industries. The major challenges include replacements for the dwindling supply of coal and demand-side energy efficiency efforts.

Primary energy sources

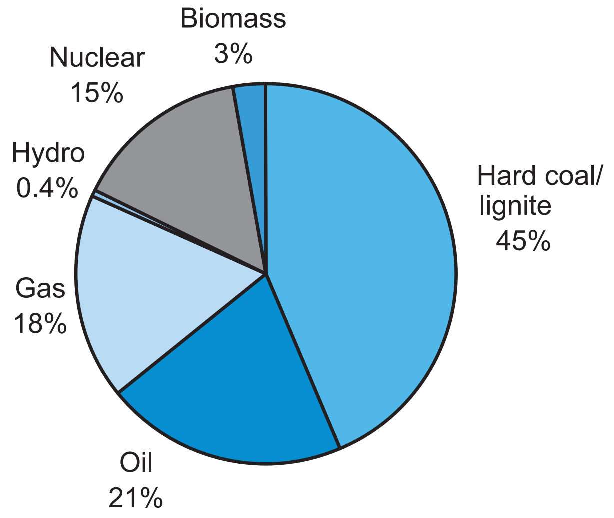
Similarly to Poland, the Czech Republic has abundant coal reserves relative to domestic demand. It also has limited small reserves of oil and natural gas. Until recently, the Czech Republic also mined uranium. In spite of increases in nuclear and hydro capacity in recent years, fossil fuels continue to account for 84% of Gross Inland Consumption. Nuclear power accounts for 15%, while the remainder includes some hydro, biomass, and energy from waste products (Figure 1.1.12).

Coal reserves include brown and hard coal; a restructuring process in the coal-mining sector has been ongoing since 1990 (1). In spite of decreased coal consumption, coal reserves have been shrinking, with availability expected only for the next 15-20 years (2).

The majority of the oil supply is imported from Russia, while a significant amount is also imported through other international sources.

Most of the gas supply also comes from Russia, while a significant amount is also delivered from Norway. The Czech Republic is also an important natural gas transit route from Russia to Western Europe; through this route, Western Europe receives 25% of its gas supply.

Figure 1.1.12: Gross inland consumption by fuel



Note: The total sum is larger than 100% due to the net export of electricity.

Electric power sector

The Czech Republic is among the major EU electricity exporters, with the majority of exports sent to Germany, and some additional exports to Austria and Slovakia. The Czech Republic also imports some electricity from Poland. Exports are somewhat constrained by the transmission capacity of the Czech grid ([1]).

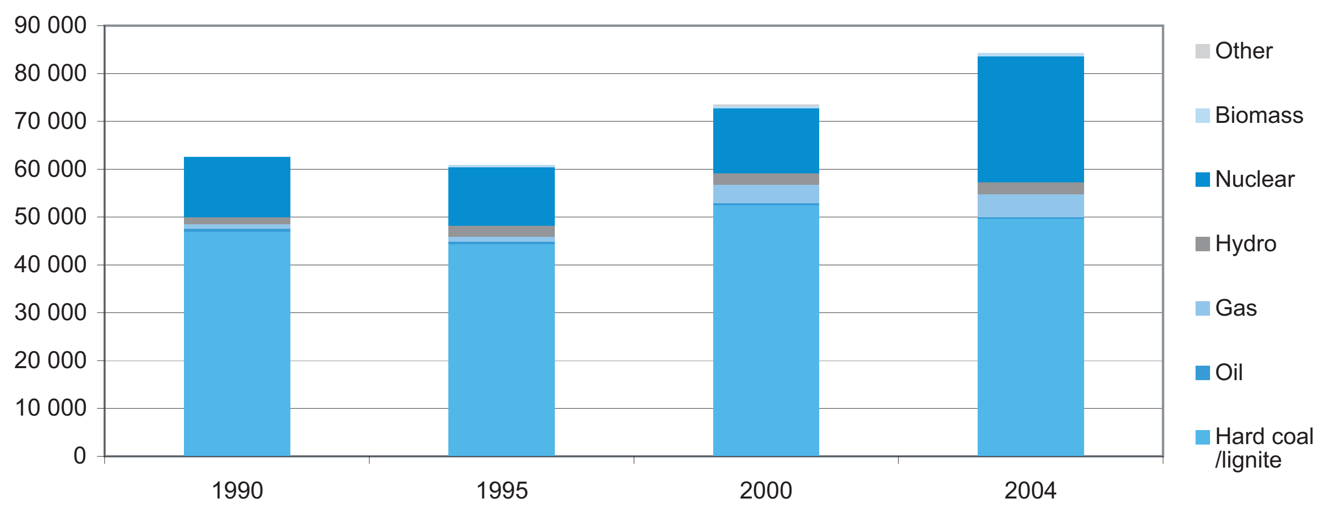
The power mix is dominated by coal and nuclear, which together provided 90% of electricity in 2004. Hydro and gas make up nearly all of the remaining 10%, although there is a small amount of biomass, wind, and waste-to-energy power generation. Between 1990 and 2004, power generation from coal has been relatively stable, while the additional demand has been met from added capacity for nuclear, hydro, and gas (Figure 1.1.13). Installed capacity for coal has declined, while capacity for nuclear has more than doubled and hydro capacity has increased by over 50%.

Nuclear power

Nuclear power plays an important role in the Czech economy, as the second major source of energy after coal and the country's only major low carbon source. The Czech Republic has two nuclear power plants: *Temelin* and *Dukovany*. The second nuclear power plant has been progressively upgraded and is expected to operate until 2025.

Until recently, the Czech Republic mined uranium for use in its plants, but domestic uranium reserves are nearing exhaustion. The mines are scheduled to be closed, decommissioned and restored over an extended period lasting until 2040 ([2]).

Figure 1.1.13: Electric power generation by source (GWh)



Privatisation and liberalisation in energy sector

Market reforms in the natural gas and electricity sector have introduced competition and compliance with the relevant EU directives. In the gas sector, the activities include management of imports, transmission, the inland pipeline grid and underground storage facilities. Natural gas, oil, and electricity sectors have all been privatised in recent years.

Renewable energy sources

The majority of renewable electricity comes from the large hydro power plants. The share of renewables in electricity generation was about 4% in 2004, compared to 2.3% in 1990. The Czech indicative renewable electricity target for 2010 is 8%. The most promising sources to meet the target include biomass, a small amount of wind, and waste-to-energy. Hydro potential is largely utilised or is limited for environmental reasons.

The support scheme for renewable energy production has evolved over time. In 1999, feed-in-tariffs were introduced, based on voluntary agreements with industry. In 2002 the government introduced a purchase obligation for electricity from renewables and CHP, which was fully implemented through the Renewable Energy Law of 2005 (which came into force in 2006). This Law includes guaranteed minimum prices for 15 years and differentiated the support for electricity produced from pure biomass from that produced through co-firing of biomass ([3]).

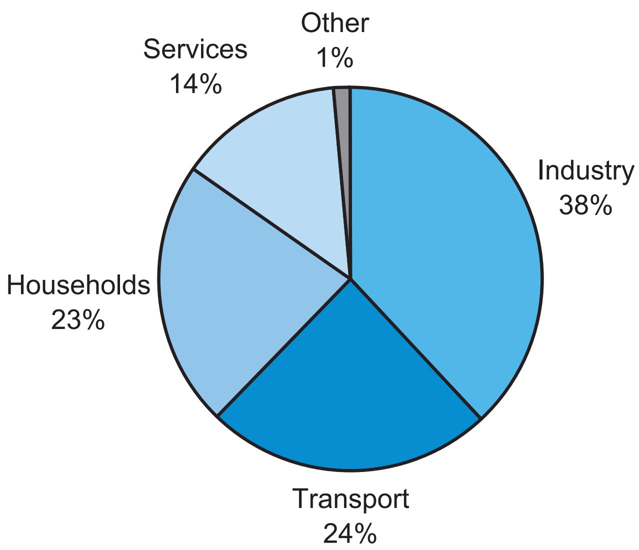
Final demand

As in other transition countries, the energy consumption of the Czech industrial sector has decreased significantly; however, energy intensity did not fall as much as it did in the other transition economies. Energy efficiency across several sectors has been identified as a key priority for Energy Policy ([4]).

Industry remains the main final energy consumer, with 38% of total final energy consumption in 2004, followed by the household and transport sectors with about 23% each (Figure 1.1.14).

Historical factors suggest considerable potential for energy efficiency, whereas renewable energy development is somewhat limited by geographical constraints ([4]).

Figure 1.1.14: Final energy consumption by sector



Czech Republic - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	32 260	23 423	88	297	-	162	-	6 791	-	1 498	-	-
Recovered products	377	-	-	278	-	-	-	-	99	-	-	-
Imports	19 250	1 492	1	6 315	3 420	7 166	-	-	-	14	-	841
Stock change	-118	-669	-4	7	16	531	-	-	-	-	-	-
Exports	8 211	4 762	77	62	893	72	-	-	-	150	3	2 192
Bunkers	-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption	43 558	19 485	9	6 835	2 543	7 788	-	6 791	99	1 363	-3	-1 351
Transformation input	34 893	18 554	100	6 851	199	1 393	630	6 791	7	368	-	-
of which: *Public thermal power stations*	*40%*	*68%*	*100%*	-	*40%*	*38%*	*35%*	-	*3%*	*68%*	-	-
Autoprod. therm. power st.	*5%*	*6%*	*0%*	-	*25%*	*15%*	*65%*	-	*16%*	*18%*	-	-
Nuclear power stations	*19%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*9%*	*18%*	-	-	-	-	-	-	-	-	-	-
Refineries	*20%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	21 367	2 376	151	-	6 809	-	1 541	-	-	-	3 459	7 030
of which: *Public thermal power stations*	*30%*	-	-	-	-	-	-	-	-	-	*68%*	*56%*
Autoprod. therm. power st.	*5%*	-	-	-	-	-	-	-	-	-	*9%*	*11%*
Nuclear power stations	*11%*	-	-	-	-	-	-	-	-	-	-	*32%*
Coke-oven plants	*14%*	*100%*	-	-	-	-	*35%*	-	-	-	-	-
Refineries	*32%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	18	-	-	15	3	-	-	-	-	-174	-	174
Consumption of the energy branch	1 925	3	-	-	222	131	417	-	-	-	363	790
of which: *Prod. and distrib. of electr.*	*29%*	-	-	-	*4%*	-	-	-	-	-	-	*70%*
Oil refineries	*21%*	-	-	-	*92%*	*79%*	-	-	-	-	*24%*	*2%*
Distribution losses	1 016	-	-	-	-	78	33	-	-	-	468	437
Available for final consumption	27 109	3 304	60	-	8 934	6 186	461	-	92	821	2 625	4 626
Final non-energy consumption	2 342	-	-	-	2 342	-	-	-	-	-	-	-
Final energy consumption	25 754	4 217	70	-	6 684	6 186	460	-	92	793	2 625	4 626
Industry	9 846	3 162	2	-	660	2 483	460	-	88	258	811	1 922
of which: *Iron & steel industry*	*29%*	*51%*	-	-	*19%*	*12%*	*95%*	-	-	-	*13%*	*14%*
Chemical industry	*21%*	*37%*	-	-	*24%*	*10%*	-	-	*5%*	*0%*	*17%*	*17%*
Glass, pottery & building mat.	*12%*	*4%*	-	-	*8%*	*26%*	*1%*	-	*87%*	-	*4%*	*11%*
Paper and printing	*4%*	*1%*	-	-	*2%*	*2%*	-	-	-	*45%*	*8%*	*8%*
Transport	6 137	-	-	-	5 939	11	-	-	-	0	-	186
of which: *Road transport*	*90%*	-	-	-	*93%*	*100%*	-	-	-	*100%*	-	-
Air transport	*5%*	-	-	-	*6%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	9 771	1 055	68	-	85	3 692	-	-	3	535	1 814	2 517
of which: *Households*	*60%*	*44%*	*97%*	-	*67%*	*64%*	-	-	-	*87%*	*65%*	*50%*
Statistical difference	-988	-913	-10	-	-93	-	1	-	-	27	-	-

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(1) IEA (International Energy Agency). 2003. Energy Policies of IEA Countries. 2003 Review. Paris.

(2) NEA (Nuclear Energy Agency), 2006. Nuclear Energy Agency Country Profiles - Czech Republic. OECD. http://www.nea.fr/html/general/profiles/czech.html.

(3) Jakubes, J. 2006. Development of the support system for RES-E in the Czech Republic. Experiences and lessons learned. Presentation at the CEERES concluding conference "Barriers against and potential of large-scale integration of renewable electricity and cogeneration into energy systems in the CE New Member States", Warsaw, 19-20 June, 2006. www.ceeres.org.

(4) MPO (Ministry of Industry and Trade), 2004. Statni energeticka koncepce Ceske Republiky. Praha. www.mpo.cz.

1.1.4 Denmark

The structure of the Danish energy system has changed significantly in the last 15-20 years due to several factors. First, the discovery of oil and gas in the North Sea in the early 1980s allowed for reductions in energy imports, and a substitution of natural gas for coal. This has helped to turn Denmark from an energy importer to an energy exporter. Second, the availability of natural gas and the promotion of biomass have contributed to a major expansion of combined heat and power and district heating, resulting in significant improvements in the efficiency of delivering heat and hot water. Third, major technical developments in wind turbine technology in Denmark and the subsequent market expansion have significantly increased the share of power generated from renewable sources, thereby improving both the energy intensity and carbon intensity of the Danish economy. Fourth, substantial efforts at improving energy efficiency have brought down energy intensity to the lowest level in the EU, helping to make the Danish economy more competitive.

Structure of domestic energy system

During the last 15 years, the electric power sector has undergone a remarkable process of diversification. In 1990, coal accounted for 90% of power production, but by 2004 its share had fallen to half of that amount. Natural gas accounted for 25% of power production in 2004, while wind and biomass accounted for 16% and 9%, respectively (Figure 1.1.15). Renewable sources in total have increased from 3% to 25% of the total over this period. In efforts to promote natural gas, an effective ban has been in place on expansion of oil and coal-based power production since 1997.

Although the dependence on oil and coal overall has decreased in favour of natural gas and renewables, the share of gross inland consumption attributable to oil and coal is still 62%; along with the growth in natural gas, the result is that 85% of primary energy was based on fossil fuels as of 2004 (Figure 1.1.16). Robust economic growth, with the resulting demand for oil in the transport sector, is among the factors for the continued prominence of fossil fuels. Structural changes and fuel-switching in the industrial sector and buildings sectors are also responsible for some of the shifts in gross inland consumption.

The dependence on oil has decreased from 74% in 1985, at a time when Denmark was an oil importer, to -117% in 2004; Denmark has become a net exporter of oil and refined petroleum products since 1997. In fact, Denmark is the third largest oil producer in Western Europe, after Norway and the UK. Oil is being used more strategically now, in the sense that it serves as a valuable export product and fuels the transport sector, but is being phased out of sectors where environmentally preferable and/or more efficient alternatives are available (e.g. electricity, district heating).

Figure 1.1.15: Electric power generation by source (GWh)

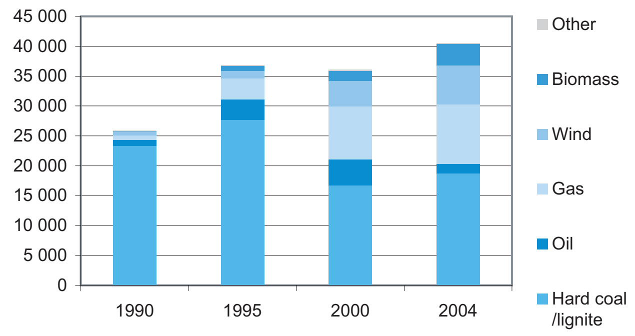
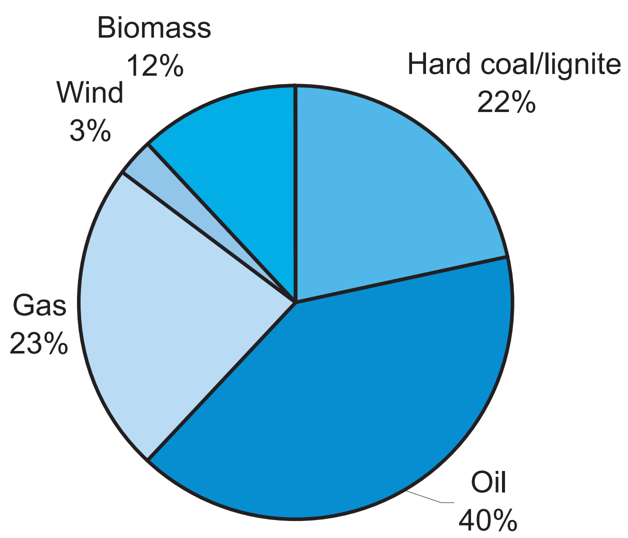


Figure 1.1.16: Gross inland consumption by fuel



The significant increase in natural gas consumption was facilitated by massive investments in a comprehensive nationwide gas infrastructure from 1985 into the mid 1990s. In addition to providing a major source for power generation, district heating plants, and industry, the gas network reaches most households in Denmark. About 75% of households receive their energy through one of the distribution networks, depending on how the local municipality has chosen to organise heat production and supply ([1]). The remaining households rely mainly on individual oil furnaces, or biomass furnaces that are fuelled by wood, wood chips, or wood pellets.

Energy sector organisation

Major institutional changes in the Danish energy sector were initiated in 1999 with the phased implementation of a series of energy sector reforms designed to comply with the EU energy market liberalisation. Consumers of gas and electricity can choose from a range of potential suppliers. Denmark also introduced the concept of CO_2 quotas designed to limit emissions by the industrial and energy producing sectors. All tax proceeds are reintroduced to the sectors through subsidies/investments into energy efficiency projects. With the agreement, Denmark became the first country in the world to introduce CO_2 quotas ([1]).

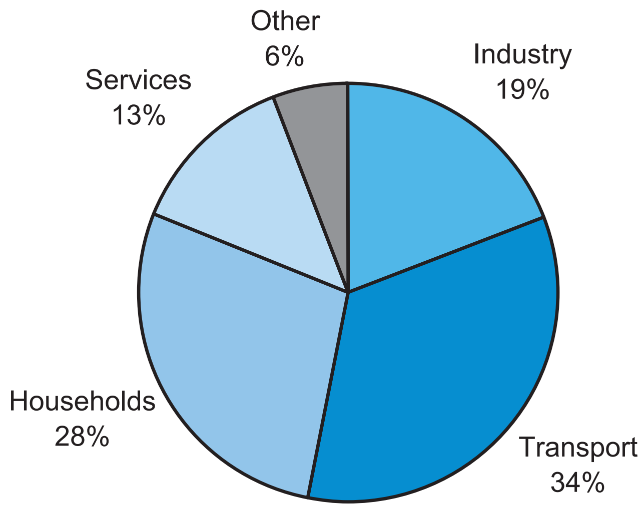
Denmark is part of the Nordic Power Exchange - *Nord Pool* - along with Finland, Sweden and Norway. The exchange has secured the Scandinavian consumers with reliable energy access at comparable and reasonable prices despite national fluctuations in power supply. In the dry summer of 2003 for example, Norway, with its hydro-based system, was able to secure thermal-based power from Denmark.

Structure of energy demand

Like most other Western countries Denmark has experienced major structural shifts in the demand for energy, as a result of economic growth patterns, increased mobilisation, and demand for new products and services. Transport accounted for about one-third of final energy consumption, while households and industry accounted for 28% and 19%, respectively (Figure 1.1.17).

In spite of high economic growth and shifts in demand between economic sectors, it is rather remarkable that the total demand for energy has not increased; a result primarily achieved through the use of energy conservation policy instruments. The energy efficiency policies in Denmark have been widely recognised as being cost-effective in reducing CO_2 emissions, in some cases coming at little or no net cost ([2]). Since 1990, GDP has increased by 50 percent, while energy consumption has remained relatively stable. A wide range of energy efficiency policies, particularly energy taxes and improved availability of information on energy consumption, have brought down energy intensity in industry, households, and service sectors. Building standards and guidelines have led to significant reductions in energy for heating, lighting, and appliances, in spite of the increased demand for ownership of energy-using equipment and appliances ([3]).

Figure 1.1.17: Final energy consumption by sector



Denmark - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	30 868	-	-	19 643	-	8 492	-	-	-	2 734	-	-
Recovered products	5	-	-	-	5	-	-	-	-	-	-	-
Imports	14 244	4 516	-	3 933	4 801	-	-	-	-	245	4	746
Stock change	-116	-63	-	-60	174	-167	-	-	-	-	-	-
Exports	24 212	94	-	15 347	4 034	3 691	-	-	-	53	-	993
Bunkers	791	-	-	-	791	-	-	-	-	-	-	-
Gross inland consumption	19 998	4 359	-	8 168	155	4 634	-	-	-	2 926	4	-247
Transformation input	16 699	4 122	-	8 205	426	2 313	-	-	-	1 633	-	-
of which: Public thermal power stations	*43%*	*100%*	-	-	*75%*	*83%*	-	-	-	*48%*	-	-
Autoprod. therm. power st.	*5%*	*0%*	-	-	*16%*	*13%*	-	-	-	*26%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*49%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	14 130	-	-	-	8 112	-	15	-	-	-	3 092	2 912
of which: Public thermal power stations	*35%*	-	-	-	-	-	-	-	-	-	*72%*	*92%*
Autoprod. therm. power st.	*4%*	-	-	-	-	-	-	-	-	-	*9%*	*8%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*57%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	1	-	-	-	1	-	-	-	-	-568	-	568
Consumption of the energy branch	1 268	-	-	-	345	649	-	-	-	1	28	245
of which: Prod. and distrib. of electr.	*14%*	-	-	-	-	-	-	-	-	-	-	*72%*
Oil refineries	*30%*	-	-	-	*100%*	-	-	-	-	-	-	*14%*
Distribution losses	772	-	-	-	-	3	1	-	-	-	615	154
Available for final consumption	15 391	236	-	-37	7 497	1 669	14	-	-	724	2 452	2 835
Final non-energy consumption	279	-	-	-	279	-	-	-	-	-	-	-
Final energy consumption	15 168	262	-	-	7 185	1 698	14	-	-	723	2 452	2 835
Industry	2 921	238	-	-	802	731	0	-	-	112	177	862
of which: Iron & steel industry	*3%*	-	-	-	*1%*	*5%*	*23%*	-	-	-	*3%*	*3%*
Chemical industry	*9%*	*7%*	-	-	*4%*	*11%*	-	-	-	*0%*	*13%*	*13%*
Glass, pottery & building mat.	*22%*	*68%*	-	-	*31%*	*17%*	-	-	-	*18%*	*9%*	*9%*
Paper and printing	*6%*	-	-	-	*2%*	*8%*	-	-	-	*1%*	*9%*	*9%*
Transport	5 137	-	-	-	5 105	-	-	-	-	-	-	32
of which: Road transport	*78%*	-	-	-	*79%*	-	-	-	-	-	-	-
Air transport	*17%*	-	-	-	*17%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	7 110	24	-	-	1 277	967	13	-	-	611	2 275	1 942
of which: Households	*60%*	*3%*	-	-	*51%*	*72%*	*92%*	-	-	*80%*	*67%*	*46%*
Statistical difference	-56	-25	-	-37	34	-29	0	-	-	1	0	0

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(1) Karnøe, P. and Buchhorn, A. (2006) "Governance for Sustainable Energy in Denmark: Comparing Government-Business Interactions in the RES-E Directive," Final project report, SUSTEN, Oslo, Norway.

(2) IEA (2006) "Energy Policies of IEA Countries - Denmark -- 2006 Review," International Energy Agency (IEA), Paris, France. ISBN 92-64-10971-4.

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1.1.5 Germany

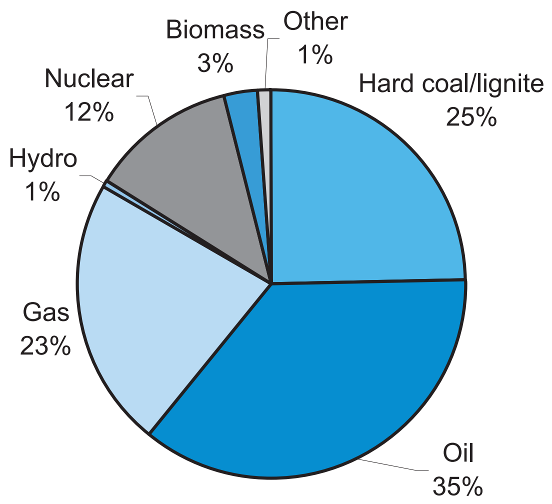
In recent years, the German energy system has been shifting from a reliance on solid fuels and nuclear towards a more diversified power system with significant contributions from renewables and natural gas. On the demand side, Germany has experienced slow growth in energy consumption during the past two decades, following a long period of steady growth. The reunification of Germany in 1990 and the resulting industrial restructuring was a key factor in reducing industrial sector energy demand. Energy taxation has stimulated energy efficiency in the buildings and transport sectors, contributing to an overall energy intensity that is below the EU average. Germany has also emerged as a leader in the production and use of bio-diesel as a transport fuel, within the EU as well as globally.

Primary energy

The German energy system currently relies on fossil fuels and nuclear power for about 95% of its primary energy supply. The share of oil in the gross inland consumption, essentially all of which is imported, has decreased to 35%, compared to about 50% three decades ago. In primary terms, renewables account for only 4% of gross inland energy consumption, although this figure rises to about 6% in terms of final delivered energy, due to the fact that hydro and wind are the main renewables. Nuclear accounted for about 12% in 2004, while the share of gas is now 23% (Figure 1.1.18).

The heavy dependence on fossil fuels -particularly coal and lignite - in the German energy system raised a variety of environmental concerns during the past two decades, which have since been reflected in legislation as well as in the shifts in the primary energy structure. Damage to forests due to acid rain was remedied in part by strict regulations on sulphur and nitrogen oxides. The substitution of nuclear for solid fuels, and the increasing use of natural gas have also been aimed partly at addressing local and regional environmental concerns as well as reducing carbon emissions. More recently, expanded heat and power production from biomass and solar thermal have gained increased interest as a way of improving the overall efficiency of energy production as well as increasing the share of renewables. Solar thermal has increased twenty-fold since 1990, while biomass has more than doubled over the same period.

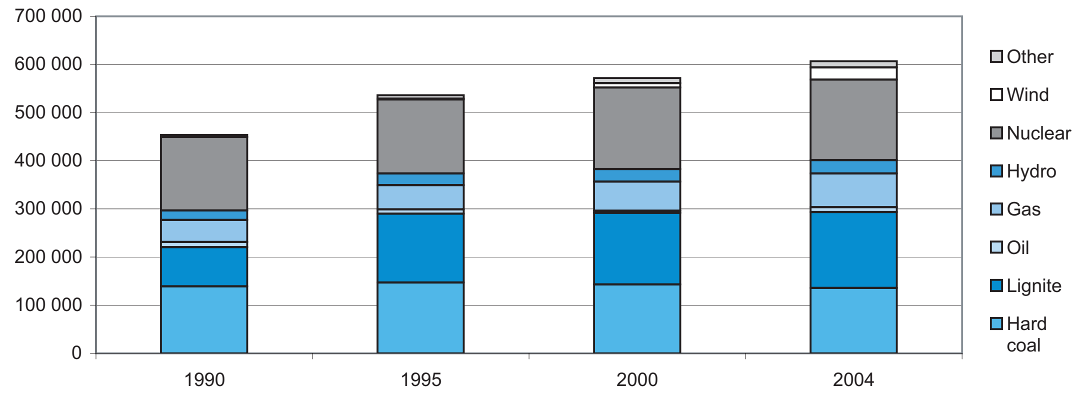
Figure 1.1.18: Gross inland consumption by fuel



Electric power sector

The main fuel for power production in Germany has traditionally been hard coal and lignite. However, with domestic production declining for the past several decades, the solid fuels supply has increasingly been supplemented with domestic lignite and also with imported hard coal. Ample supplies of lignite from eastern Germany became readily available with the reunification of Germany in 1990. Between 1990 and 2004, power production from lignite nearly doubled while production from hard coal slightly decreased (Figure 1.1.19). As a low cost domestic resource, lignite plays an important strategic role in the energy system, although the environmental costs of open mining are placing limits on further expansion.

Figure 1.1.19: Electric power generation by source (GWh)



Perhaps the most remarkable of the energy transitions that have been taking place in Germany is the rise of wind power; Germany now has the highest installed wind turbine capacity in the world, amounting to nearly 17 GW by the end of 2004, and representing 13% of total installed capacity (Figure 1.1.20). Since it is used primarily for peak power demand, wind represented just slightly over 4% of total electricity generated as of 2004, but its strategic importance within the energy sector is high, both domestically and in terms of leading the EU and global market development.

About 28% of power in 2004 was produced in nuclear plants, as compared to 34% in 1990. Two nuclear power plants were shut down in 2003 and 2005, respectively. An agreement reached in 1999-2000 resulted in legislation aimed at phasing out the remaining 17 nuclear power plants by 2020.

Production from natural gas has increased since 1990, and along with wind provides much of the peak power demand. Overall, thermal and nuclear capacities have both decreased in recent years, and the installed capacity of wind is now about double that of hydropower (Figure 1.1.20). However, because it provides some baseload power, hydro still provides slightly more electricity than wind. The fact that an increasing share of power comes from intermittent sources such as wind has had some implications for overall grid management and also provided a rationale for expansion of non-intermittent renewables, namely biomass and geothermal.

EU electricity liberalisation was transposed into German law in 1998, and the declared market opening was complete by 2001. As of the end of 2003, there were 940 electricity suppliers in Germany, although only 4 of these supplied more than 5% of the market; in 2003, 41% of non-household customers switched suppliers, which was by far the highest share in the EU (1). The opening of EU markets also facilitated a series of mergers and acquisitions that resulted in a few German companies being among the biggest utilities worldwide. The 2003 EU liberalisation directive led to the creation of an energy regulator in Germany.

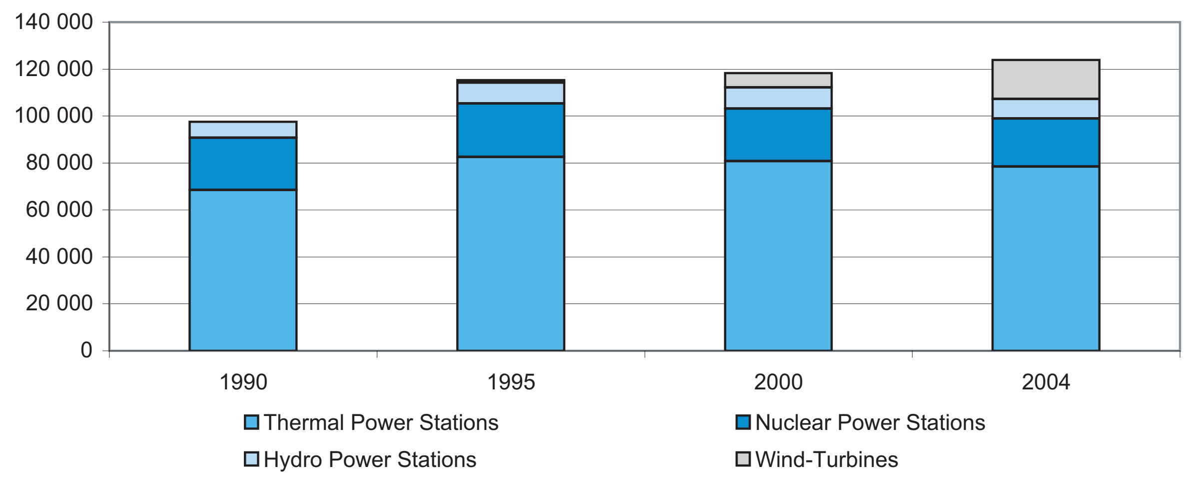
Biofuels for transport

Germany has become the world leader in production and use of bio-diesel. A support scheme has been in place in Germany and in several other EU countries for bio-diesel made from rapeseed, resulting in production increasing more than five-fold during 2000-2005. Germany, France, and Italy accounted for over 80% of EU production in 2005. Globally, bio-diesel production increased four-fold, from under 1 billion litres to nearly 4 billion litres (2). Nevertheless, bio-diesel still accounts for less than 2% of total transport fuels used in Germany; the EU target is 5.75% by 2010 (3). Bio-ethanol has also been produced and used, although at a much smaller scale.

Energy security

Energy security has historically been a major issue in Germany. The share of total energy requirements from imports was about 62% in 2004, which is higher than the EU average. The previous dependence on imported oil has been replaced in part by dependence on imported gas and coal; energy security concerns raised by increasing imports are mitigated somewhat by the diversification in the sources of supply. The emphasis on renewables addresses both energy security concerns and climate concerns.

Figure 1.1.20: Net installed capacity of electricity generating power plants, in MW



Diversification of energy sources and the origins of imports have both played a role in addressing security of supply. As the role of domestic hard coal was reduced, it was replaced not by oil or gas but by imported hard coal, thus implying rather different trading partners. Domestic production of natural gas covers about one fifth of demand, and the remaining 80% come mainly from Russia and Norway. Germany in 2005 concluded negotiations with Russia for a gas pipeline through the Baltic Sea, bypassing Belarus and Ukraine and Poland. At the same time the construction of LNG terminals is under way, which would allow for diversification of gas supply.

Renewable energy options

Germany is not particularly privileged with renewable sources. Hydropower furnishes about 4.5% of electricity demand. However, the development of new renewable sources is among the most advanced in Europe, due in part to the favourable framework for renewable energy via the feed-in tariff law of 1990 and the renewable energy act of 2000, which was amended in 2004. The German feed-in tariff system appears to have achieved the goals of advancing renewable energy and has led to one of the highest global rates of deployment of existing potential in the case of wind power. As the availability of onshore sites declines, offshore wind sites will offer a capacity which is several times greater.

Photovoltaics have also grown at a rapid rate. A so-called "100 000 roofs programme" (with subsidies) along with the introduction of a rate that made it economically attractive for private investors led to an acceleration of the market (4). In 1999, there was about 70 MW of installed capacity; by 2004, there was about 708 MW - a 10-fold increase in five years time. The German market has surpassed the combined U.S. and Japanese markets.

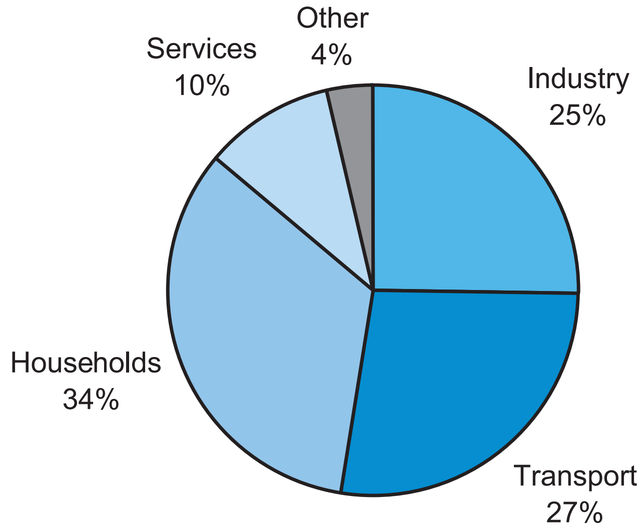
Renewable energy is also supported outside the electricity sector, especially for bio-diesel (as mentioned above) and also for space and water heating purposes. By 2005, Germany had about 6.5 square kilometres of solar thermal collectors, and had the largest collector market in the EU (5). Wood-based heating systems were also supported, with the high oil prices of the last two years leading to a veritable boom of solid biomass-based systems.

The structure of energy demand

Final energy consumption is dominated by households in Germany, which accounted for 34% in 2004, while transport and industry accounted for 27% and 25%, respectively (Figure 1.1.21). Industry accounts for nearly half of all electricity use in Germany, while the service sector accounts for less than 25%. The energy structure in Germany is considerably more dependent on electricity for industry than is the case for most EU countries. Household use of biomass is significant, in that it accounts for about half of all biomass consumption; high oil prices in recent years in combination with government support schemes have led to wide adoption of wood-based heating systems.

The reunification of Germany in 1990 and the resulting restructuring of industries led to a considerable fall in industrial energy intensity as well as structural shifts away from some energy-intensive industries. Consequently, industry's share of final demand fell considerably in the 1990s.

Figure 1.1.21: Final energy consumption by sector



Germany - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	135 266	18 701	39 640	3 513	1 830	14 732	-	43 095	-	13 755	-	-
Recovered products	1 515	-	-	-	327	-	-	-	1 188	-	-	-
Imports	251 463	28 213	47	111 721	34 471	72 869	-	-	-	-	-	4 143
Stock change	-1 120	-205	-4	-638	1 623	-1 896	-	-	-	-	-	-
Exports	36 755	240	312	1 124	23 737	6 974	-	-	-	-	-	4 369
Bunkers	2 629	-	-	-	2 629	-	-	-	-	-	-	-
Gross inland consumption	347 741	46 468	39 372	113 472	11 885	78 731	-	43 095	1 188	13 755	-	-225
Transformation input	277 337	44 563	39 925	124 033	2 039	16 727	2 038	43 095	1 188	3 729	-	-
of which: Public thermal power stations	*29%*	*64%*	*92%*	-	*43%*	*60%*	*41%*	-	-	*89%*	-	-
Autoprod. therm. power st.	*5%*	*9%*	*3%*	-	*28%*	*38%*	*55%*	-	*100%*	*7%*	-	-
Nuclear power stations	*16%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*3%*	*16%*	-	-	*18%*	-	-	-	-	-	-	-
Refineries	*45%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	200 814	5 848	2 511	-	121 741	-	5 720	-	-	-	17 403	47 592
of which: Public thermal power stations	*19%*	-	-	-	-	-	-	-	-	-	*49%*	*62%*
Autoprod. therm. power st.	*2%*	-	-	-	-	-	-	-	-	-	-	*8%*
Nuclear power stations	*7%*	-	-	-	-	-	-	-	-	-	-	*30%*
Coke-oven plants	*4%*	*99%*	-	-	-	-	*24%*	-	-	-	-	-
Refineries	*61%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	215	-	-	10 775	-10 512	-	-	-	-	-4 033	-	3 985
Consumption of the energy branch	14 621	-	247	-	7 767	703	775	-	-	87	278	4 764
of which: Prod. and distrib. of electr.	*21%*	-	-	-	-	-	-	-	-	-	-	*63%*
Oil refineries	*59%*	-	-	-	*100%*	*40%*	-	-	-	-	-	*13%*
Distribution losses	4 305	-	-	-	-	228	299	-	-	-	1 329	2 449
Available for final consumption	252 507	7 754	1 711	214	113 308	61 072	2 608	-	-	5 906	15 796	44 138
Final non-energy consumption	25 245	157	108	-	22 831	2 150	-	-	-	-	-	-
Final energy consumption	229 920	8 699	1 867	-	90 467	60 297	2 750	-	-	5 906	15 796	44 138
Industry	58 351	8 421	1 281	-	4 728	18 981	2 750	-	-	-	2 082	20 107
of which: Iron & steel industry	*24%*	*74%*	*1%*	-	*18%*	*12%*	*92%*	-	-	-	-	*10%*
Chemical industry	*18%*	*6%*	*8%*	-	*1%*	*26%*	*2%*	-	-	-	*27%*	*21%*
Glass, pottery & building mat.	*12%*	*10%*	*72%*	-	*22%*	*14%*	*1%*	-	-	-	*3%*	*7%*
Paper and printing	*8%*	*4%*	*6%*	-	*4%*	*11%*	*1%*	-	-	-	-	*10%*
Transport	62 610	-	-	-	60 242	-	-	-	-	975	-	1 393
of which: Road transport	*85%*	-	-	-	*87%*	-	-	-	-	*100%*	-	-
Air transport	*12%*	-	-	-	*12%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	108 959	278	586	-	25 496	41 316	-	-	-	4 931	13 713	22 638
of which: Households	*71%*	*100%*	*70%*	-	*68%*	*69%*	-	-	-	*100%*	*100%*	*53%*
Statistical difference	-2 658	-1 102	-264	214	10	-1 374	-143	-	-	0	0	0

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1.1.6 Estonia

Energy is an important industrial sector in Estonia, due primarily to the domestic availability of oil shale; both the energy transformation sectors and the chemical sector are based on oil shale. In addition to oil shale, peat and wood are other domestically available fuels. Approximately 90% of Estonia's energy is produced through the combustion of fossil fuels. Renewables currently account for less than 1% of electricity production, while Estonia's indicative EU target for renewable electricity in 2010 is 5.1%.

Oil shale - a strategic resource

Oil shale, a low-calorific fuel, is by far the most important domestic energy resource in Estonia. In 2005, 14.6 million tonnes of oil shale was mined, out of which 80% was used for electricity and heat production. In addition to combustion in power stations, oil shale is also used for production of oil and as feedstock for the petrochemical industry. Oil shale made up 59% of the gross inland consumption in 2004, with the remainder composed of gas, oil, and biomass. Hydro and coal together account for less than 1% (Figure 1.1.22).

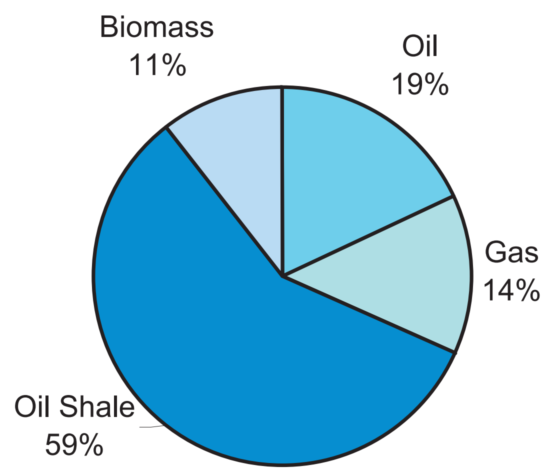
Oil shale is a strategic energy resource for Estonia. The installation of more efficient technologies, such as the two circulating fluidised-bed combustion units that were installed in 2004, is reducing greenhouse gas emissions as well as extending the lifetime of the resource ([1]). The fuel and energy sector Long Term Development Plan envisioned a stepwise decrease of dependence on oil shale ([2]).

Other fuels

Peat is used in power generation and CHP plants. The use of peat is limited, however, by environmental restrictions; natural moors in the EU are protected by Natura 2000 framework restrictions ([3]). Only peat from drained swamps can be used; new areas cannot be drained until 2025.

Natural gas provides a valuable alternative to oil shale, in part because it is the most environmentally-friendly of all fossil fuels. There are concerns about energy security and price volatility with respect to natural gas, since supply is currently limited to one country - Russia. The competitiveness of natural gas is also affected by environmental taxes.

Figure 1.1.22: Gross inland consumption by fuel



Note: The total sum is larger than 100% due to the net export of electricity.

There is currently very little consumption of coal, as it is not used for the production of electricity in Estonia. There is some consumption in industrial enterprises, households, and small boiler plants (for heat generation).

Liquid fuels include fuel oils and motor fuels. With the increasing number of motor vehicles, consumption of motor fuel has been increasing in recent years. Compliance with the EU Biofuels Directive will most likely require imports of bioethanol and/or biodiesel, which should not present major difficulties, since refined petroleum products are already imported.

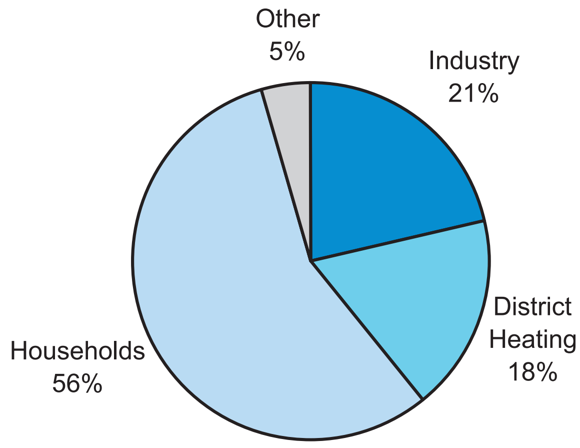
Renewable energy development

Renewable-based electricity was less than 1% of total electricity produced until 2004 (in 2005 this share increased to 1.12%). However, the Long Term Development Plan sets targets to increase the share of renewables and peat in the primary energy supply (4). The Estonian government has a demanding target of 5.1% renewable share in electricity generation by 2010 according to the EU Renewables Directive (2001/77/EC). The target will amount to a ten-fold increase from the base year of 1999. The main sources for achieving this increase are expected to be wind and biomass. The potential for hydro and solar is quite small due to geography and climate.

Biomass is expected to play a greater role in CHP and in electricity production in the future. Currently, the main use of biomass in Estonia is still in households for heating and other uses, although an increasing amount is now being used for district heating. In 2004, the amount used for district heating had risen to 18% of the total (Figure 1.1.23). There is also significant potential for biomass to replace oil shale in the future, thereby reducing greenhouse gas emissions and improving the sustainability of Estonia's energy supply (5). Substitution of biomass for other fuels is also considered an important element in improving energy security, due to Estonia's dependence on imports of natural gas and electricity (6).

Wind power only recently started to play a role in Estonia, which in fact has good wind resources. A countrywide wind atlas has been developed at Tartu University. The wind potential in the coastal zone in Estonia is higher than in the other Baltic countries. The first wind turbine for commercial energy production with a capacity of 150 kW has been operating since September 1997. Installed wind capacity was nearly 50 MW by late 2006. Several wind projects are under construction, and off-shore wind farms are in the design phase.

Figure 1.1.23: Biomass consumption by sector



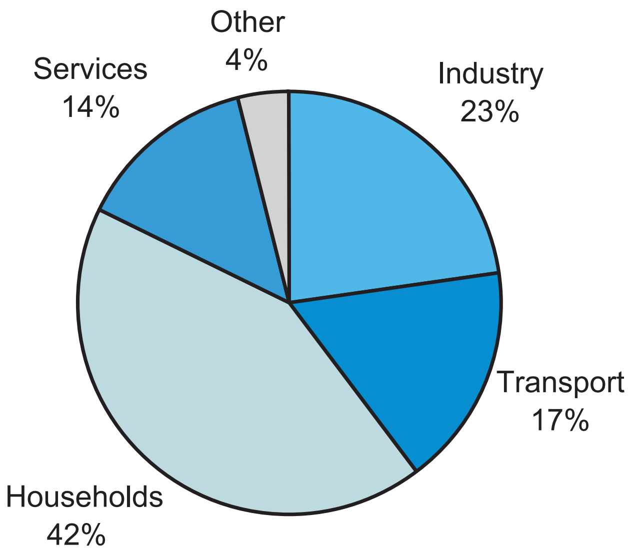
Energy consumption structure

As with nearly all economies in transition, energy demand fell drastically in the early 1990s. Electricity consumption decreased with 35% between 1990 and 1995, but has since rebounded. Energy-intensive industries went through restructuring and closures, while the more recent increases in demand are due to households and the service sectors. Electricity demand has also been dampened somewhat through gas substitution as the natural gas grid has been extended during the past decade.

Energy efficiency improvements in boilers and other major equipment were initiated in the early 1990s; several efficiency programmes were made through the Activities Implemented Jointly (AIJ) programme, which was the precursor of the Kyoto Joint Implementation mechanism for greenhouse gas reductions. Standardised greenhouse gas emissions baselines developed for the District Heating Sector were useful in improving monitoring and evaluation methods at a time when the Kyoto Protocol was being debated; the baselines also supported identification of further efficiency improvements (7).

Final energy consumption in Estonia is now dominated by the household sector, which accounted for 42% of final energy in 2004 (Figure 1.1.24). Final electricity consumption is dominated by industry (36%) and the service sector (31%).

Figure 1.1.24: Final energy consumption by sector



Estonia - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	4 031	-	3 029	-	314	-	-	-	-	687	-	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-
Imports	2 178	29	247	-	1 098	775	-	-	-	-	-	30
Stock change	106	9	90	-	7	-	-	-	-	-1	-	-
Exports	527	24	46	-	193	-	-	-	-	80	-	184
Bunkers	149	-	-	-	149	-	-	-	-	-	-	-
Gross inland consumption	5 639	14	3 321	-	1 077	775	-	-	-	607	-	-154
Transformation input	3 647	3	2 974	1	83	395	81	-	-	110	-	-
of which: Public thermal power stations	*78%*	-	*94%*	-	*13%*	*32%*	*85%*	-	-	-	-	-
Autoprod. therm. power st.	*1%*	-	*0%*	-	-	*3%*	*7%*	-	-	*3%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	*1%*	-	*1%*	-	-	-	-	-	-	-	-	-
Refineries	*0%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	1 681	24	32	-	1	-	96	-	-	-	644	883
of which: Public thermal power stations	*65%*	-	-	-	-	-	-	-	-	-	*36%*	*99%*
Autoprod. therm. power st.	*1%*	-	-	-	-	-	-	-	-	-	*1%*	*1%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	*1%*	*100%*	-	-	-	-	-	-	-	-	-	-
Refineries	*0%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	-	-	-	-3	-	3
Consumption of the energy branch	198	-	12	-	26	6	15	-	-	1	8	129
of which: Prod. and distrib. of electr.	*48%*	-	-	-	*12%*	-	-	-	-	-	-	*71%*
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	210	-	-	-	-	-	-	-	-	-	115	96
Available for final consumption	3 265	35	368	-1	969	373	-	-	-	494	522	507
Final non-energy consumption	237	-	26	-	46	165	-	-	-	-	-	-
Final energy consumption	2 747	35	50	-	934	208	-	-	-	492	522	507
Industry	623	8	43	-	100	105	-	-	-	128	56	184
of which: Iron & steel industry	*0%*	-	-	-	-	*0%*	-	-	-	-	-	*0%*
Chemical industry	*7%*	-	-	-	*1%*	*2%*	-	-	-	*0%*	*25%*	*15%*
Glass, pottery & building mat.	*15%*	*69%*	*100%*	-	*6%*	*19%*	-	-	-	*0%*	*5%*	*9%*
Paper and printing	*6%*	-	-	-	*1%*	*17%*	-	-	-	*2%*	*3%*	*6%*
Transport	467	-	-	-	459	-	-	-	-	-	-	9
of which: Road transport	*82%*	-	-	-	*83%*	-	-	-	-	-	-	-
Air transport	*6%*	-	-	-	*6%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	1 657	27	8	-	375	103	-	-	-	364	466	315
of which: Households	*70%*	*80%*	*73%*	-	*67%*	*37%*	-	-	-	*93%*	*80%*	*44%*
Statistical difference	281	0	291	-1	-11	-	-	-	-	2	-	-

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1.1.7 Ireland

With few domestic mineral resources and as an island state, the Irish energy system is characterised by high import dependence. It also has some challenging transmission and distribution issues in rural areas, due to the rugged terrain and the complicated geography of its coastline. The high import dependence, rapidly increasing energy demand in the transport sector, and rather high greenhouse gas emissions are the main challenges for future energy planning. Ireland has good potential for wind power and biomass, while its hydro resources have neared their limits in economic and/or environmental terms.

Energy supply structure

Energy consumption is heavily dominated by oil, which in 2004 accounted for nearly 60% of gross inland consumption. Coal and gas, along with peat, one of Ireland's few domestic mineral resources, make up for much of the remainder (see Figure 1.1.25). There is also a small amount of hydro and biomass, and a growing market in wind power. Import dependence reached 87% in 2004 (a recent publication (6) even states 90% for 2005), whereas in 1990, Ireland's import dependence was 65%. Energy demand has been increasing rapidly in recent years, due to the surge of economic growth that started in the 1990s .

Ireland has some other special characteristics in terms of the economic geography of energy structure in a European and global context. It has a geographical position at the end of Western Europe's gas supply chain from Russia or North Africa, and a lack of gas importing capacity in the form of LNG facilities. In the power sector, there is a concentration of load in a few east coast areas but with very extensive rural "tails" in the western part of the country, resulting in a long line length per customer (1).

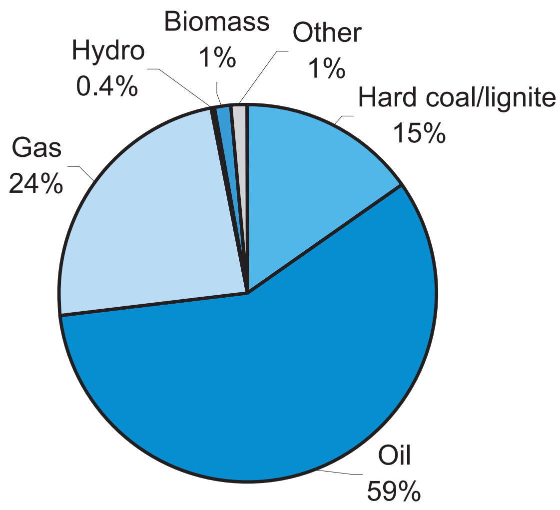
Electricity generation

The Irish electricity market is very different from electricity markets elsewhere in the EU, due to the small size of the market and its limited integration into the wider EU market. Fuel for electricity generation now accounts for 30% of total gross inland consumption and is met almost entirely from gas (47%), solid fossil fuels (36%) and oil (16%) plants.

At the end of the 1970s a large amount of new electricity generating capacity was built, in particular the *Moneypoint* coal-fired power station in County Clare. Coal was the fuel chosen in order to reduce the dependence of the economy on oil (2). The Kyoto protocol placed new environmental pressure on Ireland, prompting the possible closure of *Moneypoint*. At the same time, rapid economic growth has resulted in a need for new capacity.

In the 1930s, Ireland's hydro resources provided much of the electricity for the country, but now the limited hydro resource has been overwhelmed by rising demand. Peat has been one of the few domestic fuels available and accounts for about 5% of gross inland consumption. Peat consumption has been declining in recent years due to socio-economic and environmental concerns; there was, however, a resurgence in peat use in 2005 with the opening of new peat-fired electricity generation (3).

Figure 1.1.25: Gross inland consumption by fuel



Power interconnections

The power inter-connector between Northern Ireland and the Irish Republic improved the security of supply in the two jurisdictions until it was targeted by terrorists on both sides of the border ([4]). It was reopened in 1996 and it is estimated that 10% of electricity consumed in the Republic in the future will be imported through the North. It also provides a link to the UK through the Moyle inter-connector with Scotland. The planned Ireland-Wales inter-connector, which could be in place by the end of the decade, would reduce the isolation of the system and further transform the Irish power market.

Renewable energy

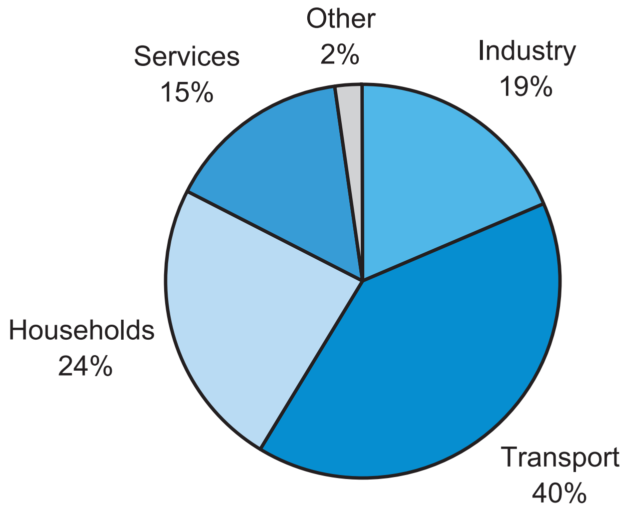
The relevant renewable sources of energy in Ireland include biomass, hydro, landfill gas, solar, and wind. Ireland currently generates 5.2% of its gross electricity consumption from renewable sources, mostly from hydro with smaller contributions from wind and landfill gas. Recent publications ([5]) indicate that this part has moved further up to 6.8% in 2005. The national target is 15% by 2010 and 30% by 2020 ([6]).
Of these sources of energy, wind is deemed to have the highest potential on a per capita basis of any European country. The biggest resources over the next twenty years for Ireland are onshore wind, off-shore wind and biomass. 292 MW of wind capacity was installed in 2004; this capacity was increased to 744 MW at the end of 2006.

Energy demand structure

Final energy demand is dominated by road transport, which accounted for 40% in 2004 (Figure 1.1.26). Industry is a rather small user of energy in comparison to many other EU countries, with only 19% of final demand. The relatively low share of industry in final energy is due to a lack of energy-intensive industries (e.g. iron and steel) and the prominence of light industry in the Irish economy; these structural differences result in higher electricity end-use in comparison to fuels.

Robust economic growth in Ireland and considerable expansion in the service sector in recent years has led to increased demand for electricity and mobility. Increased energy demand, particularly in the transport sector has contributed to higher CO_2 emissions, while the carbon intensity of electricity has also increased due to greater use of peat ([5]). The service sector is likely to receive greater attention in the future in terms of energy efficiency and climate mitigation efforts; service sector demand accounts for the greatest share of electricity consumption-about 38% in 2004.

Figure 1.1.26: Final energy consumption by sector



Ireland - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	1 902	-	889	-	-	688	-	-	-	325	-	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-
Imports	15 029	1 807	19	2 931	7 176	2 960	-	-	-	-	-	135
Stock change	240	-49	-335	31	596	-3	-	-	-	-	-	-
Exports	1 315	8	10	-	1 297	-	-	-	-	-	-	-
Bunkers	149	-	-	-	149	-	-	-	-	-	-	-
Gross inland consumption	15 707	1 750	564	2 962	6 325	3 645	-	-	-	325	-	135
Transformation input	7 912	1 415	414	3 041	773	2 247	-	-	-	22	-	-
of which: Public thermal power stations	*58%*	*98%*	*74%*	-	*99%*	*96%*	-	-	-	*89%*	-	-
Autoprod. therm. power st.	*1%*	*0%*	*3%*	-	-	*4%*	-	-	-	*11%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*38%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	5 106	37	91	-	2 920	-	-	-	-	-	-	2 058
of which: Public thermal power stations	*39%*	-	-	-	-	-	-	-	-	-	-	*97%*
Autoprod. therm. power st.	*1%*	-	-	-	-	-	-	-	-	-	-	*3%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*57%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	0	-	-	-	0	-	-	-	-	-110	-	110
Consumption of the energy branch	314	-	26	-	153	-	-	-	-	-	-	135
of which: Prod. and distrib. of electr.	*32%*	-	-	-	-	-	-	-	-	-	-	*74%*
Oil refineries	*46%*	-	-	-	*89%*	-	-	-	-	-	-	*6%*
Distribution losses	236	-	-	-	-	60	-	-	-	-	-	176
Available for final consumption	12 351	372	215	-79	8 320	1 338	-	-	-	192	-	1 993
Final non-energy consumption	277	-	-	-	277	-	-	-	-	-	-	-
Final energy consumption	11 525	274	219	-	7 535	1 325	-	-	-	192	-	1 980
Industry	2 132	37	0	-	927	433	-	-	-	146	-	590
of which: Iron & steel industry	*0%*	-	-	-	-	*0%*	-	-	-	-	-	*0%*
Chemical industry	*16%*	-	-	-	*15%*	*22%*	-	-	-	-	-	*18%*
Glass, pottery & building mat.	*15%*	-	-	-	*27%*	*6%*	-	-	-	-	-	*7%*
Paper and printing	*2%*	-	-	-	*1%*	-	-	-	-	-	-	*4%*
Transport	4 607	-	-	-	4 594	-	-	-	-	-	-	13
of which: Road transport	*83%*	-	-	-	*83%*	-	-	-	-	-	-	-
Air transport	*16%*	-	-	-	*16%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	4 786	238	219	-	2 014	891	-	-	-	46	-	1 378
of which: Households	*58%*	*89%*	*100%*	-	*54%*	*66%*	-	-	-	*95%*	-	*46%*
Statistical difference	549	97	-4	-79	508	13	-	-	-	0	-	13

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1.1.8 Greece

In recent years, Greece has been restructuring its energy system to improve sustainability, security and competitiveness, thereby addressing the key policy goals of EU Directives. Key developments in energy supply have included the addition of natural gas to the energy mix starting in 1998 and the efforts to exploit the abundantly available solar and wind energy potential. The construction of trans-European and trans-continental networks is helping to transform Greece into a key energy link between the EU and the major energy markets of Eastern Europe and Asia.

Gross inland consumption

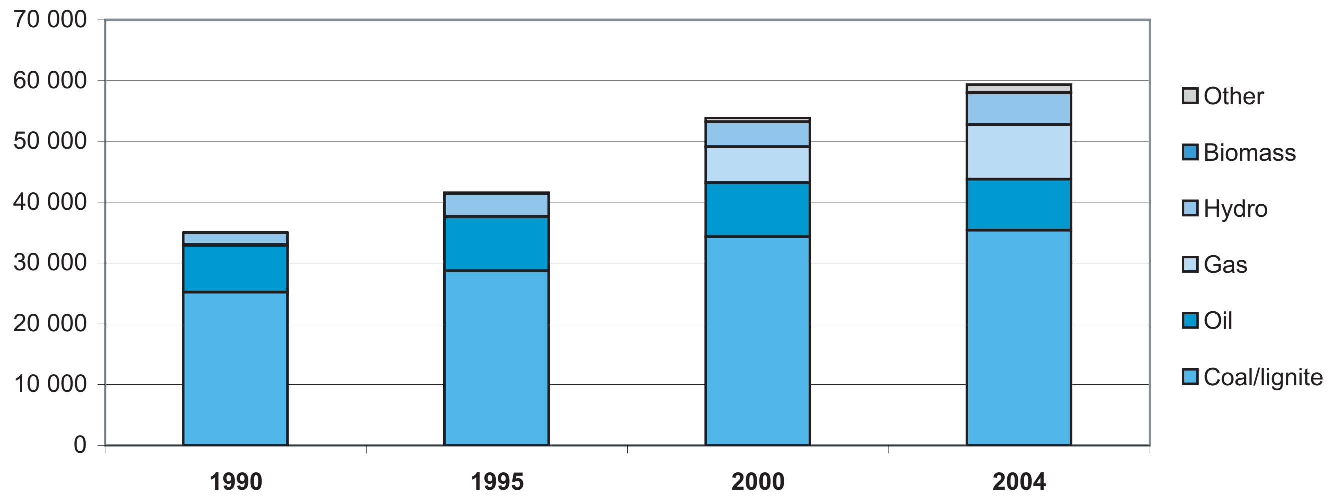
The Greek energy system has historically been characterised by continuous growth, relatively high energy intensities, and a continuing attachment to conventional fuels. Although energy intensity remains higher than many other EU states, per capita consumption of primary energy forms in Greece is relatively low. The low energy consumption per capita results from differences in economic structure, living standards and climatic conditions.

Primary energy consumption is still dominated by oil and solid fuels (mainly lignite), which together account for 95% of gross inland consumption. The entrance of natural gas into the Greek energy system in 1998 has diversified the energy mix. Driven initially by power generation, gas use grew in just a few years from zero to more than 7% of consumption by 2004. Russia is the largest gas supplier, with 82% of imports, while Algeria provides the remainder as liquefied natural gas (LNG) stored in a terminal near Athens. For further enhancing the security of gas supply a project of doubling the existing LNG storage capacity is under way.

Electric power sector

The intensive exploitation of lignite was a major strategic choice of Greece after the energy crises in the 1970s in order to preserve a minimum of energy independence. Imported oil has traditionally been used as a second major fuel for thermal plants. During the 1990s, a significant transition took place to reduce the dependence on oil and lignite for power generation. The availability of natural gas along with hydro expansion facilitated a reduction of the combined share of oil and lignite in the power supply from 94% in 1990 to 74% in 2004 (Figure 1.1.27). However, the continuing dependence on lignite, the growing electricity demand, and the low average efficiency of thermal power plants represent an environmental liability, as the power sector is responsible for over 50% of CO_2 emissions in Greece.

Figure 1.1.27: Electric power generation by source (GWh)



The power network in Greece consists of the interconnected grid on the mainland with a capacity of nearly 11 000 MW in 2004, along with several autonomous systems in the islands driven by oil and wind, which supply about 1800 MW. Existing or planned sub-sea interconnections among small islands and/or with the mainland aim to drop the cost of small autonomous units, balance load demand, and enhance the capacity of islands to exploit intermittent renewable resources. There is also a sub-sea interconnection with Italy, with a capacity of 500 MW. Besides, electricity trade with neighbouring countries amounts to about 5% of final electricity consumption, mainly with Bulgaria, Albania, F.Y.R of Macedonia and Italy.

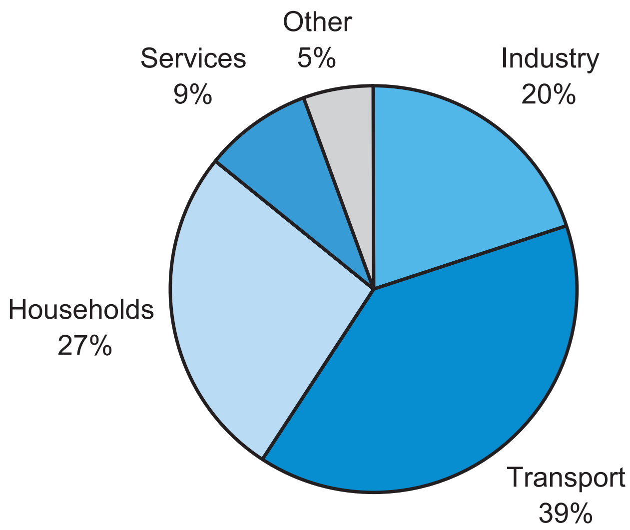
The Greek electricity market has been officially liberalised since 1999. The law issued in compliance with the EU's Directive provided for an independent authority, the Regulatory Authority for Energy, assigned with the duty to monitor and control the operation and expansion of all energy markets, as well as for an independent Transmission System Operator. The market was opened in July 2004 for all non-household consumers within the interconnected system, and government ownership in public power production and distribution has been gradually reduced. A technical issue is the rapidly growing peak load, due to cooling in the summer, necessitating expansion of interconnections, or capacity additions.

Final energy demand

Final energy consumption is dominated by transport, which accounted for 39% of the total in 2004, followed by households with 27%, and industry with 20% (Figure 1.1.28). Electricity consumption is dominated by the households sector, with 34%, while services and industry have 32% and 28%, respectively. Technical progress, increased penetration of energy-efficient equipment, and increased use of energy management techniques have reduced energy intensity in recent years, principally in the industrial sector.

One distinguishing feature in household consumption of energy is the relatively high share of biomass, which is 13% of total household final energy demand and equivalent to about half of the electricity demand in households. Petroleum products continue to serve as the main fuel used in households, although fuel-switching to solar, gas, and other options has been increasing.

Figure 1.1.28: Final energy consumption by sector



Renewable energy options

Despite considerable natural endowments, the degree of renewable energy exploitation remains confined for the most part to certain commercially mature technologies: large hydro in power generation, solar water heating collectors, and traditional use of biomass in the final demand sectors. The total share of renewable energy in final energy consumption is 5%. The ratio between electricity produced from renewable energy sources and the gross national electricity consumption was 10% in 2004. The indicative target under the EU Renewables Directive is 20.1%. The challenge to meet this target, together with the effort to comply with the Kyoto commitment, has recently accelerated the deployment of renewables, particularly of wind energy. There has also been legislation to facilitate exploitation of geothermal potential, by characterising it in legal terms as a renewable energy resource rather than a mineral resource (1). The geothermal potential has been estimated as 500 MWe(2).

Greece has the second largest solar thermal market in the EU, with over 3 million m2 installed by the end of 2005 (3). After Cyprus, Greece and Austria are roughly tied for the second highest per capita use of solar thermal systems in the EU (4). The development of the solar market, targeting the household sector for water heating purposes, started in 1975 in a period of high energy prices and was rapidly expanded in the 1980s as a result of a tax deduction incentive and a large advertising campaign. The withdrawal of the economic incentive led to the gradual increase of exports, representing today 40% of total production, making Greece appear as the largest exporter of solar systems in Europe.

eurostat

Greece - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	10 268	-	8 547	133	-	29	-	-	-	1 560	-	
Recovered products	-	-	-	-	-	-	-	-	-	-	-	
Imports	30 491	501	-	21 641	5 758	2 174	-	-	-	-	-	417
Stock change	-1 014	-10	99	-1 043	-86	26	-	-	-	-	-	
Exports	5 903	13	24	812	4 879	-	-	-	-	-	-	175
Bunkers	3 212	-	-	-	3 212	-	-	-	-	-	-	
Gross inland consumption	30 631	478	8 623	19 919	-2 419	2 229	-	-	-	1 560	-	242
Transformation input	33 180	-	8 625	21 122	1 803	1 599	-	-	-	32	-	
of which: Public thermal power stations	*36%*	-	*99%*	-	*99%*	*99%*	-	-	-	*87%*	-	-
Autoprod. therm. power st.	*0%*	-	-	-	*1%*	*1%*	-	-	-	*13%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*64%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	25 695	-	63	-	21 030	-	-	-	-	-	43	4 559
of which: Public thermal power stations	*18%*	-	-	-	-	-	-	-	-	-	*100%*	*98%*
Autoprod. therm. power st.	*0%*	-	-	-	-	-	-	-	-	-	-	*2%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*82%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	59	-	-	1 179	-1 120	-	-	-	-	-498	-	498
Consumption of the energy branch	1 765	-	-	-	1 153	37	-	-	-	-	-	576
of which: Prod. and distrib. of electr.	*22%*	-	-	-	-	-	-	-	-	-	-	*67%*
Oil refineries	*70%*	-	-	-	*100%*	-	-	-	-	-	-	*14%*
Distribution losses	454	-	-	-	-	5	-	-	-	-	-	449
Available for final consumption	20 985	478	60	-24	14 535	588	-	-	-	1 030	43	4 275
Final non-energy consumption	831	-	-	-	700	131	-	-	-	-	-	
Final energy consumption	20 245	478	81	-	13 878	461	-	-	-	1 029	43	4 275
Industry	4 045	475	78	-	1 709	373	-	-	-	207	-	1 203
of which: Iron & steel industry	*5%*	-	-	-	*1%*	*18%*	-	-	-	-	-	*11%*
Chemical industry	*6%*	-	-	-	*10%*	*8%*	-	-	-	-	-	*4%*
Glass, pottery & building mat.	*30%*	*80%*	-	-	*33%*	*18%*	-	-	-	*1%*	-	*16%*
Paper and printing	*3%*	-	-	-	*3%*	*8%*	-	-	-	-	-	*4%*
Transport	7 960	-	-	-	7 929	11	-	-	-	-	-	20
of which: Road transport	*76%*	-	-	-	*76%*	*100%*	-	-	-	-	-	-
Air transport	*15%*	-	-	-	*15%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	8 241	2	3	-	4 240	78	-	-	-	821	43	3 052
of which: Households	*65%*	-	*88%*	-	*71%*	*44%*	-	-	-	*98%*	*100%*	*47%*
Statistical difference	-91	-	-21	-24	-43	-5	-	-	-	1	-	

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1.1.9 Spain

Spain has experienced a high rate of economic growth and a rapid pace of industrialisation during the past 20-25 years, particularly after joining the EU in 1986 (1). This growth was accompanied by fairly rapid growth in energy consumption, and consequently, there has been considerable investment in energy systems infrastructure and capacity during the past two decades. The growth in demand has led to increased reliance on imports, which has led to greater energy security concerns. The overall energy system is highly dependent on petroleum products, although the power sector is fairly diversified in the mix of sources. Renewable energy development has accelerated substantially during the past 10-15 years, including biofuels as well as renewable power, in particular wind. Renewables and energy efficiency continue to be a major focus of energy policy in addressing the twin challenges of energy security and climate change mitigation.

Primary energy

The Spanish energy system is characterised by a rather high dependence on oil, which accounted for about half of the gross inland consumption of energy in 2004 (Figure 1.1.29), and essentially all of which is imported. In the past twenty years, oil, nuclear energy and renewables have maintained relatively stable shares of about 50%, 13% and 7% of the gross inland consumption respectively, with the main shift taking place between solid fuels and natural gas: the share of solid fuels decreased from 28% in 1985 to 15% in 2004, while the share of natural gas increased from 3% to 18% over the same period.

Electric power sector

Electricity consumption has grown by about 5% per year since 1980, nearly double the growth rate experienced within the EU as a whole.

The electric power system is fairly diversified compared to other EU countries. The largest share - about 28% - of Spain's electricity generation comes from solid fuels, which is Spain's major domestic energy resource. Nuclear, gas, hydro, oil and wind provide nearly all of the remainder (Figure 1.1.30). There is also a small amount of production from biomass and waste. The hydro contribution fluctuates annually and seasonally, which impacts not only the other sources but also the share of imports and exports. Renewables accounted for 19% of power generation in 2004.

Figure 1.1.29: Gross inland consumption by fuel

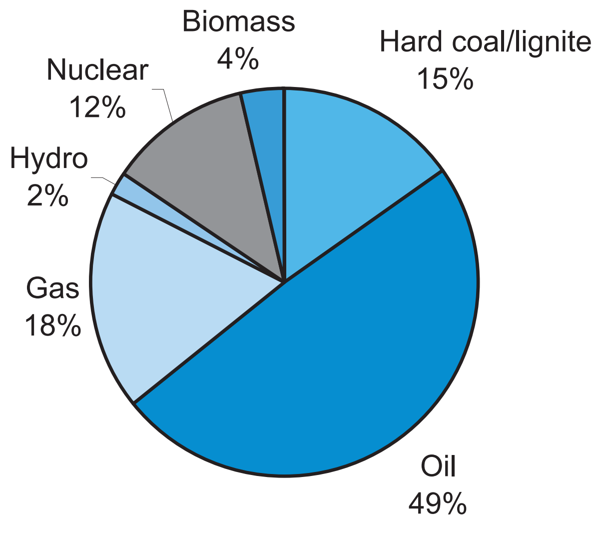
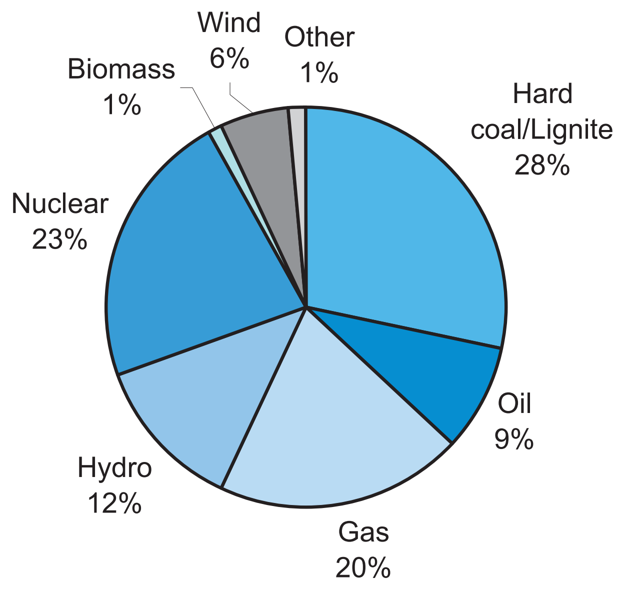


Figure 1.1.30: Electricity generation by source, 2004



Much of the diversification in the Spanish power system occurred during the past 10-15 years, particularly the expansion of natural gas and wind. Although nuclear, solid fuels, and hydro have also increased in absolute terms, their shares of generation have decreased over this period (Figure 1.1.31). Natural gas represented only 1% of generation in 1990, whereas by 2004 it had grown to 20%. Wind grew from essentially zero in 1990 to nearly 6% by 2004.

The installed capacity of wind turbines was 8 220 MW as of the end of 2004, representing about 12% of total installed capacity. Nuclear and hydro accounted for 11% and 26% of installed capacity, respectively. Thermal plants still constitute the majority, with slightly over half of the installed capacity.

The electricity and gas markets were fully liberalised in 2003, at a faster pace than required by the EU Directives. Consumers have the option of staying under regulated tariffs until July 2007 rather than opting to buy their electricity from the liberalised electricity market. The transmission system and market operations have been separated out from the vertically integrated utilities following the establishment of a Market Operator and Transmission System Operator (TSO). A TSO has been established in the gas sector, and the separation of ownership between supply and distribution is in progress.

Nuclear

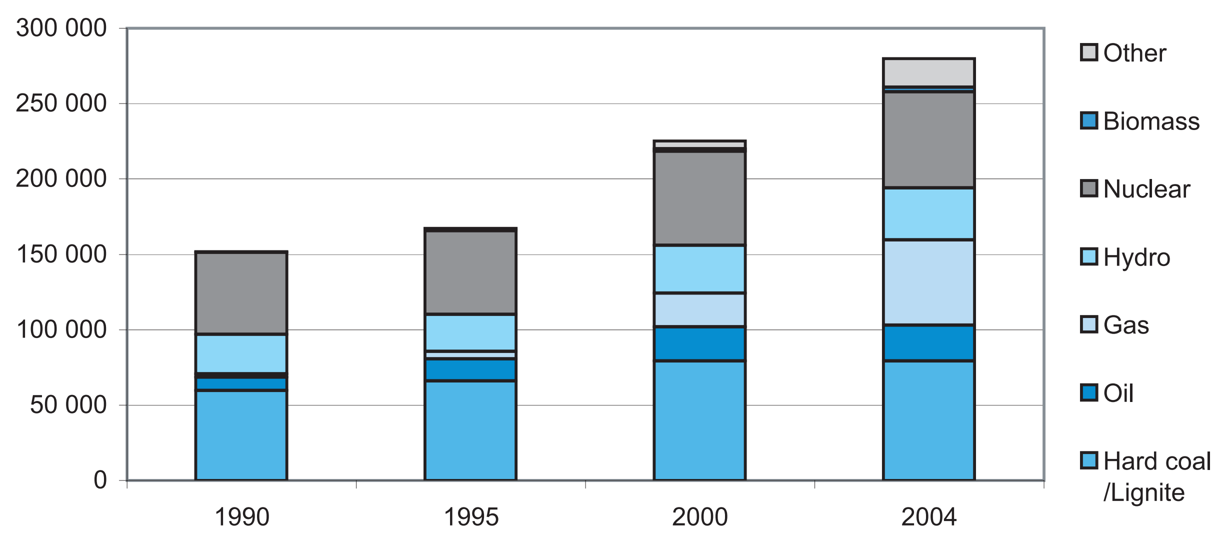
Currently, Spain has nine operating nuclear reactors, which provide nearly one quarter of electricity generation and contribute to the important base of energy resources in Spain that are both low carbon and of domestic origin. The 1997 Electric Power Act placed a moratorium on completion of five partially built nuclear units. The output of the nuclear power sector in Spain has remained relatively stable despite closures of some nuclear units, due to upgrades and efficiency gains at existing plants.

Solid fuels

Spain has significant reserves of solid fuels; despite this fact, the primary production of solid fuels has steadily declined in both absolute and relative terms over the last two decades, while the solid fuels dependency of the country on imports increased from 25% in 1985 to 67% in 2004. Coal mining is spread over a number of small, isolated fields around the country, which has complicated efforts to develop a coordinated strategy with respect to future capacity.

Spain's conventional thermal generating capacity contributes over half of the country's total power supply. Over the past several years, this capacity has begun to shift from coal towards natural gas in the form of combined-cycle, gas-fired turbines. Spain has promoted such units in order to increase existing generating capacity and reduce its carbon dioxide emissions. Natural gas accounted for 30% of Spain's conventional thermal capacity in 2004, and its share is likely to rise.

Figure 1.1.31: Electricity generation by source (GWh)



eurostat

Oil and gas

Spain has a very small stock of proven oil and gas reserves. Domestic production accounted for 1.2% of natural gas gross inland consumption in 2004, while domestic oil production accounted for only 0.4% of crude oil and feedstocks gross inland consumption. Oil is imported mainly from Russia, Mexico, Saudi Arabia, Libya and Nigeria. Oil transport and storage companies provide third party access to their facilities, and the necessary ownership separation measures are continuing. Although the share of oil in primary energy supply has fallen considerably, it is still well above the EU average. The continuously increasing demand for mobility along with dependence on oil in other sectors are among the main factors for the increase in oil consumption, which has increased by more than 50% over the past two decades since Spain joined the EU.

Spain has one of the fastest-growing natural gas markets in the world, driven mostly by the widespread introduction of gas-fired power plants. There have been efforts to diversify the supply sources of natural gas, including increasing connections to the EU grids. As with electricity, the gas interconnections to neighbouring countries remain somewhat complicated due in part to geography; Spain and Portugal lie at the end of the long natural gas supply chains that extend southward and westward within the EU. Gas supplies from northern Africa and natural gas imported as LNG are therefore strategic elements of the overall strategy. In order to improve security of supply, gas imports from a single country and by a single agent are limited by law to 60% of the total (2).

Renewable energy options

Spain has been quite successful in moving towards renewable sources, including hydro, wind, biomass, solar and waste-to-energy. Renewable resources are widely dispersed and include a significant number of small-scale (< 10 MW) hydro plants, which account for more than 10% of total hydro capacity. The use of solid biomass for heat and power has been growing, although from a small base. Electricity from biomass increased five-fold between 1990 and 2004; this amounted to just slightly over 1% of total gross electricity generation in 2004.

In 2004, Spain was the world's second-largest producer of wind power after Germany, with the energy source meeting 6% of Spain's total gross electricity generation. Spain has some 8 220 MW of installed wind capacity, with an additional 57 000 MW in various stages of planning, development, and regulatory approval.

Growth in the photovoltaic market has also been strong due to cost reductions, a rising number of applications, and a significant R&D effort especially for grid-connected photovoltaic installations. The primary incentive for new photovoltaic installations has been high guaranteed prices. Incentives are available at both the national and regional level.

Solar photovoltaic capacity increased from 5 MW in 1993 to 36 MW in 2004. Electricity generation was 24 GWh in 2001 and grew up to 56 GWh in 2004.

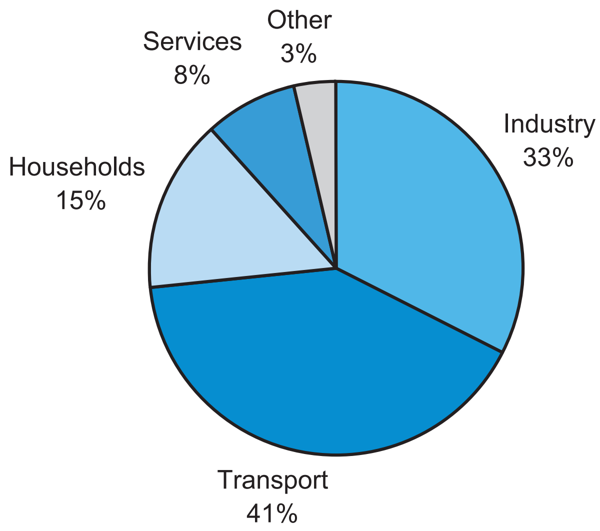
Biofuels for transport

Under the 2000-2010 Renewable Energy Plan, Spain set production targets for 2010 of 400 000 toe of ethanol and 100 000 toe of bio-diesel. Currently, Spain is one of the largest producers of biofuels in the EU. Total production in 2004 was 181 000 and 125 000 tonnes of bio-gasoline and bio-diesel, respectively. National and regional governments provide subsidies for plant construction and for promoting ethanol use. Ethanol and bio-diesel producers are exempt from the hydrocarbon tax, as is the percentage of ETBE in gasoline. Additionally, public transport programmes in Spain have promoted the use of ethanol and bio-diesel. There is also funding for demonstration plants and research and development of processes to convert lignocellulosic materials to ethanol.

Energy demand structure

Final energy consumption is dominated by transport and industry, which accounted for 41% and 33% in 2004, respectively (Figure 1.1.32). The buildings sectors (mainly households and services) have much smaller shares of final energy demand compared to the EU averages. Structural shifts in the economies of other EU countries have resulted in lower industrial sector demand for energy, and such shifts have been occurring in Spain as well, albeit starting at a later point in time. Demand for electricity for cooling has been increasing, whereas heating needs in the Mediterranean climate are much lower compared to the typical EU values. The share of electricity in the buildings sectors was thus much higher in 2004 - 54% - compared to the 23% that is observed for final demand from all energy sources.

Figure 1.1.32: Final energy consumption by sector



Energy policy for renewables and efficiency

The General Electricity Law of 2003 included the goal of 12% of primary energy consumption from renewable sources by 2010. Since 1998, there have been guaranteed prices and feed-in tariffs for renewables and co-generation. The Renewable Energy Promotion Plan (*Plan de Fomento de las Energías Renovables en España*) (1999-2010) also establishes a supply of at least 12% of Spain's total energy demand with energy generated from renewable sources by 2010. The main sources that are considered by the plan are biomass, wind, hydro, solar and urban solid waste.

The Renewable Action Plan 2000-2010 created an inter-ministerial commission to promote a package of measures and remove barriers in the deployment of renewable energy setting yearly electric tariffs. The plan and the subsequent Royal decree that modified it included a series of obligations concerning disclosure of their production forecasts and other information, as well as rules for the purchase of the electricity generated by energy traders.

The Strategy for Energy Saving and Efficiency in Spain 2004-2012 aims to reduce the high dependence on imported energy; Spain's energy dependency rate was 77% in 2004. This Strategy along with the Plan for the Promotion of Renewable Energy are the major means to promote diversification of energy sources and promote energy efficiency within the Spanish energy sector.

Spain - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	32 399	5 135	1 318	252	-	310	-	16 407	-	8 977	-	
Recovered products	-	-	-	-	-	-	-	-	-	-	-	
Imports	123 600	14 845	-	58 836	24 605	24 615	-	-	-	-	-	697
Stock change	926	466	3	165	46	247	-	-	-	-	-	
Exports	9 543	671	-	-	7 915	-	-	-	-	-	-	958
Bunkers	7 136	-	-	-	7 136	-	-	-	-	-	-	
Gross inland consumption	140 246	19 776	1 320	59 254	9 601	25 172	-	16 407	-	8 977	-	-260
Transformation input	111 120	19 561	1 561	59 436	5 025	7 701	280	16 407	-	1 149	-	
of which: Public thermal power stations	*25%*	*83%*	*100%*	-	*80%*	*65%*	*74%*	-	-	*28%*	-	-
Autoprod. therm. power st.	*4%*	*0%*	-	-	*20%*	*35%*	*26%*	-	-	*72%*	-	-
Nuclear power stations	*15%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*3%*	*14%*	-	-	-	-	-	-	-	-	-	-
Refineries	*53%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	81 510	1 933	-	-	58 870	-	934	-	-	-	0	19 774
of which: Public thermal power stations	*13%*	-	-	-	-	-	-	-	-	-	*#DIV/0!*	*56%*
Autoprod. therm. power st.	*4%*	-	-	-	-	-	-	-	-	-	-	*17%*
Nuclear power stations	*7%*	-	-	-	-	-	-	-	-	-	-	*28%*
Coke-oven plants	*3%*	*100%*	-	-	-	-	*50%*	-	-	-	-	-
Refineries	*72%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	43	-	-	194	-142	-	-	-	-	-4 063	-	4 055
Consumption of the energy branch	5 862	37	-	-	3 920	-	237	-	-	4	-	1 664
of which: Prod. and distrib. of electr.	*17%*	-	-	-	-	-	-	-	-	-	-	*58%*
Oil refineries	*72%*	-	-	-	*100%*	-	-	-	-	-	-	*17%*
Distribution losses	2 228	-	-	-	-	158	-	-	-	-	-	2 070
Available for final consumption	102 590	2 110	-241	12	59 383	17 312	418	-	-	3 762	0	19 834
Final non-energy consumption	8 216	-	-	-	7 743	440	33	-	-	-	-	
Final energy consumption	94 317	1 870	-	12	52 084	16 372	384	-	-	3 762	0	19 834
Industry	30 660	1 702	-	12	6 164	12 348	346	-	-	1 358	0	8 730
of which: Iron & steel industry	*17%*	*75%*	-	-	*8%*	*12%*	*100%*	-	-	*0%*	-	*17%*
Chemical industry	*15%*	*15%*	-	-	*12%*	*19%*	*0%*	-	-	*1%*	*#DIV/0!*	*13%*
Glass, pottery & building mat.	*23%*	*5%*	-	-	*43%*	*25%*	-	-	-	*10%*	-	*12%*
Paper and printing	*8%*	-	-	-	*4%*	*8%*	-	-	-	*34%*	-	*8%*
Transport	38 398	-	-	-	37 700	-	-	-	-	248	-	450
of which: Road transport	*80%*	-	-	-	*81%*	-	-	-	-	*100%*	-	-
Air transport	*13%*	-	-	-	*13%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	25 260	167	-	-	8 219	4 024	38	-	-	2 156	-	10 654
of which: Households	*57%*	*81%*	-	-	*50%*	*75%*	*63%*	-	-	*95%*	-	*47%*
Statistical difference	57	240	-241	-	-443	500	-	-	-	-	0	

References

(1) OECD. 2001. Spain - In-depth review . OECD/IEA. http://www.iea.org/textbase/nppdf/free/2000/spain_comp01.pdf. Accessed 14/11/06.

(2) IEA. 2006. Renewable Energy - Market and Policy Trends in IEA Countries. International Energy Agency. http://www.iea.org/textbase/nppdf/free/2004/renewable2.pdf. Accessed 14/11/06.

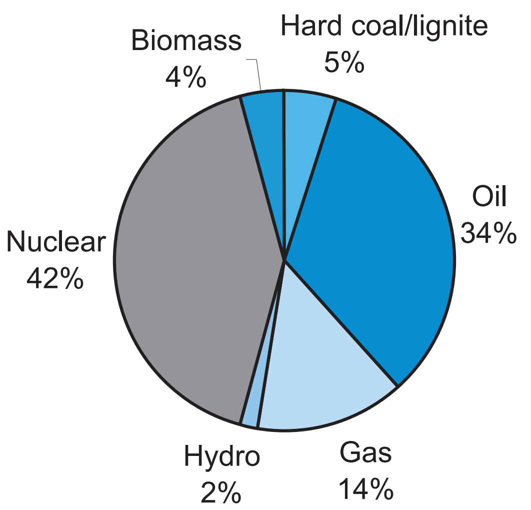
1.1.10 France

The French energy system has evolved based on the principles of energy access for all citizens, price competitiveness, environmental protection, and security of supply. With few fossil fuel resources, nuclear power and renewable energy have become key elements of the French energy system, along with imported oil and the petroleum products that are needed for the transport sector. Biomass and hydropower provide the majority of renewable energy at present, although there is also increasing investment in wind power and in solar thermal systems. France is also among the major producers of biofuels, and has promoted the use of bio-diesel and bio-ethanol in the transport sector. The Energy Act of 2005 laid down new goals for advancing renewable energy and improving energy efficiency, as well as re-affirming the principles of energy independence and environmental sustainability that have long guided energy policy decisions.

Primary energy supply

The energy system is dominated by nuclear power, which accounted for 42% of gross inland consumption in 2004, followed by oil with 34% and gas with 14% (Figure 1.1.33). Renewables and coal each provide about half of the remaining shares. France is among the few countries in the EU that is not heavily dependent on fossil fuels outside of the transport sector. The known domestic reserves of oil and gas are quite small; only about 2.8% of oil supply and about 1.6% of the gas supply in 2004 was of domestic origin. All coal is now imported; coal production in France has been decreasing steadily for several decades, and mining of coal ended in 2004. In spite of the imported fossil fuels, France's import dependence is slightly below the EU average, due mainly to the key role of nuclear power.

Figure 1.1.33: Gross inland consumption by fuel



Note: The total sum is larger than 100% due to the net export of electricity.

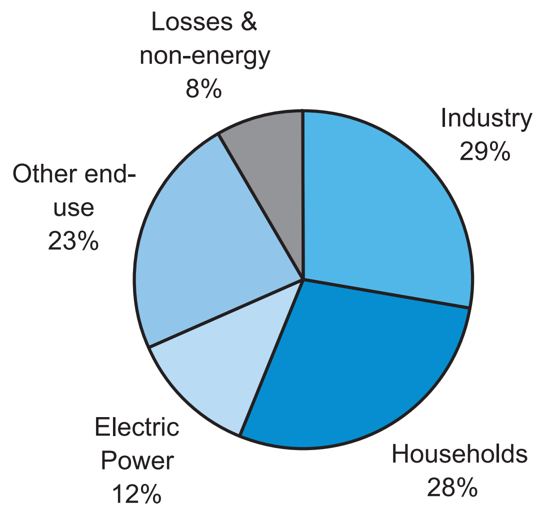
Electric power and gas sectors

The electric power sector is based mainly on nuclear power, which accounted for 54% of installed capacity and 78% of production in 2004. The share of nuclear has been increasing since 1990, while the shares of coal and oil have decreased. Hydro, which is subject to climatic fluctuations in availability, has varied between 10-15% during 1990-2004. France is also a major exporter of electricity; in 2004, exports amounted to 12% of total electricity generation.

Unlike many other EU countries, the gas supply is oriented towards non-electric uses, due in part to the dominant role of nuclear and the growing emphasis on renewables; 12% of gas was directed for electricity production in 2004. Gas consumption is consequently spread over many sectors, with households and industry accounting for almost half of the supply (Figure 1.1.34).

Since 1 July 2004, commercial customers have been able to choose their electricity supplier, and from 1 July 2007, it will be the turn of individual household consumers. The conditions for transparency and competitive efficacy have been, including an independent regulator, third party regulated access to electricity and natural gas grids, and access to natural gas stocks negotiated under transparent and non-discriminatory conditions.

Figure 1.1.34: Natural gas use by sector



Biofuels for transport

France is among the few EU countries that is active in both bio-diesel and bio-ethanol production. In 2004 and 2005, it was the second largest producer of bio-diesel and the fourth largest producer of bio-ethanol in the EU ([1]). Policies regarding biofuels have advanced considerably in recent years; a biofuels obligation of 2% was established in 2005, with an opt-out provision based on additional tax payment ([2]). New legislation in 2005 raised the biofuels target for 2010 to 7%, which exceeds the target in the EU Biofuels Directive of 5.75%.

Energy demand

Industry and transport account for more than half of final energy consumption, while households and service sector accounted for 65% of final electricity consumption (Figures 1.1.35 and 1.1.36). Although energy intensity (energy relative to GDP) declined during the past two decades, energy demand increased steadily due to robust economic growth, rising population, growth in road transport, increased domestic electricity use, and the requirements of major industrial energy consumers of energy.

Electricity consumption has increased at a much faster rate than final energy use; from 1985 to 2005, final energy consumption increased by 1% annually on average, while final electricity consumption increased by 2.7% per year. Electricity now accounts for 23% of final energy consumption compared to 17% in 1985. Some of the key factors behind the trend towards electricity were the relatively high oil prices, the growing importance of the service sector, and the increasing nuclear capacity at competitive prices.

In recent years, considerable efforts have been aimed at further reducing energy intensity. Recent legislation has been aimed at further inducing reductions in demand. A tax credit for energy saving and renewable energies was introduced on 1st January 2005 and reinforced in 2006. The tax credit rate has been increased from 40% to 50% for energy production equipment using a renewable energy source and certain types of heat pumps; and from 25% to 40% for condensing boilers and thermal insulation materials under certain conditions.

In 2006, energy savings targets were established based on the introduction of an energy saving certificate scheme, sometimes referred to as White Certificates ([3]). The principle of energy saving certificates is based on an obligation imposed on energy sellers by the public authorities to generate energy savings over a given period. Energy-intensive industries are exempt from the obligations, in part because they already are responsible for carbon reductions through the EU Emissions Trading Scheme. A savings target of 54 TWh has been set for the 3-year period from 1st July 2006 to 30th June 2009.

Figure 1.1.35: Final energy consumption by sector

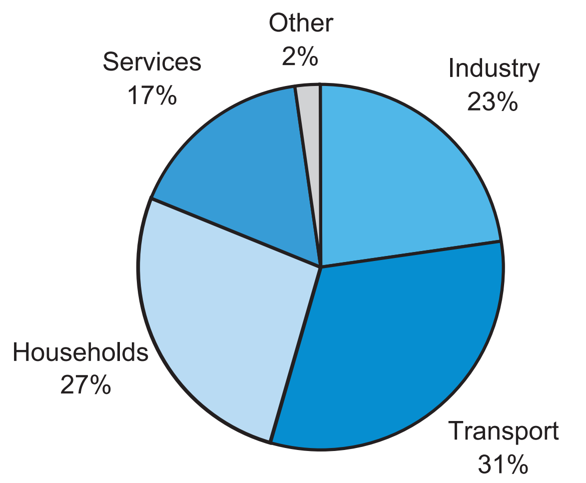
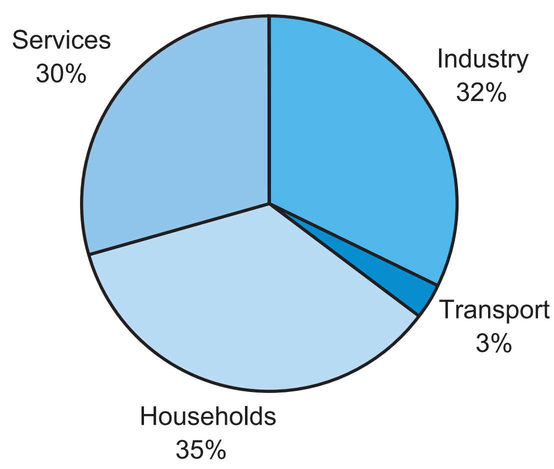


Figure 1.1.36: Electricity consumption by sector



France - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	135 591	99	-	1 374	-	1 108	-	115 625	-	17 385	-	-
Recovered products	818	442	-	275	101	-	-	-	-	-	-	-
Imports	171 505	13 897	16	85 744	32 301	38 984	-	-	-	1	-	563
Stock change	516	241	-	20	-116	371	-	-	-	-	-	-
Exports	31 749	637	-	102	23 804	1 227	-	-	-	81	-	5 898
Bunkers	2 982	-	-	-	2 982	-	-	-	-	-	-	-
Gross inland consumption	273 700	14 042	16	87 311	5 499	39 236	-	115 625	-	17 304	-	-5 334
Transformation input	226 167	11 735	-	89 846	1 213	4 777	815	115 625	-	2 156	-	-
of which: Public thermal power stations	*5%*	*49%*	-	-	*64%*	*90%*	*100%*	-	-	-	-	-
Autoprod. therm. power st.	*1%*	-	-	-	*18%*	*10%*	-	-	-	*87%*	-	-
Nuclear power stations	*51%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*2%*	*38%*	-	-	*2%*	-	-	-	-	-	-	-
Refineries	*40%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	138 064	3 169	-	-	89 071	-	2 295	-	-	-	-	43 529
of which: Public thermal power stations	*2%*	-	-	-	-	-	-	-	-	-	-	*8%*
Autoprod. therm. power st.	*1%*	-	-	-	-	-	-	-	-	-	-	*4%*
Nuclear power stations	*28%*	-	-	-	-	-	-	-	-	-	-	*89%*
Coke-oven plants	*3%*	*99%*	-	-	-	-	*32%*	-	-	-	-	-
Refineries	*65%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	48	-	-	1 876	-1 828	-	-	-	-	-5 229	-	5 228
Consumption of the energy branch	10 799	23	-	-	4 897	547	428	-	-	-	-	4 904
of which: Prod. and distrib. of electr.	*20%*	-	-	-	-	-	-	-	-	-	-	*43%*
Oil refineries	*48%*	-	-	-	*100%*	-	-	-	-	-	-	*7%*
Distribution losses	3 162	-	-	-	-	401	-	-	-	-	-	2 760
Available for final consumption	171 684	5 453	16	-658	86 632	33 511	1 051	-	-	9 919	-	35 759
Final non-energy consumption	14 575	-	-	-	12 260	2 315	-	-	-	-	-	-
Final energy consumption	157 903	4 796	16	-	73 987	32 376	1 049	-	-	9 919	-	35 759
Industry	35 891	4 388	16	-	6 634	10 910	1 049	-	-	1 374	-	11 520
of which: Iron & steel industry	*17%*	*75%*	-	-	*0%*	*5%*	*100%*	-	-	-	-	*12%*
Chemical industry	*18%*	*8%*	-	-	*35%*	*17%*	-	-	-	-	-	*18%*
Glass, pottery & building mat.	*11%*	*5%*	-	-	*18%*	*16%*	-	-	-	-	-	*7%*
Paper and printing	*9%*	*3%*	-	-	*3%*	*11%*	-	-	-	*44%*	-	*10%*
Transport	50 136	-	-	-	48 702	43	-	-	-	329	-	1 062
of which: Road transport	*84%*	-	-	-	*86%*	*100%*	-	-	-	*100%*	-	-
Air transport	*12%*	-	-	-	*13%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	71 876	408	-	-	18 651	21 424	-	-	-	8 216	-	23 177
of which: Households	*58%*	*100%*	-	-	*54%*	*52%*	-	-	-	*93%*	-	*54%*
Statistical difference	-794	657	-	-658	384	-1 180	3	-	-	-	-	-

References

(1) EurObserv'ER, 2006 "Biofuels Barometer," June 2006.

(2) The biofuels obligation refers to overall share and is not the same as a mandated blend; the latter would be inconsistent with the EU Fuel Quality Directive (Directive 2003/17/EC amending directive 98/70/EC relating to the quality of petrol and diesel fuels - OJ L 76, 22.3.2003, p. 10).

(3) Décret n° 2006-600 du 23 mai 2006 relatif aux obligations d'économies d'énergie dans le cadre du dispositif des certificats d'économies d'énergie ; Ministère de l'économie, des finances et de l'industrie; http://www.legifrance.gouv.fr/

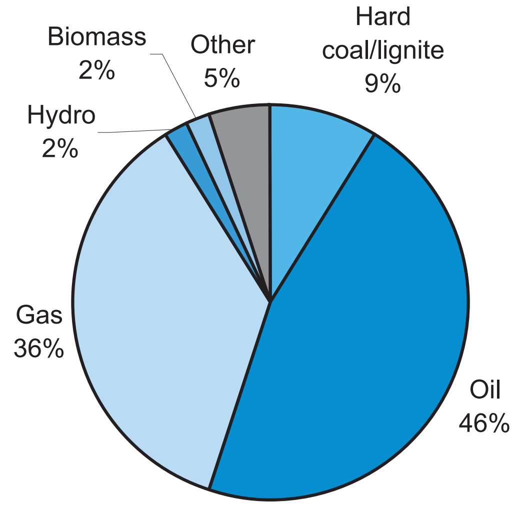
1.1.11 Italy

The energy sector in Italy has strategic importance for the economy, due to the lack of indigenous fossil resources and the high dependence on imports. Oil and gas account for the overwhelming majority of primary energy consumption. The high degree of structural oil dependence has been the driver behind national strategies for geographic and source diversification of energy supplies, infrastructure investments and environmental policy choices. The ongoing process of market liberalisation has opened up opportunities for new players in the electricity and gas markets and facilitated the expansion of a broader array of potential technical applications. Energy sector policies have been aimed at the challenges of increasing energy security, improving economic competitiveness and meeting environmental policy commitments.

Energy supply structure

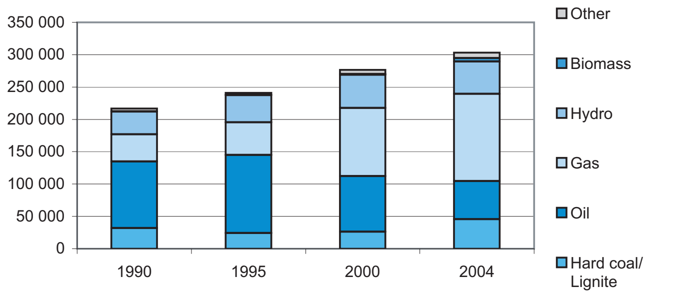
The Italian energy system is based primarily on oil and gas, which together accounted for 82% of gross inland consumption in 2004. Since coal provides 9%, the result is that 91% of the energy system is based on fossil fuels. Hydro, geothermal (included in 'other'), and biomass provide the remaining 9% (Figure 1.1.37). The overwhelming majority of the energy supply is imported - 85% of natural gas, 97% of petroleum products, and essentially all of the coal. The markets for other renewable sources - wind and solar photovoltaic -have recently been expanding and could provide a small although not insignificant share in the future.

Figure 1.1.37: Gross inland consumption by fuel



The electric power sector has undergone a shift towards a somewhat more diversified mix of sources during the past 10-15 years (Figure 1.1.38). However, the main shift has been from oil to natural gas; the share of oil in electricity production decreased from 47% in 1990 to 19% in 2004, while the share of gas increased from 18% in 1990 to 43% in 2004. The proportion taken by coal increased only very slightly. The shares of geothermal, wind, and biomass have also increased over this period, albeit starting from a low base. The share of hydro has remained constant; the absolute amount has slightly increased but the annual electricity production from hydro fluctuates in function of rainfall. Electricity imports have also been used to address the rapid increase in electricity demand; in 2004, about 15% of final electricity consumption was imported electricity.

Figure 1.1.38: Electricity generation by source (GWh)



Energy market structure

The Decree 79/1999 initiated a power sector reform process, later integrated with a process of harmonisation with the EU Directives. The new planning and regulatory framework that is taking shape is geared to gradually increase the number of suppliers, guarantee them equity in access to the transmission and distribution network and offer a transparent choice to the electricity end-users. The continued evolution of a plurality of suppliers is to be matched with a gradual liberalisation on the demand side. The reform introduced the status of "Eligible Clients", which gives end-users the possibility to choose electricity supplier. From July 2004, all non-residential end-users could choose suppliers, while all residential end-users will be able to do so, as of 1 July 2007 ([1]).

Renewable energy options

Renewable energy in Italy accounted for 6.7% of gross inland consumption in Italy in 2004. In the power sector, renewables accelerated in recent years due to the electricity market reforms in Decree 79/1999, which introduced an obligation regime that started in 2001 for power suppliers to use renewable sources (except large hydro) for production of 2% of annual electricity. The quota amount increases over time. Such regime has been integrated with a market trade mechanism: depending on their marginal costs, power suppliers can choose to generate renewable electricity or purchase it on the market via so-called Green Certificates (2).

34% of all renewable energy and 78% of renewable electricity is generated by hydro plants. 21% of hydro is generated by small-scale plants (below 10 MW). Geothermal energy accounted for 642 MW of installed capacity and 41% of all renewables in 2004. Italy has a leadership position in this field in Europe due to the concentration of geothermal potential, and is among one of the largest producers in the world. Production is concentrated in central Italy regions with the largest fields (Toscana and Lazio regions). The other main renewable source is biomass, which accounts for 26% of all renewable energy. Wind and photovoltaic have considerable unexploited potential and are likely to gain larger markets in the near-term.

Solar thermal technology has been historically underexploited in Italy compared to other EU countries that have much lower natural endowments; there is (data are approximations) 240 000 m^2 of thermal solar heating in Italy compared to 6 million in Germany and 3 million in Austria. New growth in the sector is being driven by high fossil fuel prices and is supported by some central and local government programs.

Biomass energy has a high potential in Italy, estimated at 21-23 million toe (3), which is nearly twice as much as current renewable energy from all sources. In production of heat, there has been a growing use of wood, pellets and wood-chips for both industrial uses and for residential sector. High fossil prices in the recent years have contributed to a major increase in the market for household pellet stoves.

Biofuels for transport

In the transport sector, Italy is a major producer of bio-diesel - the third largest in the EU. However, this represented only about 1% of diesel consumption in the transport sector. Achievement of the goal is based in part on the Decree 128/2005, which introduced an obligation to mix at least 1% of bio-diesel and bio-ethanol into diesel and gasoline.

Structure of energy demand

Transport accounts for 33% of final energy consumption, while industry is the next highest with 31%. Households and service sector combined account for 35% which is hardly more than transport, again placing emphasis on the structural dependence on oil for transport and the road infrastructure that supports it. Industry has the highest share of demand for electricity (49%), emphasising again the importance of renewed efforts on industrial sector energy efficiency. However, today there is an increasing interest in more efficient freight transport investments. A modal shift from road to rail and sea transport e.g. could constitute a considerable decrease in lower energy intensity in the transport sector.

Energy efficiency

The dependence of the Italian economic system on imported energy sources traditionally provided a driver for structural investments and technological innovation towards an increasingly energy-efficient industrial system. More recently, such efforts have been outpaced by the rapid shift to a service sector economy, accompanying by increasing demand for electricity for air conditioning and other uses. Other factors that have complicated energy efficiency efforts include the rapid growth of natural gas markets, a growing transport sector that depends increasingly on road freight transport, and the recent upsurge in electricity demand in the residential sector. Although the overall energy intensity remains lower than the EU average, it has been rather stationary during the last 15 years.

In the electric power sector, there are a number of recent efforts towards higher efficiency along with increasing use of co-generation; 8% of gross electricity generation is CHP (Combined Heat and Power), mainly using combined cycle technologies. This trend is supported by the energy efficiency Ministerial Decrees of 20 July 2004, which places an obligation on electricity and gas distributors with at least 100 000 customers to obtain annual demand-side energy savings of 2.9 million toe (4).

Italy - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	28 036	62	-	5 476	-	10 615	-	-	-	11 882	-	-
Recovered products	1 297	-	-	290	212	-	-	-	794	-	-	-
Imports	185 173	16 935	2	93 953	14 028	55 617	-	-	-	646	-	3 992
Stock change	-244	-251	-	-435	332	111	-	-	-	-	-	-
Exports	26 100	166	-	1 431	24 111	324	-	-	-	-	-	68
Bunkers	3 343	-	-	-	3 343	-	-	-	-	-	-	-
Gross inland consumption	184 819	16 580	2	97 854	-12 882	66 019	-	-	794	12 528	-	3 924
Transformation input	158 442	14 875	-	100 190	11 143	23 630	1 137	-	794	6 674	-	-
of which: Public thermal power stations	*30%*	*70%*	-	-	*77%*	*87%*	*87%*	-	*89%*	*99%*	-	-
Autoprod. therm. power st.	*4%*	*1%*	-	-	*22%*	*13%*	*13%*	-	*11%*	*1%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	*2%*	*24%*	-	-	-	-	-	-	-	-	-	-
Refineries	*63%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	124 359	2 765	-	-	98 798	-	1 165	-	-	-	-	21 631
of which: Public thermal power stations	*16%*	-	-	-	-	-	-	-	-	-	-	*93%*
Autoprod. therm. power st.	*1%*	-	-	-	-	-	-	-	-	-	-	*7%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	*2%*	*100%*	-	-	-	-	*26%*	-	-	-	-	-
Refineries	*79%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	56	-	-	2 302	-2 246	-	-	-	-	-3 831	-	3 830
Consumption of the energy branch	8 013	45	-	-	5 390	344	12	-	-	-	-	2 221
of which: Prod. and distrib. of electr.	*14%*	-	-	-	-	-	-	-	-	-	-	*51%*
Oil refineries	*74%*	-	-	-	*100%*	-	-	-	-	-	-	*23%*
Distribution losses	2 261	-	-	-	-	467	-	-	-	-	-	1 794
Available for final consumption	140 518	4 425	2	-33	67 137	41 578	16	-	-	2 024	-	25 369
Final non-energy consumption	8 753	142	-	-	7 673	938	-	-	-	-	-	-
Final energy consumption	131 206	4 110	2	-	59 044	40 640	17	-	-	2 024	-	25 369
Industry	41 232	4 102	2	-	7 509	17 000	17	-	-	203	-	12 399
of which: Iron & steel industry	*18%*	*86%*	-	-	*2%*	*11%*	*100%*	-	-	-	-	*14%*
Chemical industry	*15%*	*0%*	-	-	*23%*	*17%*	-	-	-	-	-	*13%*
Glass, pottery & building mat.	*21%*	*14%*	*100%*	-	*40%*	*22%*	-	-	-	*100%*	-	*10%*
Paper and printing	*7%*	-	-	-	*3%*	*10%*	-	-	-	-	-	*7%*
Transport	43 948	-	-	-	42 539	361	-	-	-	265	-	784
of which: Road transport	*89%*	-	-	-	*90%*	*100%*	-	-	-	*100%*	-	-
Air transport	*8%*	-	-	-	*9%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	46 025	8	-	-	8 996	23 279	-	-	-	1 556	-	12 187
of which: Households	*65%*	*100%*	-	-	*67%*	*74%*	-	-	-	*77%*	-	*47%*
Statistical difference	560	174	-	-33	420	0	0	-	-	-	-	0

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1.1.12 Cyprus

Cyprus is an island in the Eastern Mediterranean with a population of 750 000. Cyprus has enjoyed continuous economic growth during the last 30 years, due mainly to growth in the tourism and financial services' sectors. Energy demand has been increasing steadily and electricity demand has been increasing at a rate faster than economic growth. The energy system in Cyprus is based almost exclusively on oil and imported petroleum products. Energy strategies are therefore focused on improving energy efficiency, diversifying the sources of supply and developing renewable energy sources.

Primary energy structure

Cyprus possesses no known indigenous mineral energy resources, and consequently relies on imported sources. Since the existing power plants run only on residual fuel oil, Cyprus depends on imported oil for 97% of its energy needs. The remaining 3% consists of solar used in buildings and some biomass used in industry. Since April 2004 when the only petroleum refinery in Cyprus ceased its operation, all petroleum products are imported directly as finished products. Climate mitigation efforts are focused on reducing oil consumption through energy efficiency and renewables (1).

Energy consumption structure

In 2004, road transport consumed 30% of final energy, while industry accounted for 29%. Aviation accounted for 16%, which is higher than any other EU country except Malta, being also an island state. Households and services accounted for 15% and 9% of final energy, respectively, in 2004 (Figure 1.1.39). The situation is reversed with electricity, where final demand is dominated by the services sector, which in 2004 accounted for almost half of demand. Households and services together account for 78% of final electricity consumption; increases in recent years are due to higher air conditioning and lighting demand.

Cyprus has enjoyed sustained economic growth in the last three decades, led by the tourist industry and the financial sector. Because of economic growth, total final energy consumption rose by 4.7% per year between 1991 and 2004. Electricity consumption has increased even faster, on average 7.9% annually between 1990 and 2004.

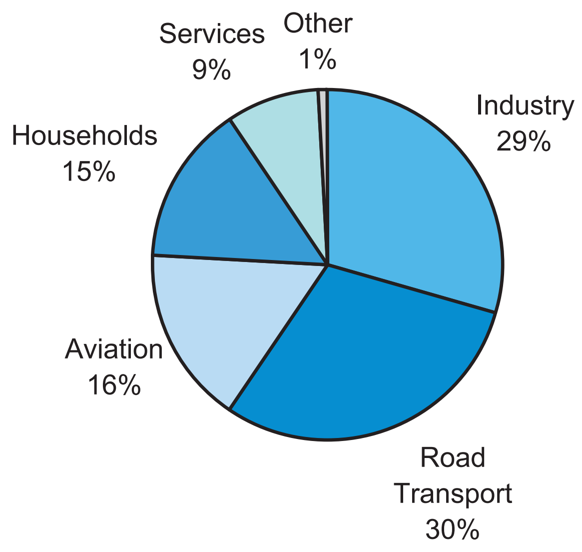
Electricity sector

Cyprus has only thermal power plants that run on residual fuel oil. Installed capacity has more than doubled since 1990, amounting to 994 MW in 2004. In 2004, electricity production was 4200 GWh, which is more than double the production in 1990. Starting in 2009, new power plants are scheduled to operate on natural gas too, which is planned to be transported to the island in liquefied form.

Renewable energy development

The main renewable energy form in Cyprus today is solar thermal, often used for hot water heating. With the favourable climate, the potential solar applications are significant. There are good opportunities for wind and biomass as well. Renewable energy is important in the national energy strategies, as it helps to diversify the energy supply and take advantage of the sunny climate in Cyprus (2). The target for Cyprus is 6% renewable electricity by 2010.

Figure 1.1.39: Final energy consumption by sector



Cyprus - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	97	-	-	-	-	-	-	-	-	97	-	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-
Imports	2 407	24	3	243	2 138	-	-	-	-	-	-	-
Stock change	39	11	-	35	-7	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-
Bunkers	56	-	-	-	56	-	-	-	-	-	-	-
Gross inland consumption	2 488	36	3	278	2 075	-	-	-	-	97	-	-
Transformation input	1 278	-	-	279	999	-	-	-	-	-	-	-
of which: Public thermal power stations	*78%*	-	-	-	*100%*	-	-	-	-	-	-	-
Autoprod. therm. power st.	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*22%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	638	-	-	-	279	-	-	-	-	-	-	359
of which: Public thermal power stations	*56%*	-	-	-	-	-	-	-	-	-	-	*100%*
Autoprod. therm. power st.	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*44%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the energy branch	31	-	-	-	11	-	-	-	-	-	-	20
of which: Prod. and distrib. of electr.	*62%*	-	-	-	-	-	-	-	-	-	-	*95%*
Oil refineries	*37%*	-	-	-	*100%*	-	-	-	-	-	-	*3%*
Distribution losses	18	-	-	-	-	-	-	-	-	-	-	18
Available for final consumption	1 798	36	3	-1	1 343	-	-	-	-	97	-	320
Final non-energy consumption	69	-	-	-	69	-	-	-	-	-	-	-
Final energy consumption	1 850	36	3	-	1 400	-	-	-	-	97	-	315
Industry	545	36	3	-	458	-	-	-	-	5	-	44
of which: Iron & steel industry	-	-	-	-	-	-	-	-	-	-	-	-
Chemical industry	*0%*	-	-	-	-	-	-	-	-	-	-	*4%*
Glass, pottery & building mat.	*42%*	*100%*	-	-	*38%*	-	-	-	-	*100%*	-	*37%*
Paper and printing	*0%*	-	-	-	-	-	-	-	-	-	-	*4%*
Transport	859	-	-	-	856	-	-	-	-	-	-	3
of which: Road transport	*64%*	-	-	-	*65%*	-	-	-	-	-	-	-
Air transport	*35%*	-	-	-	*35%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	446	-	-	-	86	-	-	-	-	92	-	268
of which: Households	*62%*	-	-	-	*100%*	-	-	-	-	*81%*	-	*42%*
Statistical difference	-120	-	0	-1	-125	-	-	-	-	-	-	6

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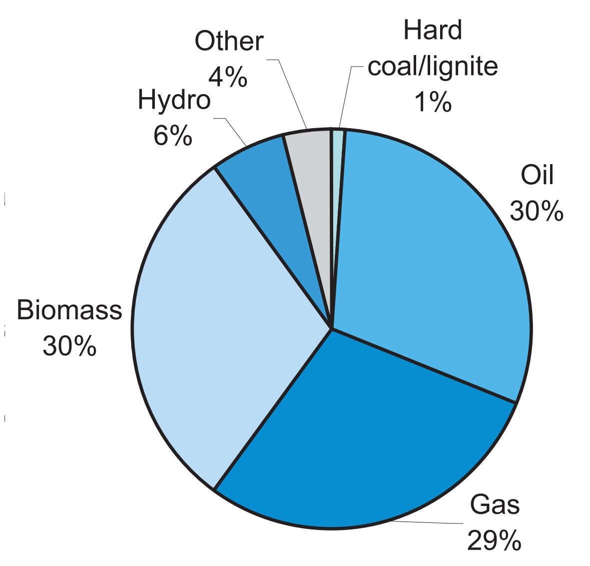
1.1.13 Latvia

The Latvian energy system is based primarily on hydropower and natural gas for electricity generation; petroleum products for transport; and biomass and natural gas for households and district heating. Natural gas is imported from Russia, while petroleum products are imported and used in principle for road transport. After the economic transition of the 1990s, energy demand has been increasing due to brisk economic growth, and efforts are underway to reduce energy intensity through a variety of energy efficiency programmes.

Primary energy structure

Gross Inland Consumption is dominated by biomass, oil and natural gas in roughly equal amounts; natural gas and biomass are used for electricity and/or heat production as well as industrial processes. Hydro along with a small amount of wind, coal, and imported electricity make up the balance (Figure 1.1.40).

Figure 1.1.40: Gross inland consumption by fuel



Natural gas and biomass are used in approximately equal amounts for district heating in Latvia. District heating plants account for nearly half of the heat supplied, with thermal cogeneration plants accounting for the majority remainder. A high share of electricity (32% in 2004) is produced in Combined Heat and Power (CHP) plants in Latvia, which also have high efficiency - the average thermal efficiency in 2002 was 79% (see CHP section in Chapter 3).

Electricity sector

Installed capacity as of 2004 included 1536 MW of hydro, 594 MW of thermal and 26 MW of wind capacity. Apart from nearly 200 small hydro plants, there are two large hydro plants on the Daugava River. The thermal plants run primarily on natural gas, with supplementary biomass fuel at CHP plants and a small amount of coal and oil. The use of oil for electricity production has been gradually phased out during the past two decades.

Approximately two-thirds of electricity production in 2004 came from hydro, and nearly all of the remainder from natural gas. The heavy reliance on hydro requires balancing during dry years and to make up for seasonal fluctuations; imported electricity from Estonia and Russia has been used to fill the gap. In 2004, net imports of electricity amounted to nearly 40% of total electricity consumed. Consequently, although a large percentage of electricity *generation* came from renewables, the *consumption* attributable to renewables-which is the relevant metric for the EU renewables Directive-was much lower, due to the high reliance on imports.

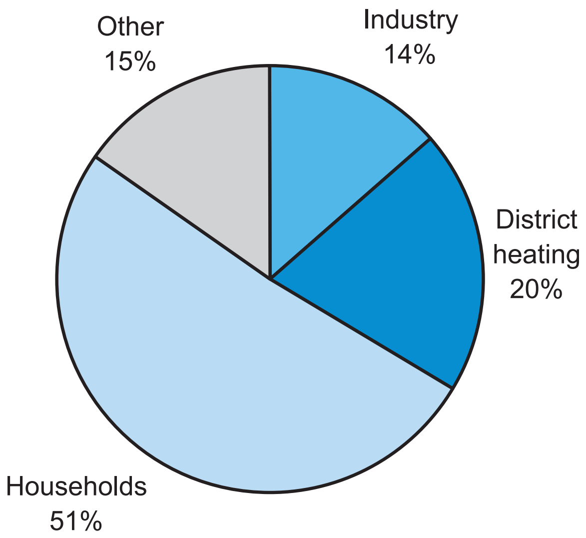
Renewable energy development

Slightly more than 68% of electricity generated in 2004 was based on renewable sources - hydro along with a small amount of wind and biomass. The Latvian government has an indicative target of 49% renewable share in electricity consumption by 2010 in accordance with the EU Renewables Directive (2001/77/EC). The main source for the additional renewable capacity is expected to be biomass. The potential for further hydro development is impacted by environmental considerations, while wind and solar are somewhat limited by geography and climate.

Currently, the main use of biomass in Latvia is still in households for heating and other uses, although an increasing amount is now being used for district heating. In 2004, the amount used for district heating was 20% of the total (Figure 1.1.41). The considerable expansion in the use of biomass for district heating was initiated in the early 1990s through the support of the Swedish programme on Environmentally Adapted Energy Systems (EAES) ([1]).

A framework programme for biofuels was adopted by the government in 2003, in order to reduce dependence on fossil fuels and to establish the basis for meeting the 2010 target of the EU Biofuels Directive ([2]). Rapeseed and rapeseed oil production has been successful; biofuels production was initiated during 2004-2005, with production of 2000 tonnes of biodiesel in 2005.

Figure 1.1.41: Biomass consumption by sector

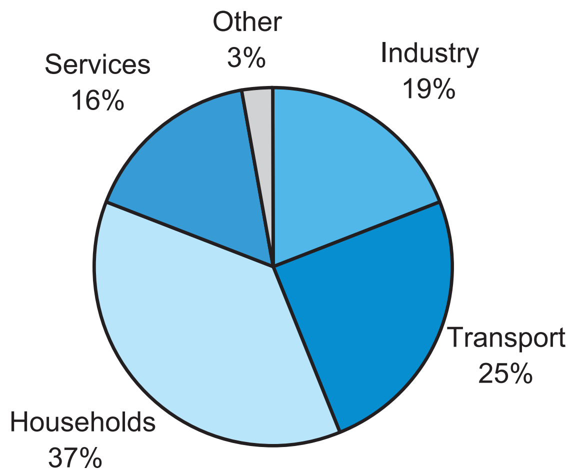


Energy consumption structure

Final energy consumption in Latvia is dominated by the household sector, which accounted for 37% of final energy in 2004; transport, industry and services accounted for 25%, 19%, and 16%, respectively (Figure 1.1.42). Final electricity consumption is dominated by the service sector, with a 41% share; industry had a 30% share; and households had a 27% share in 2004. The buildings sector-i.e. housing and services together-account for more than half of final energy; recent legislation and programmes have focused considerable effort on improving efficiency in buildings, consistent with EU Directives ([3]).

Energy demand decreased significantly during the early 1990s. Electricity demand decreased by about one third between 1990 and 1995, but has rebounded somewhat since then. The availability of district heating and natural gas has also exerted some downward pressure on electricity demand. In the 1990s Latvia realised improvements in energy efficiency in the district heating sector with a series of Kyoto pilot projects in cooperation with Sweden; these resulted in significant decreases in energy consumption and greenhouse gas emissions ([4]).

Figure 1.1.42: Final energy consumption by sector



eurostat

Latvia - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	2 141	-	3	-	-	-	-	-	-	2 137	-	-
Recovered products	11	-	-	-	3	-	-	-	7	-	-	-
Imports	3 915	63	-	4	1 873	1 739	-	-	-	1	-	235
Stock change	-400	2	-1	-	10	-406	-	-	-	-5	-	-
Exports	872	-	-	-	332	-	-	-	-	485	-	55
Bunkers	200	-	-	-	200	-	-	-	-	-	-	-
Gross inland consumption	4 594	65	2	4	1 354	1 332	-	-	7	1 649	-	180
Transformation input	1 197	7	1	1	66	807	-	-	-	314	-	-
of which: Public thermal power stations	*48%*	-	-	-	*39%*	*64%*	-	-	-	*11%*	-	-
Autoprod. therm. power st.	*2%*	-	-	-	-	*2%*	-	-	-	*1%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*0%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	875	-	-	-	1	-	-	-	-	-	743	132
of which: Public thermal power stations	*54%*	-	-	-	-	-	-	-	-	-	*46%*	*95%*
Autoprod. therm. power st.	*2%*	-	-	-	-	-	-	-	-	-	*1%*	*5%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*0%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-12	-	-	-	-12	-	-	-	-	-272	-	272
Consumption of the energy branch	111	-	0	-	10	21	-	-	-	6	29	45
of which: Prod. and distrib. of electr.	*63%*	-	-	-	*100%*	*100%*	-	-	-	-	*72%*	*43%*
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	216	-	-	-	-	13	-	-	-	-	127	76
Available for final consumption	3 934	58	0	3	1 267	492	-	-	7	1 057	587	463
Final non-energy consumption	71	-	-	-	71	-	-	-	-	-	-	-
Final energy consumption	3 873	58	-	-	1 210	492	-	-	7	1 055	587	463
Industry	742	9	-	-	99	284	-	-	7	187	15	140
of which: Iron & steel industry	*17%*	*47%*	-	-	*17%*	*34%*	-	-	-	-	-	*9%*
Chemical industry	*2%*	-	-	-	-	*3%*	-	-	-	*1%*	*1%*	*4%*
Glass, pottery & building mat.	*13%*	*7%*	-	-	*31%*	*15%*	-	-	*100%*	*1%*	*5%*	*6%*
Paper and printing	*1%*	*7%*	-	-	-	*1%*	-	-	-	*0%*	*8%*	*3%*
Transport	959	-	-	-	947	2	-	-	-	-	-	10
of which: Road transport	*85%*	-	-	-	*86%*	*100%*	-	-	-	-	-	-
Air transport	*5%*	-	-	-	*5%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	2 172	49	-	-	164	206	-	-	-	868	573	312
of which: Households	*66%*	*38%*	-	-	*35%*	*46%*	-	-	-	*80%*	*76%*	*40%*
Statistical difference	-9	0	0	3	-14	-	-	-	-	2	-	-

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1.1.14 Lithuania

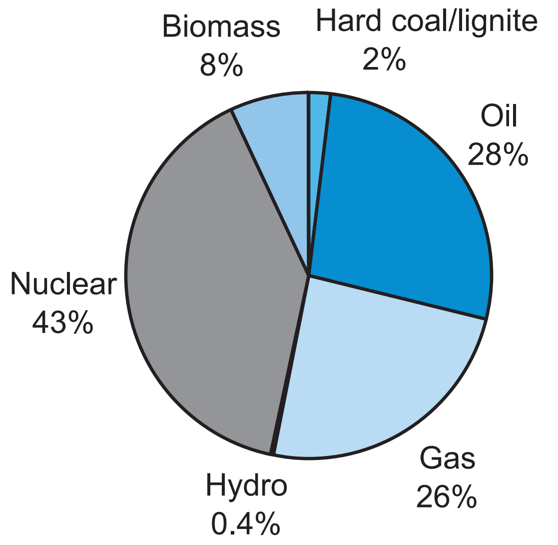
Lithuania depends significantly on imported oil and gas from Russia, as well as uranium for its nuclear power plant. Electricity production, however, significantly exceeds demand, thereby allowing for net exports of electricity in the region.

Structure of energy sector

As of 2004, slightly more than half of gross inland consumption was based on oil and gas (Figure 1.1.43). About 43% was based on nuclear power from the two units at *Ignalina*, although one of the units was closed down at the end of 2004. Biomass accounted for about 8% of supply, most of which is for household use in heating. A small amount of solid fuels and oil is also used directly in buildings and agriculture.

The Lithuania energy system is highly dependant on imports, mainly oil and gas from Russia. There is also import of heavy crude ('orimulsion') from Venezuela; the 1800 MW power plant in Elektrenai is adapted to burn orimulsion. The total capacity of the *Ignalina* nuclear units is 2600 MW. There is also a Hydro Pumped Storage Power Plant with installed capacity of 900 MW.

Figure 1.1.43: Gross inland consumption by fuel



One feature that Lithuania has in common with some of its northern neighbours (see section of Sweden) is the high level of cogeneration and district heating. Heat generation in district heating companies amounts to about 40% of total heat production (see also CHP section in Chapter 3). In Lithuania more than 60 district heating companies are operating. A decrease in demand was experienced during the economic transition of the 1990s, due in part to closure of some factories that were large heat consumers. In recent years heat demand from district heating has become more stable. Natural gas accounts for about 60% of the fuel input in district heating plants.

Electric power sector

Starting in 2002, the electricity sector in Lithuania was restructured in order to separate the activities of electricity generation, distribution and transmission. The one vertically integrated company was divided into five independent companies: two generation companies, one transmission company and two distribution companies.

A specific feature of the Lithuanian energy sector has been a considerable surplus of power generation, although this capacity decreased at the end of 2004 when one of the units at *Ignalina* nuclear power plant was closed; the remaining unit at *Ignalina* has a capacity of 1300 MW. In 2004 total installed electrical capacity in Lithuania amounted to nearly 6000 MW. The amount of electricity exported in 2004 was almost equal to the final energy consumption.

The Lithuanian power grid is connected with Latvia, Byelorussia and the Kaliningrad region (Russia). It is foreseen in the National Energy Strategy project to connect the transmission system with Scandinavian countries and Poland no later than 2012. Exported electricity in 2004 amounted to 63% of total electricity generated.

Nuclear power

Until 2005, the two units of the *Ignalina* nuclear power plant provided 82% of electricity generated in Lithuania. Due to the conditions of EU accession, the 1st unit of *Ignalina* was closed on 31 December 2004. Due to the significant electricity surplus, the closure did not have a major impact on domestic availability, but instead resulted in decreased exports. The second unit of *Ignalina* is scheduled to be closed on 31 December 2009.

The National Energy Strategy (2007) proposed that a nuclear power plant be put into operation by 2015 in order to meet the electricity demand of the Baltic States and other neighbouring countries. In October 2006, a study on the construction of a new nuclear power plant concluded that completion of such a project was feasible by 2015. The decision on whether to go ahead with the plant is clearly a major strategic issue for Lithuania and for the whole Baltic region.

Energy demand structure

Final energy consumption is dominated by transport and households, which together accounted for more than half of final demand (Figure 1.1.44) in 2004. The high demand in households is due to high space heating needs and the higher heating demands of the aging building stock. Non-energy needs, mainly in the chemical sector, account for 23% of gross inland consumption for natural gas. The service sector accounted for about 36% of the electricity consumption in 2004, while industry accounted for 34% and households accounted for 27%.

During the economic transition of the 1990s, energy consumption in Lithuania decreased dramatically due to the closure of a number of factories and companies, particularly those that were energy-intensive. In recent years, energy consumption in Lithuania has been growing again, but average consumption remains far from the EU average: the average final energy consumption in the EU-25 in 2004 amounted to 2.498 toe per capita while in Lithuania this figure was 1.242 for the same year.

Energy efficiency improvements in boilers and other major equipment have also put downward pressure on energy demand; several efficiency investments were made through the Activities Implemented Jointly (AIJ) programme, which was the precursor of the Kyoto Joint Implementation mechanism for greenhouse gas reductions.

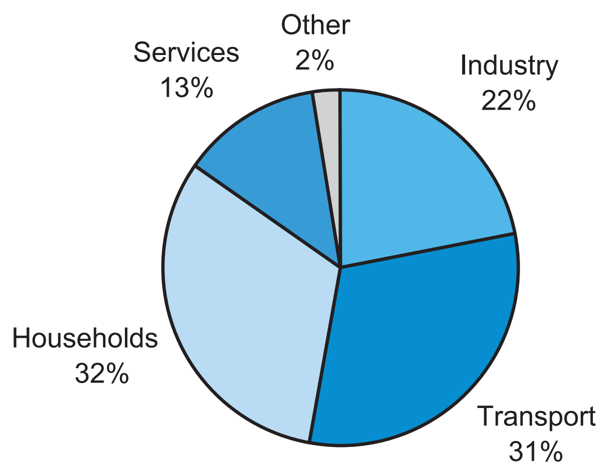
Renewable energy

In accordance with the EU Renewables Directive, Lithuania committed to double the amount of electricity generated from renewable energy sources in the balance of consumed electricity, from 3.3% in 1999 to 7% in 2010. Thus far, the main source of renewable electricity has been hydropower.

The National Energy Strategy set a goal for 2025 that 20% of primary energy shall be from renewable energy sources. In accordance with this plan, the targeted shares for biofuels within the total transport fuel market are 15% in 2020 and 20% in 2025. These goals are also set within the project framework of the National Energy Strategy.

Feed-in tariffs are applied for the purchasing of electricity generated using renewable energy sources. National legislation specifies that these tariffs will be applied until 2020. Individual tariffs are set for the three major renewable electricity sources: small hydropower plants (capacity less than 10 MW), wind power plants, and biomass power plants. Renewable energy power plants also receive a 40% discount for the cost of connection to the network.

Figure 1.1.44: Final energy consumption by sector

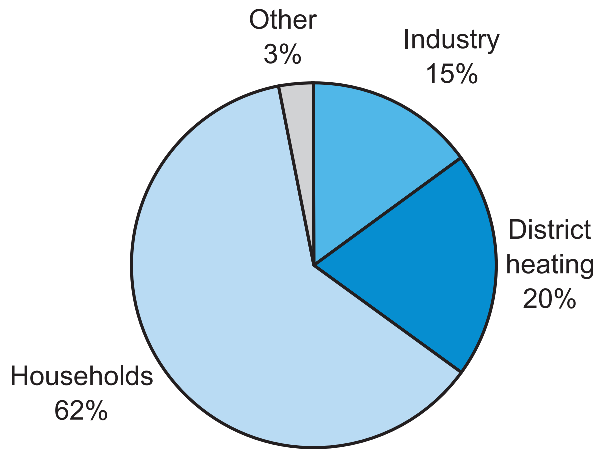


The role of biomass

The main use of biomass in Lithuania is still in households for heating and other uses, although an increasing amount is now being used for district heating. In 2004, the amount used for district heating had risen to 20% of the total (Figure 1.1.45). The increasing international trade in compacted biomass, particularly pellets, is also contributing to greater market flexibility in the various end-use energy options for biomass.

The growth of fuel prices and strong environmental requirements has encouraged operators of boiler houses to switch to biomass. The amount of biomass used in district heating has been increasing steadily, and has roughly doubled during the past two years.

Figure 1.1.45: Biomass consumption by sector



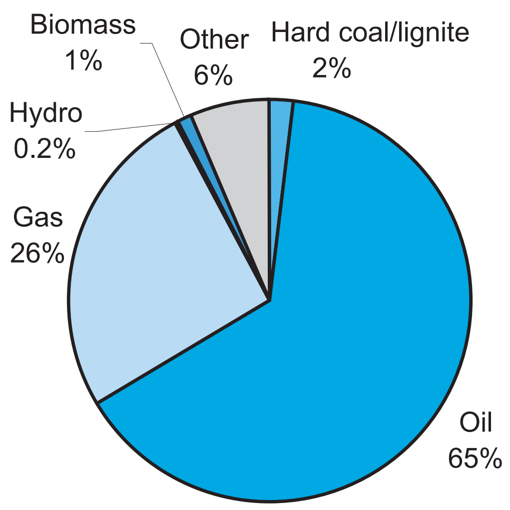
Lithuania - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	4 959	-	14	307	-	-	-	3 896	-	742	-	-
Recovered products	22	-	-	20	2	-	-	-	-	-	-	-
Imports	12 318	167	2	8 971	435	2 372	-	-	-	2	-	369
Stock change	-164	1	1	-190	17	-	-	-	-	8	-	-
Exports	7 876	1	1	196	6 672	-	-	-	-	17	-	988
Bunkers	109	-	-	-	109	-	-	-	-	-	-	-
Gross inland consumption	9 150	168	15	8 912	-6 327	2 372	-	3 896	-	734	-	-619
Transformation input	14 435	7	9	8 853	220	1 296	-	3 896	-	154	-	-
of which: Public thermal power stations	*8%*	-	-	-	*72%*	*74%*	-	-	-	-	-	-
Autoprod. therm. power st.	*0%*	-	-	-	-	*2%*	-	-	-	*6%*	-	-
Nuclear power stations	*27%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*61%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	11 542	-	7	-	8 775	-	-	-	-	-	1 184	1 576
of which: Public thermal power stations	*7%*	-	-	-	-	-	-	-	-	-	*46%*	*16%*
Autoprod. therm. power st.	*1%*	-	-	-	-	-	-	-	-	-	*10%*	*2%*
Nuclear power stations	*12%*	-	-	-	-	-	-	-	-	-	*4%*	*82%*
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*76%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-15	-	-	-57	42	-	-	-	-	-36	-	36
Consumption of the energy branch	881	-	-	-	586	11	-	-	-	0	54	230
of which: Prod. and distrib. of electr.	*15%*	-	-	-	-	-	-	-	-	-	-	*59%*
Oil refineries	*76%*	-	-	-	*99%*	*6%*	-	-	-	-	*52%*	*24%*
Distribution losses	323	-	-	-	-	22	-	-	-	-	191	109
Available for final consumption	5 039	160	14	2	1 684	1 043	-	-	-	544	938	655
Final non-energy consumption	725	-	-	-	178	547	-	-	-	-	-	-
Final energy consumption	4 281	159	13	-	1 502	482	-	-	-	576	895	655
Industry	937	86	0	-	78	275	-	-	-	103	158	236
of which: Iron & steel industry	*0%*	-	-	-	-	*0%*	-	-	-	-	-	*1%*
Chemical industry	*22%*	-	-	-	-	*16%*	-	-	-	-	*70%*	*20%*
Glass, pottery & building mat.	*18%*	*94%*	-	-	*33%*	*10%*	-	-	-	*13%*	*1%*	*8%*
Paper and printing	*2%*	-	-	-	-	*0%*	-	-	-	-	*8%*	*3%*
Transport	1 319	-	-	-	1 315	-	-	-	-	-	-	5
of which: Road transport	*91%*	-	-	-	*91%*	-	-	-	-	-	-	-
Air transport	*3%*	-	-	-	*3%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	2 026	73	12	-	110	207	-	-	-	473	737	414
of which: Households	*68%*	*35%*	*88%*	-	*58%*	*59%*	-	-	-	*92%*	*73%*	*43%*
Statistical difference	33	1	1	2	3	14	-	-	-	-32	43	-

1.1.15 Luxembourg

Luxembourg relies on imports for nearly all of its energy needs; the only domestic resources that are used are hydropower and biomass, although a small amount of wind power - 35 MW - has been installed in recent years. In 2004, 92.2% of gross inland consumption came from fossil fuels, mainly oil and gas along with a small amount of coal (Figure 1.1.46). Petroleum products accounted for 65% of gross inland consumption. 53% of the electricity consumed was imported.

Figure 1.1.46: Gross inland consumption by fuel



The oil, gas and coal sectors

Coal was Luxembourg's main energy source until the mid-1980s, but it now plays only a marginal role, due to the restructuring of Luxembourg's steel industry. During the restructuring process, several steel plants were closed down. The remaining blast furnaces were later replaced with electric arc furnaces, so that coal consumption fell significantly, while electricity consumption rose.

Since Luxembourg has neither domestic oil production nor petroleum refineries, all oil products are imported, generally from Belgian and Dutch refineries. The main products are diesel and petrol fuels for transportation. As Luxembourg has lower excise duties on road fuels than its neighbouring countries, a large number of drivers are attracted from abroad to fill up their vehicles.

The government has been promoting the use of natural gas in order to diversify energy supply. The gas network has been extended in recent years, and a number of gas-fired CHP units and a 350 MW gas turbine plant have been installed. Since 2004, businesses can choose their gas supplier and from July 2007 this will also be the case for households. In addition to the main domestic gas network operator/marketer, some municipalities are also suppliers of natural gas.

Electricity sector

Total electricity consumption in 2004 was 6 377 GWh, two-thirds of which was used by industry. Domestic production was 4136 GWh, with the balance being imported from Germany and Belgium. 76% of domestic power was generated in gas-fired plants and 21% in hydro plants (the bulk of which in a major pumped storage station in the North of the country). The remainder was supplied from biomass and wind.

In 2001 the power market was liberalised for large industrial users (>9GWh/year) and in 2004 for businesses. Households will be free to choose their supplier from 2007. The grid operator is also involved in end-user supply and generation, as part owner of the main gas power plant.

Energy demand

Transport accounted for 60% of final energy consumption in 2004, while industry accounted for 65% of final electricity consumption. 46% of industrial electricity use is for iron & steel production. Households account for only 14% of final energy consumption and 12% of final electricity consumption.

Since 1999 total energy consumption has been rising again, due to robust economic growth. With significant amount of fuel-switching to electricity, the consumption of electricity has been rising continuously, with the shortfall in domestic supply made up from significant levels of imports in recent years.

Natural gas consumption has been growing since the 1980s, with steeper growth since 1994, due to the extension of the national gas network and the installation of more CHP plants. The jump in natural gas consumption during 2001-2002 was due to the installation of Luxembourg's first major thermal power plant, a 350 MW gas turbine. A recently completed district heating plant was one of the flagship projects in the re-design of the distinguished Kirchberg district of Luxembourg. The 16 MW_t natural gas-fired plant supplies much of the area with district heat and is a showcase feature in the ecological-architectural design that has transformed the area.

Renewable energy

The government has provided incentives for renewable energy production since 1994. The main incentive mechanisms are investment subsidies, as well as some production subsidies for renewable power generation. This has led to considerable growth rates in renewables, such as photovoltaics in particular between 2003 and 2004. The share of renewables (excluding pumping) in gross electricity consumption in 2004 was 3.2%.

Luxembourg - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	73	-	-	-	-	-	-	-	-	73	-	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-
Imports	4 874	90	4	-	3 021	1 199	-	-	-	-	-	559
Stock change	13	-	-	-	13	-	-	-	-	-	-	-
Exports	284	-	-	-	15	-	-	-	-	-	-	269
Bunkers	-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption	4 676	90	4	-	3 020	1 199	-	-	-	73	-	290
Transformation input	563	-	-	-	-	520	-	-	-	43	-	-
of which: Public thermal power stations	*83%*	-	-	-	-	*82%*	-	-	-	*88%*	-	-
Autoprod. therm. power st.	*17%*	-	-	-	-	*18%*	-	-	-	*12%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-
Transformation output	330	-	-	-	-	-	-	-	-	-	51	278
of which: Public thermal power stations	*73%*	-	-	-	-	-	-	-	-	-	-	*86%*
Autoprod. therm. power st.	*27%*	-	-	-	-	-	-	-	-	-	*100%*	*14%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	-1	-	-	-	-	-	-	-	-	-13	-	12
Consumption of the energy branch	29	-	-	-	-	-	-	-	-	-	-	29
of which: Prod. and distrib. of electr.	*9%*	-	-	-	-	-	-	-	-	-	-	*9%*
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	4	-	-	-	-	-	-	-	-	-	-	4
Available for final consumption	4 409	90	4	-	3 020	680	-	-	-	16	51	548
Final non-energy consumption	12	-	-	-	12	-	-	-	-	-	-	-
Final energy consumption	4 396	90	4	-	3 007	680	-	-	-	16	51	548
Industry	993	90	3	-	86	427	-	-	-	-	26	360
of which: Iron & steel industry	*38%*	*31%*	-	-	*2%*	*43%*	-	-	-	-	-	*46%*
Chemical industry	*5%*	-	-	-	*4%*	-	-	-	-	-	*100%*	*7%*
Glass, pottery & building mat.	*7%*	*69%*	*100%*	-	*8%*	-	-	-	-	-	-	-
Paper and printing	-	-	-	-	-	-	-	-	-	-	-	-
Transport	2 640	-	-	-	2 630	-	-	-	-	1	-	9
of which: Road transport	*84%*	-	-	-	*84%*	-	-	-	-	*100%*	-	-
Air transport	*16%*	-	-	-	*16%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	764	-	0	-	290	253	-	-	-	15	26	179
of which: Households	*83%*	-	*100%*	-	*94%*	*100%*	-	-	-	*100%*	*100%*	*36%*
Statistical difference	1	-	-	-	1	-	-	-	-	-	-	-

1.1.16 Hungary

As with other countries in the region, the Hungarian energy sector changed significantly during the 1990s, as a result of economic restructuring and the closure of some energy-intensive industries. The shift away from coal and the wide use of natural gas resulted in considerable reductions in carbon emissions. The process of energy sector privatisation and liberalisation was initiated already in 1994, several years earlier than many other EU countries. Renewable energy amounted to about 2.8% of electricity generation in 2004. However, investments over the past few years, particularly in biomass, have helped to accelerate the market share for renewables.

Primary energy supply

Hungary depends on fossil fuels for 82% of its gross inland consumption. Nuclear provides most of the remainder, along with small shares of biomass and hydropower. 80% of gas and 77% of oil was imported in 2004, mainly from Russia, while 33% of hard coal and lignite were imported. The national primary production of solid fuels is mainly lignite, whereas imports consist essentially of only higher quality hard coal. The use of solid fuels has been decreasing fairly steadily since the 1980s, with plants either converted to biomass or natural gas, or closed altogether due to restricting environmental standards (1). There is one major open mine and one major underground mine. The other mines are small open mines serving local coal markets (as opposed to supplying power plants).

Natural gas

Natural gas emerged as the key fuel in Hungary even before the 1990s, and now accounts for 45% of gross inland consumption (Figure 1.1.47). Natural gas offered the most economical and environmentally-friendly way for Hungary to reduce consumption of lignite, coal and oil. Households and services account for 80% of the final energy consumption of natural gas; this share is the highest in EU-25. The direct use of gas offers greater overall efficiency, although it also exposes more sectors to disruption in the event of import availability being reduced. New gas-pipes and cooperation agreements have diversified the sources of gas supply to a certain extent (2).

Electric power sector

Total installed capacity as of 2004 was 8631 MW; the capacity shares were 22% for nuclear, 78% for thermal plants, and 0.6% for hydro. The main shift since 1990 in the shares of electricity produced has been the substitution of gas for lignite and petroleum products (Figure 1.1.48). Another more general trend has been a slight diversification in the supply mix, with the addition of biomass as well as gas. Electricity production from biomass has more than doubled in just one year-between 2004 and 2005 (3). Combined Heat & Power (CHP) installations are increasing, partly due to feed-in tariffs introduced by the Electricity Act starting in 2003 (4).

Figure 1.1.47: Natural gas use by sector

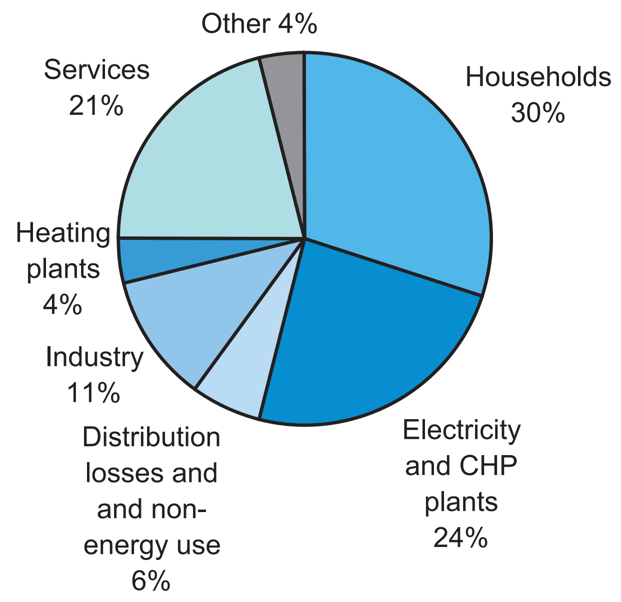
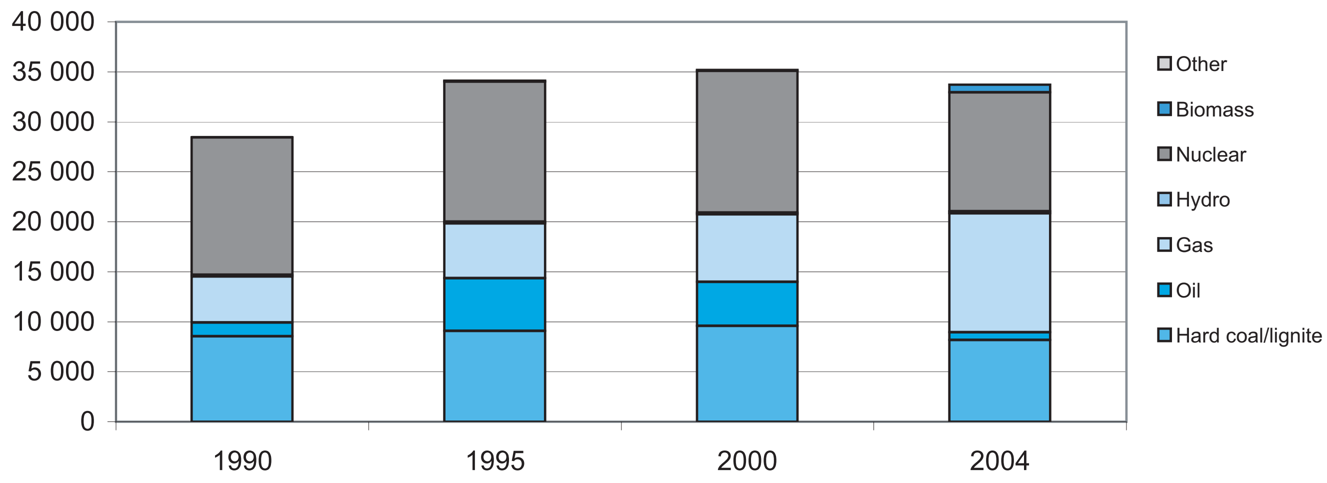


Figure 1.1.48: Electric power generation by source (GWh)



Nuclear power

Hungary has one nuclear power plant at Pacs with four reactor units of 460 MW capacity each, which commenced operation between 1983 and 1987. The proposal to extend the life-cycle of the reactor units by 20 years was approved by Parliament in 2005 ([5]). Uranium was mined in Hungary close to *Pécs* until 1997, and supplied all needs. The public is highly supportive of nuclear power; a Eurobarometer showed that 86% of respondents were in favour of nuclear power ([6]).

The structure of energy demand

Energy consumption declined sharply-about 3.3% annually-in the period 1990 to 2000 due to the structural changes and the associated decrease in industrial energy intensity. The resulting industrial restructuring led to an increasing share of the non-energy intensive machinery and equipment industry.
Starting in 2000, a rising demand in the residential and transport sectors resulted in an increased overall energy consumption. Energy demand in the transport sector has increased continuously since the mid-1990s. One factor behind this is the increasing car penetration, which went from 190 cars/1000 inhabitants in 1990 to 280 in 2004 ([7]).

Renewable energy options

The largest share of renewable energy is in the form of biomass, representing 3.3% of gross inland consumption as of 2004. After biomass, geothermal energy is considered to have the largest potential in the country; however due to the low enthalpy characteristic of the source in general, the potential is more for heating purposes than for electricity generation ([1]).

There are 31 hydro power plants with a total of 51 MW capacity. There has been a growing interest in wind energy, stimulated partially by the favourable feed-in tariff. By 2006, plans for the installation of 330 MW of wind power capacity were approved.

The share of renewables in electricity production (RES-E) was 2.3% in 2004, consisting almost exclusively of hydro and biomass. The RES-E electricity target for renewables for the year 2010 is 3.6%.

Hungary - Summary energy balance, 2004

expressed in 1000 TOE

eurostat		Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production		10 132	-	2 182	1 545	-	2 367	-	3 074	-	965	-	-
Recovered products		91	-	-	63	-	-	-	-	28	-	-	-
Imports		19 005	1 204	6	5 597	2 015	9 278	-	-	-	-	-	905
Stock change		54	7	122	-153	11	67	-	-	-	-	-	-
Exports		3 091	56	16	151	2 606	-	-	-	-	-	-	263
Bunkers		-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption		26 191	1 155	2 294	6 901	-580	11 712	-	3 074	28	965	-	642
Transformation input		17 702	933	2 280	7 465	252	3 326	128	3 074	-	244	-	-
of which:	*Public thermal power stations*	*32%*	*17%*	*98%*	-	*77%*	*84%*	*78%*	-	-	*94%*	-	-
	Autoprod. therm. power st.	*0%*	-	-	-	*3%*	*1%*	-	-	-	*2%*	-	-
	Nuclear power stations	*17%*	-	-	-	-	-	-	*100%*	-	-	-	-
	Coke-oven plants	*4%*	*65%*	-	-	*7%*	*0%*	-	-	-	-	-	-
	Refineries	*42%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output		12 321	463	17	-	7 367	-	223	-	-	-	1 371	2 880
of which:	*Public thermal power stations*	*22%*	-	-	-	-	-	-	-	-	-	*61%*	*63%*
	Autoprod. therm. power st.	*0%*	-	-	-	-	-	-	-	-	-	*1%*	*1%*
	Nuclear power stations	*8%*	-	-	-	-	-	-	-	-	-	*1%*	*36%*
	Coke-oven plants	*5%*	*100%*	-	-	-	-	*42%*	-	-	-	-	-
	Refineries	*60%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns		69	-	-	577	-509	-	-	-	-	-18	-	18
Consumption of the energy branch		1 142	-	1	14	317	152	-	-	-	-	195	463
of which:	*Prod. and distrib. of electr.*	*20%*	-	-	-	*4%*	-	-	-	-	-	-	*46%*
	Oil refineries	*43%*	-	-	-	*96%*	*94%*	-	-	-	-	-	*10%*
Distribution losses		687	-	-	-	-	345	-	-	-	-	-	342
Available for final consumption		19 048	685	30	-	5 709	7 889	95	-	28	704	1 176	2 735
Final non-energy consumption		1 513	-	-	-	1 192	321	-	-	-	-	-	-
Final energy consumption		17 399	664	45	-	4 507	7 488	57	-	28	700	1 176	2 735
Industry		3 406	482	7	-	190	1 301	57	-	28	56	469	817
of which:	*Iron & steel industry*	*19%*	*80%*	-	-	*2%*	*10%*	*100%*	-	-	-	*4%*	*6%*
	Chemical industry	*19%*	-	-	-	*10%*	*14%*	-	-	-	*2%*	*59%*	*22%*
	Glass, pottery & building mat.	*17%*	*18%*	*79%*	-	*53%*	*21%*	-	-	-	*30%*	*2%*	*10%*
	Paper and printing	*5%*	-	-	-	*4%*	*5%*	-	-	-	*11%*	*9%*	*5%*
Transport		3 867	-	-	-	3 771	2	-	-	-	-	-	94
of which:	*Road transport*	*90%*	-	-	-	*92%*	*100%*	-	-	-	-	-	-
	Air transport	*6%*	-	-	-	*6%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.		10 126	182	38	-	546	6 185	-	-	-	644	707	1 824
of which:	*Households*	*59%*	*98%*	*83%*	-	*42%*	*58%*	-	-	-	*77%*	*78%*	*52%*
Statistical difference		136	20	-15	-	10	79	38	-	-	4	-	-

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1.1.17 Malta

Malta includes 3 islands and 4 islets in the centre of the Mediterranean Sea. The three inhabited islands are interconnected by a single electricity grid; power is supplied by two fossil-fuelled plants. Malta is currently dependent on oil imports to supply all of its energy needs. However, renewable energy development is underway and is expected to provide an increasing share in the coming years.

Energy supply structure

Although some electricity was previously generated from coal in the 1990s, today all electricity generation uses oil, and consequently Malta depends on oil for essentially all energy consumption. Electricity generation more than doubled between 1990 and 2004.

National energy policy and renewable energy policy

A draft national energy policy went out for public consultation in August 2006, based on three objectives: security of supply, competitive pricing and environmental responsibility. Renewable energy targets are proposed for 2010 and beyond, focusing on photovoltaics, wind, and energy production from waste. The Malta Resources Authority was set up in the year 2000 to regulate energy and other resource sectors.

Electricity generation

Residual fuel oil provides the main fuel for generation of electricity. During peak hours, gas turbines running on light distillate gas oil are brought on line. For a number of years, there have been greater peak electricity demands in summer rather than in winter, due to increased air-conditioning loads.

Renewable energy

Until the past few years, there have not been any renewable energy sources in Malta's electric power system. In recent years, however, small grid-connected solar photovoltaic systems have been installed. The technical/economic potential for photovoltaic electricity generation in 2010 was estimated at about 7% of total electricity generation ([1]). A government subsidy or grant is provided for small domestic photovoltaic systems and for small wind systems.

The potential for large-scale offshore wind generation is considerable, estimated to reach up to 10% of the total ([1]).

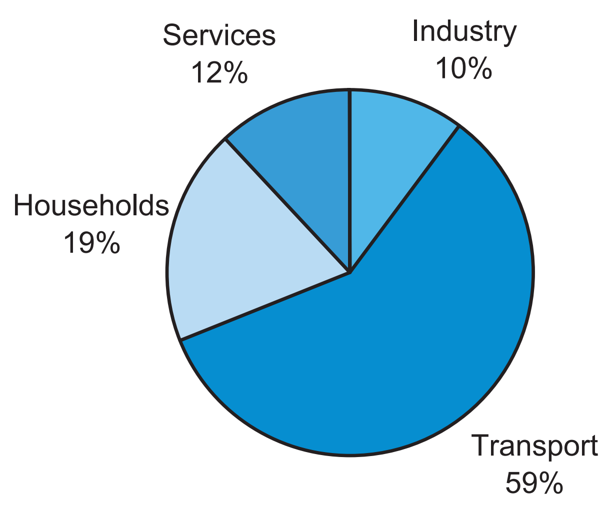
A first waste-to-energy pilot plant will come on line in 2008, followed by plants in northern Malta and Gozo. It is envisaged that waste-to-energy plants will be small and distributed at suitable sites around Malta and Gozo. The overall potential for electricity from waste residues and landfill gas is estimated at 5.6% of the total ([2]).

The fastest growing renewable market has been for domestic solar water heating systems; although only 8% of households had systems as of 2004, sales have increased by 40% during the past year.

Transport sector

As of September 2006 there was 1 private car for every 2 persons in Malta. The consumption of fuel is continuously rising, so that in 2004, road transport accounted for 37% of final energy consumption in Malta, while 22% was used for aviation. Transport thus dominates the energy demand structure and efforts are now aimed at promoting public transport to reduce total energy demand for transport. Households have the next highest share, at 19% (Figure 1.1.49).

Figure 1.1.49: Final energy consumption by sector



Malta - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	-	-	-	-	-	-	-	-	-	-	-	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-
Imports	910	-	-	-	910	-	-	-	-	-	-	-
Stock change	-	-	-	-	-	-	-	-	-	-	-	-
Exports	-	-	-	-	-	-	-	-	-	-	-	-
Bunkers	23	-	-	-	23	-	-	-	-	-	-	-
Gross inland consumption	887	-	-	-	887	-	-	-	-	-	-	-
Transformation input	585	-	-	-	585	-	-	-	-	-	-	-
of which: *Public thermal power stations*	*100%*	-	-	-	*100%*	-	-	-	-	-	-	-
Autoprod. therm. power st.	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-
Transformation output	191	-	-	-	-	-	-	-	-	-	-	191
of which: *Public thermal power stations*	*100%*	-	-	-	-	-	-	-	-	-	-	*100%*
Autoprod. therm. power st.	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the energy branch	11	-	-	-	-	-	-	-	-	-	-	11
of which: *Prod. and distrib. of electr.*	*100%*	-	-	-	-	-	-	-	-	-	-	*100%*
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	25	-	-	-	-	-	-	-	-	-	-	25
Available for final consumption	456	-	-	-	302	-	-	-	-	-	-	155
Final non-energy consumption	-	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	456	-	-	-	302	-	-	-	-	-	-	155
Industry	47	-	-	-	-	-	-	-	-	-	-	47
of which: *Iron & steel industry*	-	-	-	-	-	-	-	-	-	-	-	-
Chemical industry	-	-	-	-	-	-	-	-	-	-	-	-
Glass, pottery & building mat.	-	-	-	-	-	-	-	-	-	-	-	-
Paper and printing	-	-	-	-	-	-	-	-	-	-	-	-
Transport	267	-	-	-	267	-	-	-	-	-	-	-
of which: *Road transport*	*62%*	-	-	-	*62%*	-	-	-	-	-	-	-
Air transport	*38%*	-	-	-	*38%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	142	-	-	-	35	-	-	-	-	-	-	107
of which: *Households*	*62%*	-	-	-	*100%*	-	-	-	-	-	-	*50%*
Statistical difference	-	-	-	-	-	-	-	-	-	-	-	-

References

(1) Farrugia, R.N. , M. Fsadni, E.A. Mallia and C. Yousif (2006). "The Renewable Energy Potential of Malta," Proceedings of the World Renewable Energy Congress - IX, 19th-25th August 2006, Florence, Italy.

(2) MRA (2006b). The Malta Resources Authority, http://www.mra.org.mt

1.1.18 Netherlands

The Netherlands has a high-density energy infrastructure of electricity cables, power stations, gas pipelines and gas fields; this infrastructure facilitates access to electricity and natural gas essentially anywhere in the country. The high population density in combination with the country's small-scale, low-lying geography, and intensity of economic activity has led to an energy system that is highly concentrated and technically well-developed. The reliability of both the gas and electricity systems is among the best in Europe. The gas grid is well-connected with international grids to facilitate international trade.

Resource base

The electric power system in the Netherlands is a fossil-based thermal system. Electricity production has benefited from the availability of domestic natural resources; initially coal, followed by natural gas starting in the 1960s. After the gas discovery the Dutch coal mines were closed; since then, coal has been imported. Fossil fuels made up 94% of total gross inland consumption in 2004, dominated by gas with 45% (Figure 1.1.50). Natural gas has been widely used for electricity production as well as in many direct uses for heating, appliances, and industry.

The indicative target for renewable electricity in 2010 is 9%. The major renewable options are wind and biomass; the flat landscape results in essentially no opportunities for hydropower.

Energy consumption and demand

The Dutch economy is somewhat energy-intensive due to the extensive use of greenhouse horticulture sectors and due to a large chemical sector which consumes a quite considerable amount of feedstocks. Industry and transport account for similar shares of final energy demand, while services and households make up the remaining 29% (Figure 1.1.51 does not include non-energy use). The high overall efficiency of gas mitigates to some extent the energy intensity in the overall final energy demand structure.

The Dutch energy system has undergone significant changes since the mid 1980s, with efficiency improvements on both the demand and supply sides as core drivers. The high dependence on fossil fuels has led to much debate in the Netherlands about new national energy paths and strategies to address climate change. Consequently, demand-side energy efficiency and renewables have become strategically important in recent years.

Figure 1.1.50: Gross inland consumption by fuel

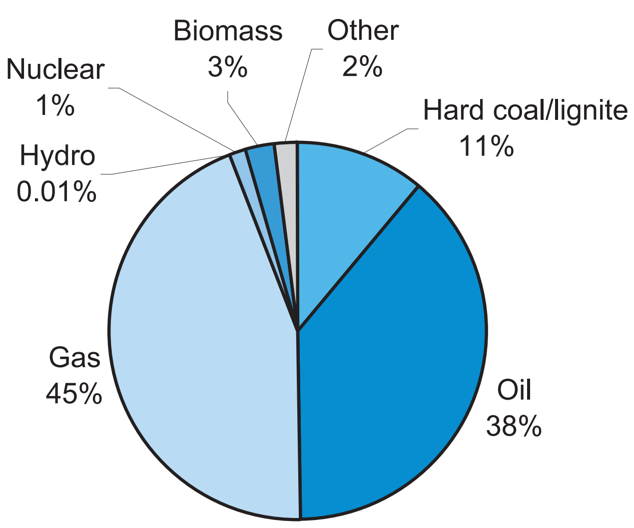
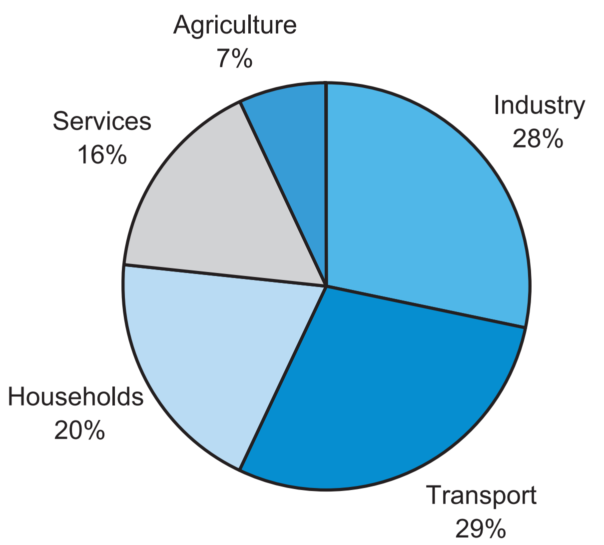


Figure 1.1.51: Final energy consumption by sector



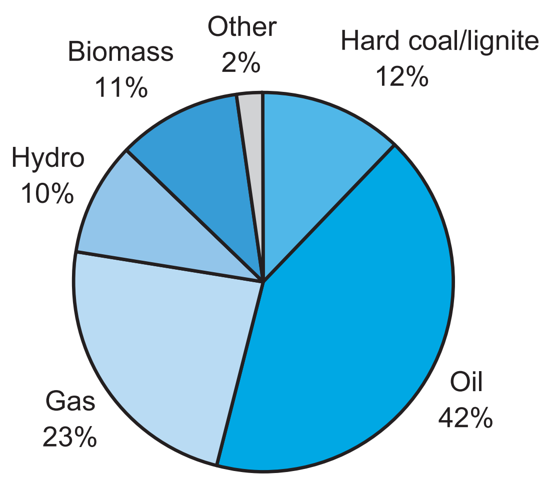
Netherlands - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	67 860	-	-	2 925	-	61 585	-	986	-	2 364	-	-
Recovered products	-	-	-	-	-	-	-	-	-	-	-	-
Imports	146 303	15 013	22	61 093	54 833	13 502	-	-	-	-	-	1 840
Stock change	-691	120	-1	-5	-826	20	-	-	-	-	-	-
Exports	116 600	5 976	-	1 221	70 594	38 362	-	-	-	-	-	446
Bunkers	14 589	-	-	-	14 589	-	-	-	-	-	-	-
Gross inland consumption	82 283	9 156	21	62 792	-31 176	36 745	-	986	-	2 364	-	1 394
Transformation input	110 085	8 367	-	85 632	593	12 094	620	986	-	1 794	-	-
of which: Public thermal power stations	*16%*	*64%*	-	-	*23%*	*88%*	*97%*	-	-	*25%*	-	-
Autoprod. therm. power st.	*3%*	-	-	-	*77%*	*12%*	*3%*	-	-	*75%*	-	-
Nuclear power stations	*1%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*2%*	*26%*	-	-	-	-	-	-	-	-	-	-
Refineries	*78%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	98 975	1 607	-	-	84 556	-	1 311	-	-		3 008	8 493
of which: Public thermal power stations	*10%*	-	-	-	-	-	-	-	-	-	*94%*	*83%*
Autoprod. therm. power st.	*1%*	-	-	-	-	-	-	-	-	-	-	*13%*
Nuclear power stations	*0%*	-	-	-	-	-	-	-	-	-	-	*4%*
Coke-oven plants	*2%*	*100%*	-	-	-	-	*32%*	-	-	-	-	-
Refineries	*85%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	56	-	-	22 840	-22 784	-	-	-	-	-172	-	172
Consumption of the energy branch	6 325	-	-	-	3 970	1 346	188	-	-	-	-	821
of which: Prod. and distrib. of electr.	*6%*	-	-	-	-	-	-	-	-	-	-	*44%*
Oil refineries	*76%*	-	-	-	*100%*	*47%*	-	-	-	-	-	*27%*
Distribution losses	823	-	-	-	-	-	-	-	-	-	451	372
Available for final consumption	64 082	2 396	21	1	26 034	23 305	503	-	-	399	2 556	8 866
Final non-energy consumption	10 965	206	-	-	8 603	2 156	-	-	-	-	-	-
Final energy consumption	52 456	1 529	21	-	17 431	21 149	503	-	-	399	2 556	8 867
Industry	14 801	1 506	11	-	1 679	5 993	503	-	-	117	1 435	3 556
of which: Iron & steel industry	*17%*	*97%*	-	-	*0%*	*4%*	*100%*	-	-	-	-	*7%*
Chemical industry	*39%*	-	-	-	*84%*	*36%*	-	-	-	*0%*	*78%*	*29%*
Glass, pottery & building mat.	*5%*	*2%*	*78%*	-	*1%*	*9%*	-	-	-	-	-	*3%*
Paper and printing	*7%*	-	-	-	*0%*	*8%*	-	-	-	*4%*	*11%*	*9%*
Transport	15 038	-	-	-	14 896	-	-	-	-	-	-	142
of which: Road transport	*73%*	-	-	-	*74%*	-	-	-	-	-	-	-
Air transport	*24%*	-	-	-	*24%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	22 618	23	10	-	856	15 156	-	-	-	283	1 121	5 168
of which: Households	*46%*	*21%*	-	-	*7%*	*52%*	-	-	-	*85%*	*18%*	*39%*
Statistical difference	661	661	-	1	0	-	-	-	-	-	-	0

1.1.19 Austria

Austria relies significantly on domestic resources in the form of hydropower and biomass. There is also some domestic production of natural gas and oil, although the overwhelming majority - more than 80% - is imported. National energy independence is a major goal in the electricity sector, as well as sustainability and competitiveness. Gross inland consumption of energy is dominated by petroleum products, due to the rather high use in transport and in buildings. The use of gas has also increased in recent years (Figure 1.1.52). The share of renewables other than hydro (particularly biomass) increased remarkably during the past years.

Figure 1.1.52: Gross inland consumption by fuel

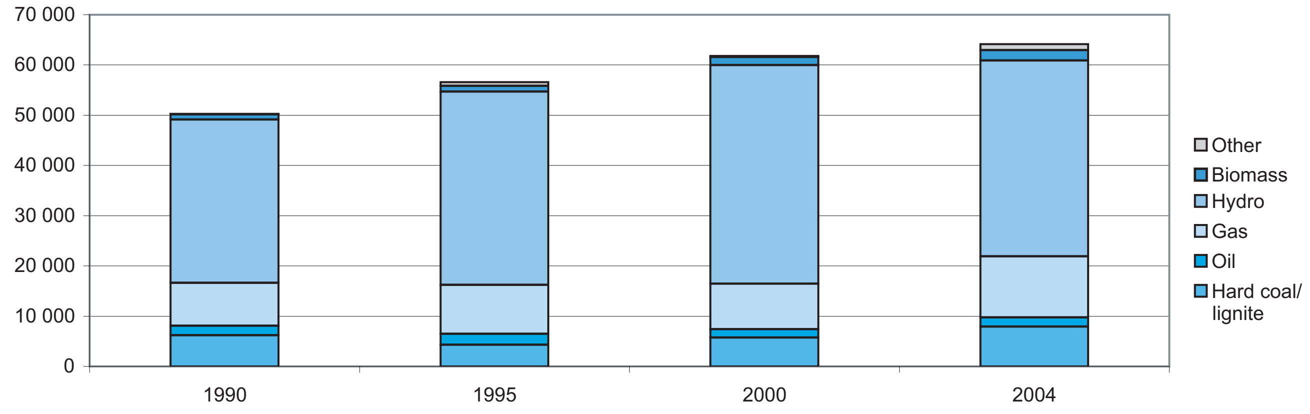


Electric power sector

Hydro accounted for 61% of electricity generation in 2004 vs. 64% in 1990, while gas had risen from 17% to nearly 20%. Electricity from renewables other than hydro made up 3% of supply in 2004. Electricity generated from biomass doubled during 1990-2004, to more than 2 100 GWh. Overall, some diversification is quite apparent in the power sector, although hydro continues to dominate (Figure 1.1.53).

The power sector has undergone significant changes during the past 10-15 years in the wake of EU accession in 1995, privatisation in the late 1990s, and market liberalisation during the past several years in accordance with EU Directives. Until privatisation and liberalisation, a doctrine of energy independence was applied for electricity, i.e. maximising the use of domestic resources, mainly in the form of hydropower. Seasonal trading of electricity and pumped storage, however, have long been common, as is generally necessary in hydro-based systems. There is a regular flow of peak power from Austrian pumped hydro storage plants in the Alps to German industrial areas, balanced by a flow in the opposite direction at times of low demand from German thermal power plants.

Figure 1.1.53: Electric power generarion by sources (GWh)



Energy security

As with many EU countries, energy security concerns have returned in recent years, although it is interesting to note that Austria has traditionally given more emphasis to energy independence than many other countries, as the hydropower and biomass expansions have shown. There has been a significant decline in coal use since 1970 as domestic coal mines were being closed, although in recent years, some imported coal has been used for thermal capacity to balance hydro.

Austria has long had an active trade in oil and gas from the Soviet Union and later Russia. Slightly less than 25% of natural gas used or exported was of domestic origin in 2004. Current efforts to increase energy security rely on increasing the volume of gas storage and also in supply diversification, such as the *Nabucco* pipeline to deliver gas from the Caspian via the Balkans.

10% of crude oil was of domestic origin in 2004. In addition to importing the remaining crude oil, Austria also imports nearly as much energy in the form of refined petroleum products. About 65% of oil is consumed in the transport sector, and the relatively high level of motorisation in Austria results in rather high consumption of oil relative to other energy sources. An active biodiesel industry has been growing in recent years.

Renewable energy options

A significant share of hydro capacity is already utilised. Austria has therefore started to develop renewable energy options other than hydro. The focus has been on biomass and wind, although there have also been some pioneering deployment activities for solar thermal and solar photovoltaic installations.

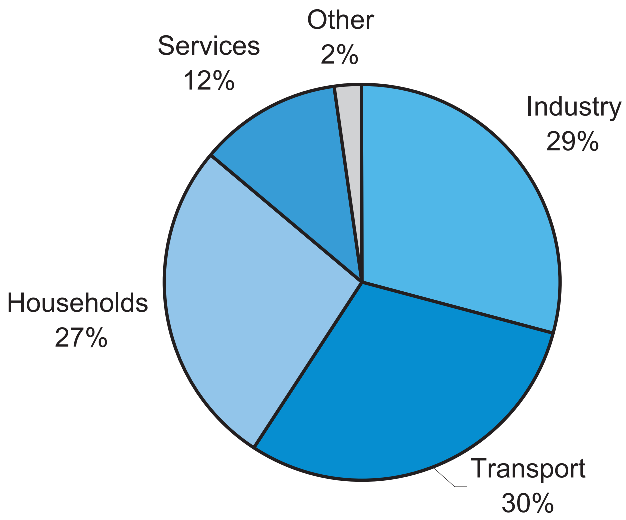
Biomass is the second biggest renewable energy source in Austria. The liquid waste from paper production (lignin) is used for process heat and electricity generation. The use of wood chips, straw, and biogas has been expanding considerably. Austria has pioneered the efficient production of wood pellets for use in high efficiency stoves for heating or for heat and power (cogeneration) and district heating plants.

Annual installation of wind energy grew from 10 MW in 1996 to 560 MW in 2004, with 924 GWh produced, amounting to 1.5% of total electricity consumption.

The structure of energy demand

As with many EU countries, energy consumption has grown significantly in the past thirty years, particularly in the transport sector. Energy demand in households has been stable, although future decreases can be expected due to new building codes that have been put in place in recent years. Energy consumption in industry has increased at a much lower pace, due to significant improvements in energy efficiency and structural shifts away from the energy-intensive industries. In 2004, the shares of industry, transport, and households in final energy consumption were fairly even, while the service sector has a share of 12% (Figure 1.1.54).

Figure 1.1.54: Final energy consumption by sector



Austria - Summary energy balance, 2004

expressed in 1000 TOE

eurostat			Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
	Primary production		9 526	-	55	1 035	-	1 667	-	-	-	6 769	-	
	Recovered products		307	-	-	-	9	-	-	-	298	-	-	
	Imports		27 232	3 774	33	7 604	7 084	7 123	-	-	-	184	-	1 430
	Stock change		-269	-90	227	24	-374	-55	-	-	-	-	-	
	Exports		4 083	43	-	5	1 570	1 115	-	-	-	186	-	1 165
	Bunkers		-	-	-	-	-	-	-	-	-	-	-	
	Gross inland consumption		32 713	3 641	315	8 658	5 150	7 620	-	-	298	6 766	-	265
	Transformation input		16 462	3 487	231	8 683	316	2 355	282	-	74	1 034	-	
of	which:	*Public thermal power stations*	*24%*	*41%*	*97%*	-	*88%*	*76%*	-	-	*55%*	*26%*	-	-
		Autoprod. therm. power st.	*7%*	*1%*	*3%*	-	*3%*	*18%*	*100%*	-	*44%*	*37%*	-	-
		Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
		Coke-oven plants	*8%*	*38%*	-	-	-	-	-	-	-	-	-	-
		Refineries	*53%*	-	-	*100%*	-	-	-	-	-	-	-	-
	Transformation output		13 961	953	-	-	8 644	-	942	-	-	-	1 338	2 084
of	which:	*Public thermal power stations*	*17%*	-	-	-	-	-	-	-	-	-	*60%*	*74%*
		Autoprod. therm. power st.	*5%*	-	-	-	-	-	-	-	-	-	*6%*	*26%*
		Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
		Coke-oven plants	*9%*	*100%*	-	-	-	-	*25%*	-	-	-	-	-
		Refineries	*62%*	-	-	-	*100%*	-	-	-	-	-	-	-
	Exchanges and transfers, returns		2	-	-	37	-33	-	-	-	-	-3 212	-	3 211
	Consumption of the energy branch		2 005	-	-	-	889	468	195	-	-	-	-	452
of	which:	*Prod. and distrib. of electr.*	*8%*	-	-	-	-	-	-	-	-	-	-	*33%*
		Oil refineries	*45%*	-	-	-	*78%*	*31%*	-	-	-	-	-	*15%*
	Distribution losses		470	-	-	-	-	138	23	-	-	-	48	261
	Available for final consumption		27 740	1 108	84	12	12 554	4 659	442	-	224	2 519	1 291	4 847
	Final non-energy consumption		2 097	657	-	-	1 197	242	-	-	-	-	-	
	Final energy consumption		25 671	451	82	-	11 399	4 417	442	-	224	2 519	1 291	4 847
	Industry		7 507	325	50	-	1 391	2 424	442	-	195	610	174	1 897
of	which:	*Iron & steel industry*	*17%*	*60%*	-	-	*0%*	*15%*	*100%*	-	-	-	*1%*	*12%*
		Chemical industry	*12%*	*17%*	-	-	*2%*	*15%*	-	-	*26%*	*10%*	*24%*	*16%*
		Glass, pottery & building mat.	*10%*	*3%*	*60%*	-	*9%*	*13%*	-	-	*54%*	*0%*	-	*8%*
		Paper and printing	*19%*	*15%*	*40%*	-	*3%*	*15%*	-	-	*2%*	*77%*	*31%*	*21%*
	Transport		7 699	-	-	-	7 420	-	-	-	-	10	-	268
of	which:	*Road transport*	*88%*	-	-	-	*91%*	-	-	-	-	*100%*	-	-
		Air transport	*8%*	-	-	-	*8%*	-	-	-	-	-	-	-
	Househ., commerce, pub. auth., etc.		10 465	125	32	-	2 588	1 993	-	-	29	1 899	1 117	2 681
of	which:	*Households*	*66%*	*88%*	*93%*	-	*68%*	*75%*	-	-	-	*84%*	*51%*	*48%*
	Statistical difference		-28	0	2	12	-42	-	-	-	-	-	-	

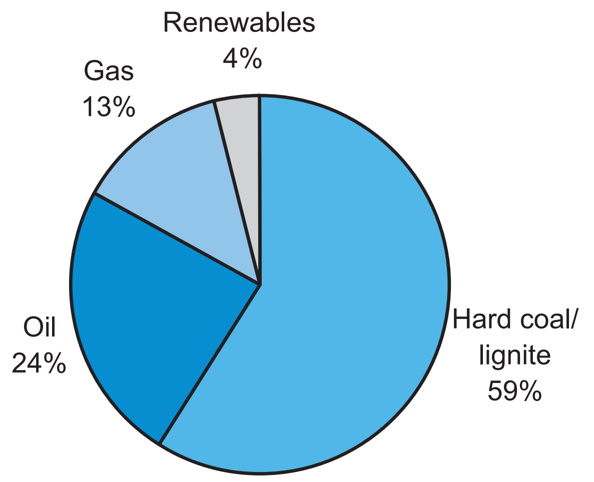
1.1.20 Poland

The Polish energy sector, with its vast deposits of high quality hard coal and lignite, has traditionally been heavily dependent on these sources. Now the Government is looking towards diversification of the fuel mix through increasing the share of renewable energy sources and ensuring the reliability of natural gas and oil imports from various countries. Although there was a major restructuring in energy demand after the economic transition that began in 1988, the overall energy intensity remains well above the EU-25 average.

Electric power sector

Hard coal accounted for 56% and lignite 36% of electricity generation in 2004. A small amount of natural gas and biomass generation capacity has been added since 1990. The total capacity of thermal plants in 2004 was slightly less than 33 000 MW, which is 93% of total installed capacity, while the remaining capacity is hydro (2 300 MW) along with a very small amount (40 MW) of wind. Primary energy consumption is dominated by coal along with oil for the transport sector (Figure 1.1.55).

Figure 1.1.55: Gross inland consumption by fuel



Following EU accession, Poland has to comply with the EU Directives on the liberalisation of energy markets. Legal unbundling of transmission system operators has been in effect since 1 July, 2004. while Poland is a member of CENTREL, which is a regional group of transmission system operators in Poland, Hungary, Slovakia and the Czech Republic, which are also now members of the *Union for the Co-ordination of Transmission of Electricity* (UCTE) ([1]). The group is a net exporter of electricity, and Poland is the major contributor to the export pool.

Hard coal and lignite

Poland has considerable reserves of high quality solid fuels; total recoverable reserves of hard coal are estimated at over 32 billion short tons, while those of lignite and subbituminous coal are estimated at over 14 billion short tons. Due to geological features some of the coal is difficult to mine. Poland is among the world's major exporters of hard coal, which was historically a major source of foreign exchange. At present, Polish coal is exported mainly to neighbouring countries, particularly Germany, the United Kingdom and Finland.

The future of coal in Poland will depend in part on its environmental impacts. The long tradition of coal utilisation has caused in the past environmental concerns in the main area of coal extraction and electricity generation.

Renewable energy options

Renewable energy sources currently have a low contribution to the Polish energy mix. To increase their share, the Polish Government adopted first preferential feed-in tariffs which were later replaced by a quota obligation and annual targets until 2014. The strategy document *Energy Policy of Poland until 2025* (2) identified the renewable sources with the most potential as: wind and hydro for electricity generation; geothermal energy for heat generation, and biomass electricity and heat generation.

Hydro is the dominant renewable energy source in Poland, with two-thirds of the capacity found in large-scale plants . Although new units are still being commissioned, the potential for large-scale hydro is rather limited.

Biomass electricity generation increased four-fold between 2000 and 2004-from 221 GWh to 850 GWh-although even after this increase, it still only represents 1% of the total.

Wind capacity reached 40 MW in 2004, with electric output of 142 GWh in 2004, which is only 0.1% of the total. The wind potential in Poland is considered as 'excellent' and the country as having one of the most promising wind energy markets in Europe. The southern mountains and the Baltic coast are considered as the most promising regions.

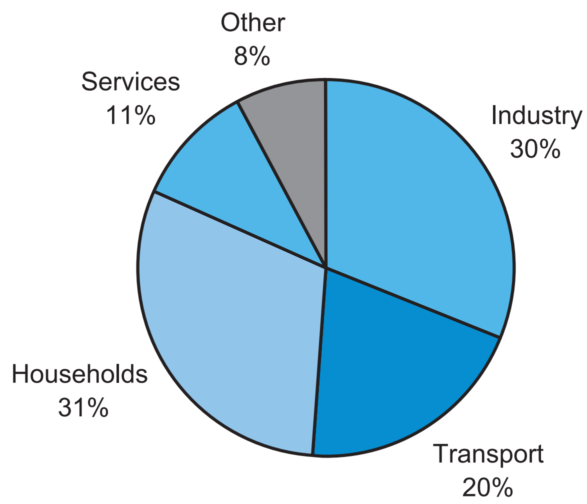
The structure of energy demand

As with the other eastern European countries, the transition to a market economy resulted in a reduction in final energy consumption. In 2004, final consumption was 56 Mtoe whereas in 1990 this figure was 60 Mtoe. The restructuring of the economy led to significant changes in the share of the various sectors in final energy consumption, due to a decline in shares of energy intensive industries (e.g. iron & steel, ammonia production, cement, machinery) and the introduction of energy saving measures (3).

Final energy consumption in 2004 was dominated by industrial and households, with fairly even shares that together add up to 61% (Figure 1.1.56). The share of transport in final energy, at 20%, is somewhat low.

The general trend of reduction in consumption led also to reduction of greenhouse gas emissions.

Figure 1.1.56: Final energy consumption by sector



Poland - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	77 946	55 881	12 924	890	-	3 926	-	-	-	4 325	-	-
Recovered products	1 508	396	-	579	52	-	-	-	482	-	-	-
Imports	33 472	1 594	1	17 759	5 504	8 157	-	-	-	-	-	457
Stock change	-315	23	1	4	-177	-166	-	-	-	-	-	-
Exports	19 852	16 239	5	139	2 175	38	-	-	-	-	-	1 256
Bunkers	250	-	-	-	250	-	-	-	-	-	-	-
Gross inland consumption	92 509	41 656	12 921	19 093	2 953	11 879	-	-	482	4 325	-	-799
Transformation input	71 221	37 109	12 283	19 357	277	1 288	564	-	98	244	-	-
of which: Public thermal power stations	*50%*	*60%*	*99%*	-	*57%*	*67%*	*38%*	-	*0%*	*38%*	-	-
Autoprod. therm. power st.	*3%*	*4%*	-	-	*16%*	*9%*	*58%*	-	*96%*	*47%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	*14%*	*26%*	-	-	-	*1%*	-	-	-	-	-	-
Refineries	*27%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	49 270	6 829	-	-	18 700	-	2 553	-	-	-	8 261	12 926
of which: Public thermal power stations	*34%*	-	-	-	-	-	-	-	-	-	*53%*	*95%*
Autoprod. therm. power st.	*3%*	-	-	-	-	-	-	-	-	-	*10%*	*5%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	*17%*	*100%*	-	-	-	-	*68%*	-	-	-	-	-
Refineries	*38%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-6	-	-	214	-220	-	-	-	-	-191	-	191
Consumption of the energy branch	7 779	577	12	3	1 396	967	1 026	-	8	0	1 287	2 502
of which: Prod. and distrib. of electr.	*17%*	-	-	-	*1%*	-	-	-	-	-	*11%*	*46%*
Oil refineries	*28%*	-	-	-	*97%*	*57%*	-	-	*63%*	-	*16%*	*2%*
Distribution losses	1 477	-	-	-	-	203	40	-	-	-	-	1 234
Available for final consumption	61 297	10 799	625	-53	19 761	9 421	924	-	375	3 890	6 974	8 582
Final non-energy consumption	4 088	45	-	-	2 132	1 911	-	-	-	-	-	-
Final energy consumption	56 935	11 155	106	-	17 325	7 413	923	-	375	3 890	7 166	8 582
Industry	17 742	5 560	4	-	1 866	2 699	920	-	375	764	1 905	3 648
of which: Iron & steel industry	*24%*	*35%*	-	-	*0%*	*17%*	*93%*	-	*10%*	*0%*	*12%*	*17%*
Chemical industry	*22%*	*13%*	-	-	*48%*	*7%*	*2%*	-	*56%*	*0%*	*56%*	*20%*
Glass, pottery & building mat.	*14%*	*16%*	*23%*	-	*15%*	*34%*	*4%*	-	*12%*	*1%*	*2%*	*8%*
Paper and printing	*7%*	*6%*	-	-	*3%*	*2%*	-	-	*1%*	*59%*	*3%*	*7%*
Transport	11 316	-	-	-	10 934	-	-	-	-	17	-	365
of which: Road transport	*93%*	-	-	-	*96%*	-	-	-	-	*100%*	-	-
Air transport	*3%*	-	-	-	*3%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	27 877	5 595	101	-	4 525	4 714	3	-	0	3 109	5 261	4 569
of which: Households	*62%*	*75%*	*48%*	-	*26%*	*64%*	*98%*	-	-	*80%*	*87%*	*43%*
Statistical difference	274	-401	519	-53	304	97	1	-	-	-	-192	-

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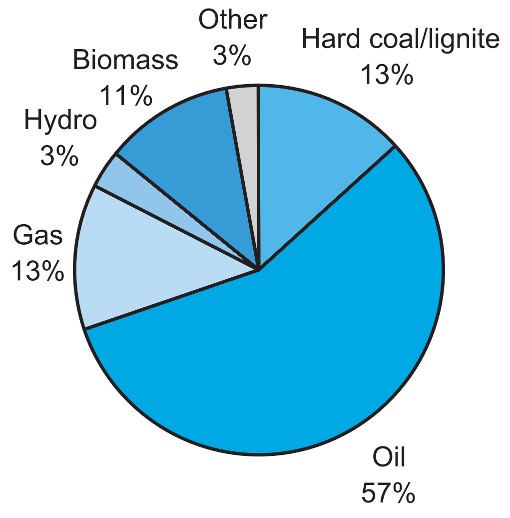
1.1.21 Portugal

Like many EU countries, Portugal depends on imported fossil fuels for most of its energy needs, including coal, natural gas, liquefied natural gas and oil. The total share of these imported fossil fuels in gross inland consumption was 83% in 2004 (Figure 1.1.57). Portugal's largest domestic energy resource is hydropower, which provides more than one-fifth of its electricity. Other renewable energy resources have experienced significant investment and/or development in recent years, particularly wind and solar power.

Figure 1.1.57: Gross inland consumption by fuel



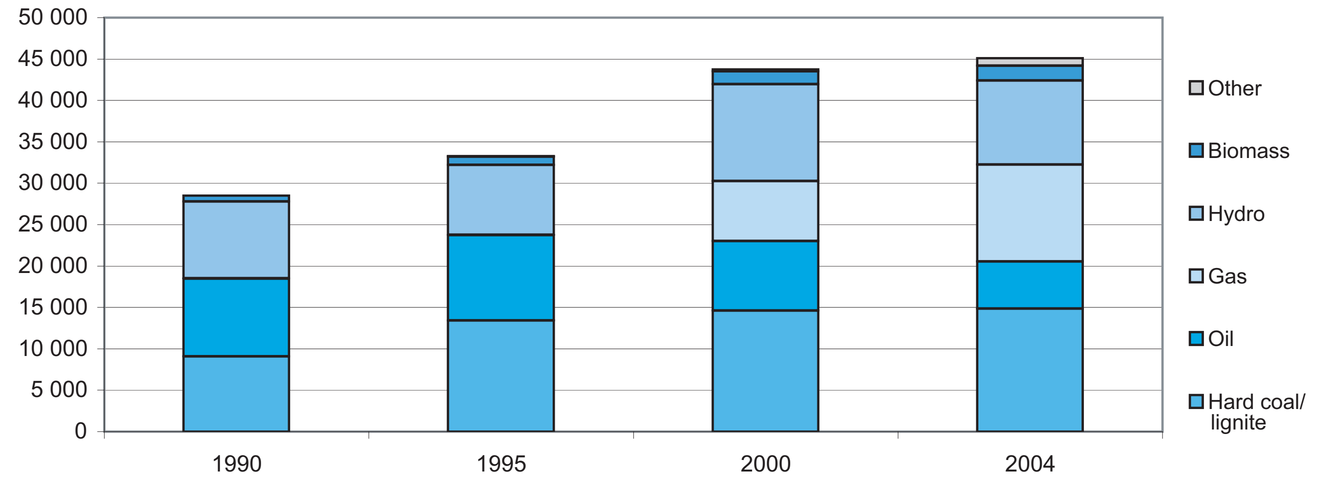
Energy market structure and energy security

Diversification and improved energy infrastructure have formed important elements of the energy reorganisation that has occurred in recent years, addressing energy security concerns as well as compliance with EU market Directives. The transport and distribution infrastructure for oil and gas has improved in recent years, including work on the natural gas pipelines, the two oil terminals, and a liquefied gas natural gas terminal that started operation in 2003. According to the *Direcção geral de Geologia e Energia de Portugal* (2006), the country continues to prioritise efforts to diversify the energy mix, improve security of supply and comply with climate change mitigation and environmental protection.

Electric power

Between 1990 and 2004, installed capacity for hydropower and thermal grew by 45% and 80%, respectively. The main increase has been in generation by natural gas, which has increased substantially during the past ten years, from essentially zero in 1995 to 26% of electricity production in 2004, while at the same time electricity production from oil has decreased significantly (Figure 1.1.58). Integration of the grids contributed to the increasing share of imported electricity, which in 2004 amounted to 15% of Portugal's electricity demand.

Figure 1.1.58: Electricity power generation by source (GWh)



Natural gas

The Portuguese natural gas sector has grown considerably in recent years, despite lacking any domestically viable reserves. The increase in natural gas consumption can be attributed in part to improved import infrastructure, especially the Sines liquified natural gas (LNG) import terminal and the *Maghreb-Europe* pipeline, which connects the Iberian Peninsula to Algerian natural gas sources. The Sines terminal for LNG started to operate in 2003, allowing Portugal to diversify its natural gas supply, which previously was dependent on Spain's natural gas network to process and transport natural gas from Algeria and Nigeria.

Renewable energy options

At the end of the 1990s, the Portuguese passed legislation that was more favourable to renewable energy, which will help facilitate Portugal's indicative target of 39% under the EU Renewable Electricity Directive. Currently, production of electricity from renewables is dominated by large hydro. However, there has been significant investment in other renewables, especially wind, in recent years. In order to attract investment in renewables projects, the Portuguese government established a new tariff regime, which awards higher rates per kilowatt-hour depending on the type of technology and monthly usage.

Wind Energy

The Atlantic archipelagos of the Azores and Madeira, with high wind energy potential, were the sites of the first wind parks, starting in the late 1980s. Since that time, several wind projects have been developed on the mainland; by the end of 2004, 553 MW of wind capacity were installed, mostly on the mainland but also in the Azores and Madeira.

Solar

Portugal has also been investing in solar power, taking advantage of the excellent conditions in the country. Several projects have been initiated during the past few years. One plant located south of Lisbon is expected to produce enough electricity for 8 000 homes when it starts generating power in 2007. The 11-megawatt solar power plant is made up of 52 000 photovoltaic modules, which cover a 60-hectare southern-facing hillside.

Geothermal

Limited geothermal resources on mainland Portugal have been developed for direct use, for space heating (including domestic hot water), greenhouse heating, bathing and swimming. Geothermal sources in the Azores are used for production of electricity as well as being used directly. The total installed capacity was 14 MW as of 2004.

Bioenergy and Biofuels

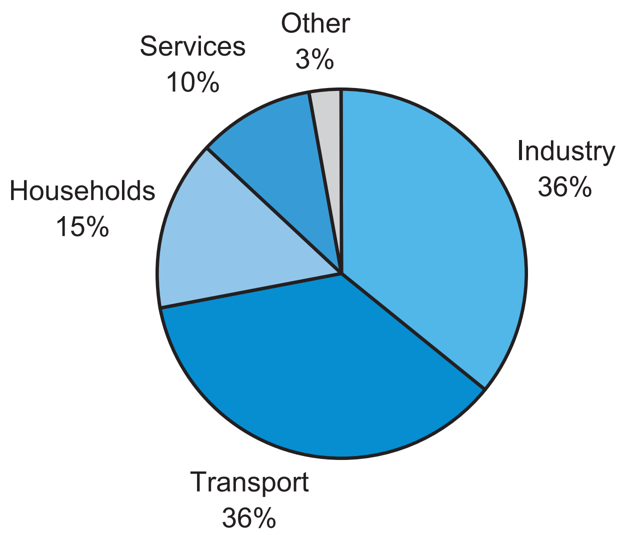
Biomass accounts for 11% of gross inland consumption of energy. Nearly half of biomass use is in the industry sectors. Households and thermal power plants account for 40% and 14% of biomass consumption, respectively. Biomass use is expected to increase; the government issued a tender for the allocation of 15 forestry-based biomass thermal power stations, with a total installed capacity of 100 MW.

Energy demand and energy efficiency

The industry and transport sectors each account for more than one-third of final energy demand, while residential, services, and other sectors together account for somewhat less than one-third (Figure 1.1.59). Since 1990, overall energy demand in Portugal has grown faster than GDP, thus increasing energy intensity.

A number of recent national measures are aimed at reducing energy intensity. They include the Regulations on Characteristics of the Thermal Behaviour of Buildings (RCCTE) and Regulations on Air Conditioning Systems in Buildings (RSECE), whose aim is to establish an energy certification system for buildings, in accordance with the EU Directives. Also adopted was a Plan to Promote the Efficiency on Consumption for the period 2006-2009, focusing particularly on electricity consumption.

Figure 1.1.59: Final energy consumption by sector



Portugal - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	3 894	-	-	-	-	-	-	-	-	3 894	-	-
Recovered products	7	-	-	-	-	-	-	-	7	-	-	-
Imports	24 595	3 210	-	13 266	4 074	3 305	-	-	-	-	-	740
Stock change	498	162	-	-95	433	-1	-	-	-	-	-	-
Exports	2 173	-	-	-	1 990	-	-	-	-	-	-	183
Bunkers	650	-	-	-	650	-	-	-	-	-	-	-
Gross inland consumption	26 172	3 372	-	13 171	1 867	3 303	-	-	7	3 894	-	557
Transformation input	20 372	3 227	-	13 438	1 239	1 987	-	-	7	473	-	-
of which: Public thermal power stations	*29%*	*100%*	-	-	*70%*	*82%*	-	-	-	*21%*	-	-
Autoprod. therm. power st.	*5%*	-	-	-	*30%*	*18%*	-	-	*100%*	*79%*	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*66%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	16 571	-	-	-	13 378	-	-	-	-	-	258	2 936
of which: Public thermal power stations	*16%*	-	-	-	-	-	-	-	-	-	*32%*	*85%*
Autoprod. therm. power st.	*4%*	-	-	-	-	-	-	-	-	-	*68%*	*15%*
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*81%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	77	-	-	253	-175	-	-	-	-	-919	-	919
Consumption of the energy branch	999	-	-	-	760	17	-	-	-	-	-	222
of which: Prod. and distrib. of electr.	*14%*	-	-	-	-	-	-	-	-	-	-	*63%*
Oil refineries	*82%*	-	-	-	*100%*	*99%*	-	-	-	-	-	*20%*
Distribution losses	369	-	-	-	-	20	-	-	-	-	-	349
Available for final consumption	21 081	146	-	-14	13 070	1 279	-	-	-	2 502	258	3 841
Final non-energy consumption	905	-	-	-	905	-	-	-	-	-	-	-
Final energy consumption	20 122	87	-	-	12 156	1 280	-	-	-	2 502	258	3 841
Industry	7 208	87	-	-	3 143	946	-	-	-	1 321	242	1 469
of which: Iron & steel industry	*2%*	-	-	-	*1%*	*4%*	-	-	-	-	-	*7%*
Chemical industry	*29%*	*17%*	-	-	*54%*	*6%*	-	-	-	*3%*	*42%*	*15%*
Glass, pottery & building mat.	*25%*	*83%*	-	-	*21%*	*54%*	-	-	-	*26%*	*1%*	*14%*
Paper and printing	*15%*	-	-	-	*2%*	*3%*	-	-	-	*57%*	*18%*	*14%*
Transport	7 277	-	-	-	7 229	9	-	-	-	-	-	40
of which: Road transport	*87%*	-	-	-	*88%*	*100%*	-	-	-	-	-	-
Air transport	*12%*	-	-	-	*12%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	5 636	-	-	-	1 784	325	-	-	-	1 180	16	2 332
of which: Households	*54%*	-	-	-	*34%*	*56%*	-	-	-	*99%*	*56%*	*46%*
Statistical difference	54	59	-	-14	10	0	-	-	-	-	-	-

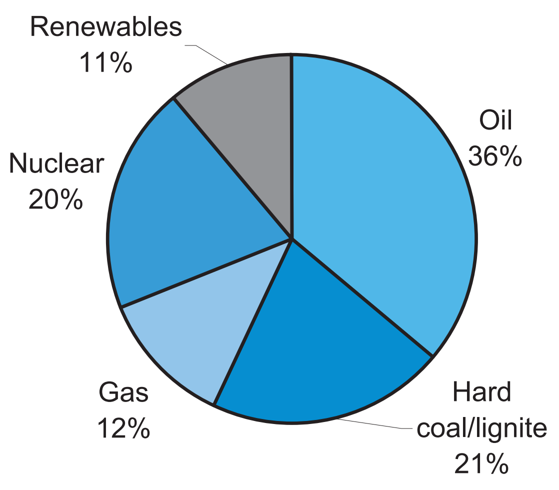
1.1.22 Slovenia

The Slovenian energy system has evolved in recent years to meet EC Directives and to improve overall competitiveness and efficiency. Energy demand has been increasing steadily since the mid-1990s due to solid economic growth. The economy remains dependent on fossil fuel imports and some energy-intensive industries, which pose challenges to the lowering of greenhouse gas emissions. Targets have been set for renewable energy and energy efficiency.

Gross inland consumption

Primary energy supply is dominated by fossil fuels, with oil accounting for 36% of gross inland consumption in 2004; solid fuels accounted for 21% and gas 12%. Nuclear accounts for 20%, while renewables account for 11% (Figure 1.1.60). Almost all of the natural gas used is imported, which is due in part to Slovenia's rather strategic location with respect to natural gas transit routes. However, unlike some other EU countries, very little of this gas is used for electricity production; the overwhelming majority - about 85% - is used directly in industry or for heating. Most of the solid fuels is domestic lignite, and 29% imported hard coal.

Figure 1.1.60: Gross inland consumption by fuel

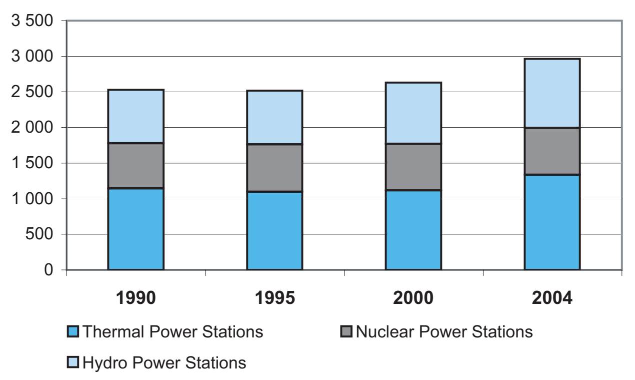


Electric power sector

The electric power sector is based primarily on nuclear, conventional thermal plants mainly burning lignite and hydropower. About 6% of electricity generated is from combined heat and power plants (CHP), which are fuelled mainly by solid fuels along with a small amount of gas and biomass. In 2004, about 36% was generated by nuclear and 27% from hydro. The installed capacity for hydro has increased by 30% between 1990 and 2004, and now makes up about one-third of total installed capacity (Figure 1.1.61).

The Slovenian electricity market has been privatised and is nearing the completion of the process of liberalisation, in accordance with the EC market directive. Customers with more than 41 kW of connected power have been able to choose their electricity supplier since July 2001, while other non-residential customers have been able to do so since July 2004. The last group of electricity consumers-households-will be brought into the liberalised market as of 1 July 2007 (1).

Figure 1.1.61: Net installed capacity of electricity generating power plants, in MW



Nuclear power

A third of Slovenia's electricity is produced by the bi-national Krško nuclear power plant, jointly owned by Slovenia and Croatia. Public attitudes have been shifting in favour of the current plant, although not in favour of expansion; a recent Eurobarometer survey showed that 44% were in favour of energy produced in nuclear power plants, while 5% were in favour of further expansion of nuclear power (2).

Dependence on fossil fuels

Like many EU countries, Slovenia is dependent on imported fossil fuels, particularly oil and gas. The high level of dependence on fossil fuels was extended to all refined petroleum products after the closure of the Lendava refinery in 2001. One of the two major coal mines in Slovenia is scheduled to be shut down in 2007, partly for environmental considerations (3)

The geographical position of Slovenia has made it into a key transit country for various gas pipe lines. Slovenia has a gas network connected to the main European networks, coming from Russia and Algeria (4). The gas sector is undergoing the process of liberalisation according to the EC Directive, which will be completed in July 2007.

Renewable energy options

Although hydro already represents one-third of installed power capacity, there appears to be significant potential for further expansion. Other intermittent renewables -wind and solar- are somewhat more limited due to geography and climate considerations.

Biomass is considered another important potential contributor to the national RES-E targets, promulgated in the national energy programme; forests cover over 50% of the country (5). There is, however, competition for the use of biomass for use by wood panel and furniture manufacturers.

There is currently about 100 MWt of geothermal heating capacity, concentrated in health spas, agriculture and institutions. The theoretic potential is much higher and could also be suitable for electricity production. Investigations carried out during the early 2000s suggested a potential for expanding geothermal for heat to 500 MWt by 2020 and developing geothermal electric capacity of 40 MW (6).

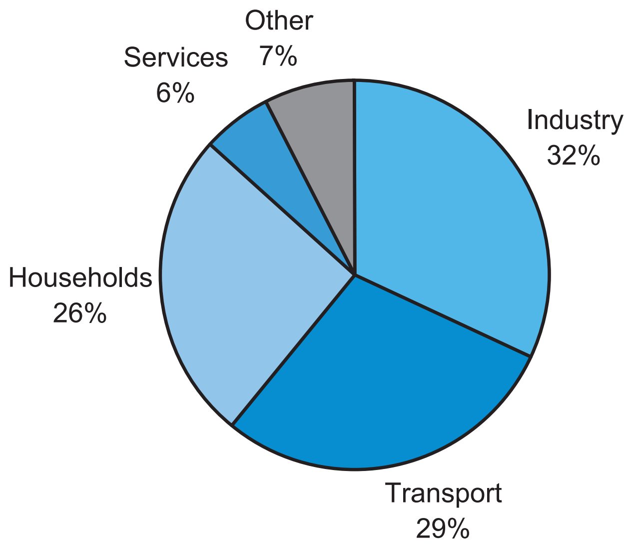
Energy demand

Unlike other countries in the region, energy demand and the associated CO_2 emissions during the economic transition period of the 1990s did not decline, due to successful redirection of exports that limited the extent of recession (7). The share of electricity used by industry is quite high - 54% - due to the continuing economic importance of a number of electricity-intensive industries, including aluminum, steel, stone, pulp and paper industries.

Transport accounted for 29% and industry for 32% of final energy consumption in 2004, while households, services and other 39% (Figure 1.1.62).

As part of the demand-side energy efficiency strategy, the Agency for Energy Efficiency and Renewable Energy (AURE) was established under the Ministry of the Environment, Spatial Planning and Energy. The Agency is responsible for carrying out different programmes for promotion of energy efficiency, renewable energy sources, and combined heat and power production targeting households, industry and the public service sectors. Furthermore, the National Energy Programme identified several sub-targets for energy efficiency improvements by 2010, including a 10% improvement in energy efficiency in all sectors and a doubling of the share of electricity from cogeneration (8).

Figure 1.1.62: Final energy consumption by sector



Slovenia - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	3 436	-	1 201	1	-	4	-	1 408	-	822	-	
Recovered products	146	-	-	136	-	-	-	-	10	-	-	
Imports	4 466	360	0	-	2 669	894	-	-	-	-	-	543
Stock change	-35	8	-8	-	-35	-	-	-	-	-	-	
Exports	820	25	-	-	186	-	-	-	-	-	-	610
Bunkers	-	-	-	-	-	-	-	-	-	-	-	
Gross inland consumption	7 193	343	1 193	137	2 448	899	-	1 408	10	822	-	-67
Transformation input	2 994	214	1 191	1	14	126	-	1 408	1	40	-	
of which: Public thermal power stations	*48%*	*97%*	*100%*	-	*29%*	*32%*	-	-	-	*14%*	-	-
Autoprod. therm. power st.	*2%*	*3%*	-	-	*35%*	*18%*	-	-	*100%*	*58%*	-	-
Nuclear power stations	*47%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*0%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	1 194	-	-	-	1	-	-	-	-	-	232	961
of which: Public thermal power stations	*52%*	-	-	-	-	-	-	-	-	-	*69%*	*48%*
Autoprod. therm. power st.	*3%*	-	-	-	-	-	-	-	-	-	*1%*	*3%*
Nuclear power stations	*39%*	-	-	-	-	-	-	-	-	-	-	*49%*
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	*0%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	-	-	-	-352	-	352
Consumption of the energy branch	101	-	-	-	-	4	-	-	-	-	7	90
of which: Prod. and distrib. of electr.	*86%*	-	-	-	-	-	-	-	-	-	*69%*	*92%*
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	104	-	-	-	-	-	-	-	-	-	31	73
Available for final consumption	5 189	129	3	136	2 435	768	-	-	10	430	195	1 082
Final non-energy consumption	338	27	-	-	208	102	-	-	-	-	-	
Final energy consumption	4 787	78	-	-	2 326	666	-	-	10	430	195	1 082
Industry	1 532	77	-	-	197	511	-	-	10	104	53	581
of which: Iron & steel industry	*9%*	-	-	-	*1%*	*14%*	-	-	-	-	*10%*	*10%*
Chemical industry	*12%*	-	-	-	*5%*	*13%*	-	-	-	*7%*	*30%*	*13%*
Glass, pottery & building mat.	*14%*	*51%*	-	-	*22%*	*18%*	-	-	-	-	-	*7%*
Paper and printing	*17%*	*49%*	-	-	*6%*	*20%*	-	-	-	*43%*	*2%*	*11%*
Transport	1 379	-	-	-	1 363	-	-	-	-	-	-	16
of which: Road transport	*96%*	-	-	-	*98%*	-	-	-	-	-	-	-
Air transport	*1%*	-	-	-	*2%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	1 876	0	-	-	767	155	-	-	-	326	142	485
of which: Households	*66%*	*100%*	-	-	*58%*	*63%*	-	-	-	*99%*	*75%*	*53%*
Statistical difference	64	24	3	136	-99	-	-	-	-	-	-	

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1.1.23 Slovakia

Slovakia has gone through a period of restructuring during the past 15 years, starting with the transition to a market economy in the early 1990s and followed by privatisation and liberalisation in the energy sector, in accordance with the EU Directives. Industrial restructuring led to a decrease in final energy consumption of 12%. However, energy-intensive industries continue to have a significant share in the economy, and Slovakia is highly dependent on imported fuel. Consequently, energy policy goals are aimed at further reductions in energy intensity along with diversification of energy sources and development of domestic resources (1).

Primary energy sources

The primary energy sources in Slovakia are solid fuels, natural gas, nuclear, hydro, biomass and oil (Figure 1.1.63). The net import of energy constitutes 93% of the gross inland consumption; their imports are primarily natural gas and oil from Russia, brown coal from the Czech Republic and black coal from several other countries in the region.

As with other new Member States, the consumption of coal in Slovakia has decreased considerably in recent years, due in part to stricter environmental standards. Despite efforts to reduce coal consumption and plans to phase out extraction of brown coal by 2030, in the interim the use of domestic coal for electricity production will help to decrease import dependency (1).

Most oil is imported from Russia through the oil pipeline *Druzba*, which also serves as a transit pipeline to the Czech Republic. As an alternative, oil can be imported via the pipeline *Adria*. Consumption of liquid fossil fuels is expected to increase in the transport sector.

Slovakia lies along the main transit route for natural gas from Russia to Western Europe, and nearly all natural gas is imported from Russia. Slovakia has one of the most developed distribution networks for natural gas in Europe, with more than two-thirds of all municipalities having access to natural gas.

Electric power sector

The majority of electricity is produced by nuclear plants, followed by hydro, coal and gas (Figure 1.1.64). Slovakia is a net exporter of electricity, although it also imports a significant amount; in 2004, it imported an amount that was more than one-third of final domestic electricity demand. The existence of dense population areas, major centres of industrial demand and supply, and grid connections in the region facilitate the trade in electricity. As part of the liberalisation process most of the electricity companies have been privatized, and market openings are proceeding in accordance with the EU Directives.

Figure 1.1.63: Gross inland consumption by fuel

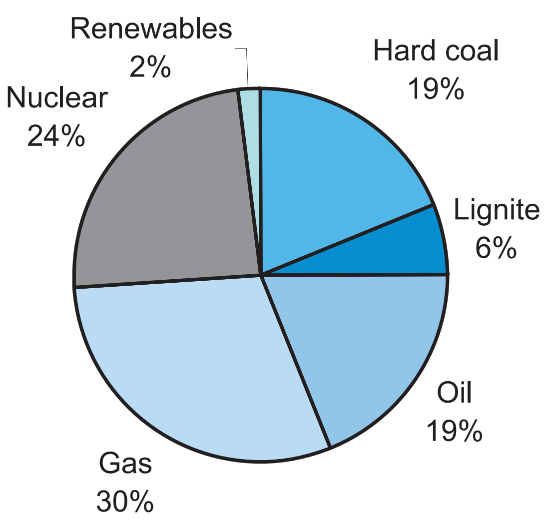
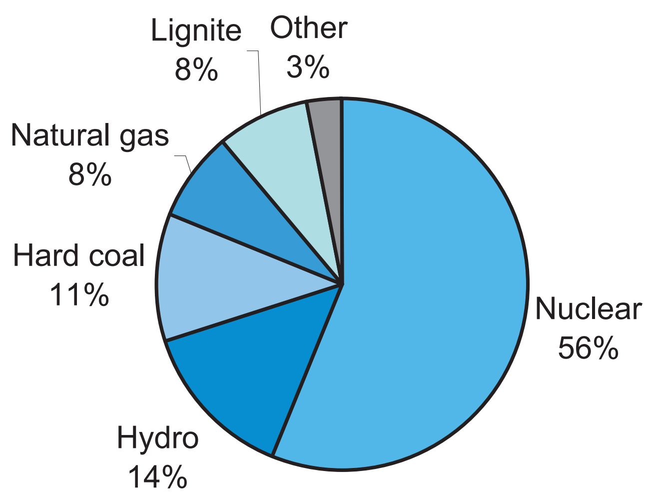


Figure 1.1.64: Electricity generation by source, 2004



Nuclear power

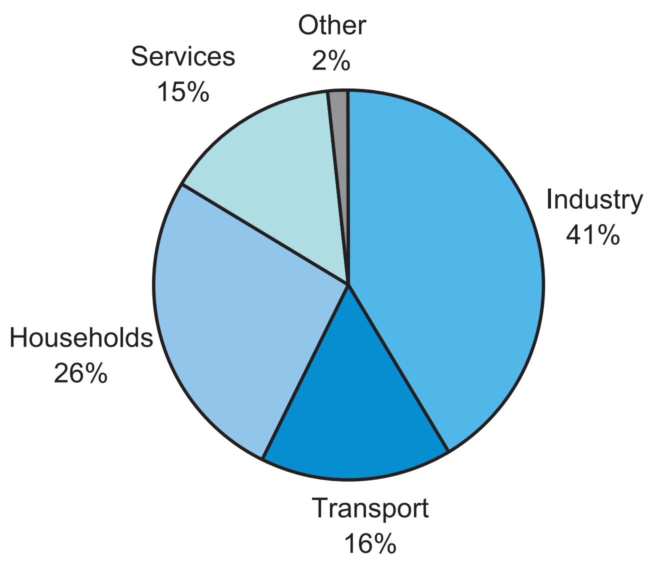
There are two nuclear power plants in Slovakia - *Jaslovske Bohunice* and *Mochovce*. The former has four working reactors and one decommissioned reactor. The working reactors are scheduled to be decommissioned in 2006 and 2008, respectively, in accordance with the energy chapter of the Accession Treaty with the EU (2). *Mochovce* has two functioning reactors and two uncompleted reactors. Completion of these two reactors was halted in 1992 due to lack of financing. In 2004 the government adopted a plan to renovate and complete the two blocks, in order to compensate for the shortfall of energy supply after the decommissioning of the two *Jaslovske Bohunice* reactors.

Final demand

Industry accounts for 41% of final energy consumption, followed by the household sector, with 26% (Figure 1.1.65). The share of transport in final energy consumption is quite low; car ownership per capita in Slovakia is the lowest in the EU, at 222 per 1000 inhabitants, compared to the EU average of 472 (3). The high share of industry is due in part to the continued concentration of energy-intensive industries - including metallurgy, chemicals, machinery, building materials, and cement.

Demand-side energy efficiency is starting to be addressed, which is important in light of the relatively high carbon intensity of the economy, the upcoming decommissioning of the two *Jaslovske Bohunice* reactors, and the dependence on energy imports (4). Significant potential for cost-effective energy savings has been identified in all sectors; a programme providing investment support for energy conservation measures and renewable energy was run by the Slovak Energy Agency from 2003-2006 (5).

Figure 1.1.65: Final energy consumption by sector



Slovakia - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	5 808	-	817	43	23	142	-	4 392	-	392	-	
Recovered products	298	-	-	274	-	-	-	-	24	-	-	
Imports	17 378	3 586	209	6 062	1 091	5 679	-	-	-	-	-	751
Stock change	-425	-50	-7	-73	26	-321	-	-	0	-	-	
Exports	4 891	37	-	181	3 762	1	-	-	-	-	-	911
Bunkers	-	-	-	-	-	-	-	-	-	-	-	
Gross inland consumption	18 168	3 500	1 019	6 125	-2 622	5 498	-	4 392	24	392	-	-160
Transformation input	16 833	3 142	809	6 770	104	1 518	61	4 392	4	33	-	
of which: Public thermal power stations	*13%*	*24%*	*97%*	-	*8%*	*43%*	-	-	*2%*	-	-	-
Autoprod. therm. power st.	*2%*	*3%*	*1%*	-	*87%*	*5%*	*98%*	-	-	*74%*	-	-
Nuclear power stations	*26%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*10%*	*54%*	-	-	-	-	-	-	-	-	-	-
Refineries	*40%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	12 304	1 274	-	-	6 589	-	889	-	-	-	1 286	2 266
of which: Public thermal power stations	*9%*	-	-	-	-	-	-	-	-	-	*42%*	*27%*
Autoprod. therm. power st.	*2%*	-	-	-	-	-	-	-	-	-	-	*8%*
Nuclear power stations	*12%*	-	-	-	-	-	-	-	-	-	*4%*	*65%*
Coke-oven plants	*13%*	*100%*	-	-	-	-	*36%*	-	-	-	-	-
Refineries	*54%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-9	-	-	646	-655	-	-	-	-	-353	-	353
Consumption of the energy branch	2 071	-	3	-	501	793	369	-	0	-	124	280
of which: Prod. and distrib. of electr.	*10%*	-	-	-	-	*1%*	-	-	-	-	-	*74%*
Oil refineries	*32%*	-	-	-	*100%*	*21%*	-	-	-	-	-	-
Distribution losses	429	-	-	-	-	124	33	-	-	-	158	113
Available for final consumption	11 131	1 632	207	-	2 707	3 063	427	-	20	6	1 004	2 066
Final non-energy consumption	1 003	-	-	-	646	357	-	-	-	-	-	
Final energy consumption	10 001	1 506	233	-	2 034	2 707	427	-	19	6	1 004	2 066
Industry	4 138	1 411	59	-	346	855	427	-	19	0	99	922
of which: Iron & steel industry	*48%*	*88%*	*0%*	-	*2%*	*17%*	*89%*	-	-	-	-	*24%*
Chemical industry	*12%*	-	*18%*	-	*70%*	*9%*	-	-	*99%*	-	*47%*	*13%*
Glass, pottery & building mat.	*10%*	*8%*	*0%*	-	*16%*	*19%*	-	-	-	-	*5%*	*7%*
Paper and printing	*6%*	*2%*	*71%*	-	*2%*	*7%*	-	-	-	*100%*	*22%*	*10%*
Transport	1 585	-	-	-	1 518	6	-	-	-	-	-	61
of which: Road transport	*94%*	-	-	-	*98%*	*100%*	-	-	-	-	-	-
Air transport	*2%*	-	-	-	*2%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	4 278	95	173	-	169	1 846	-	-	-	6	905	1 083
of which: Households	*62%*	*4%*	*57%*	-	*3%*	*81%*	-	-	-	-	*69%*	*38%*
Statistical difference	127	125	-25	-	27	-	-	-	0	0	-	

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(5) Bergasse, E. (2006) "IEA 2005 Slovak Energy Policy Review: Main Messages on Energy Efficiency," IEA/EBRD Side Event on Energy Efficiency in Slovakia: Challenges and Opportunities, Bratislava, Slovak Energy Agency, 28 March.

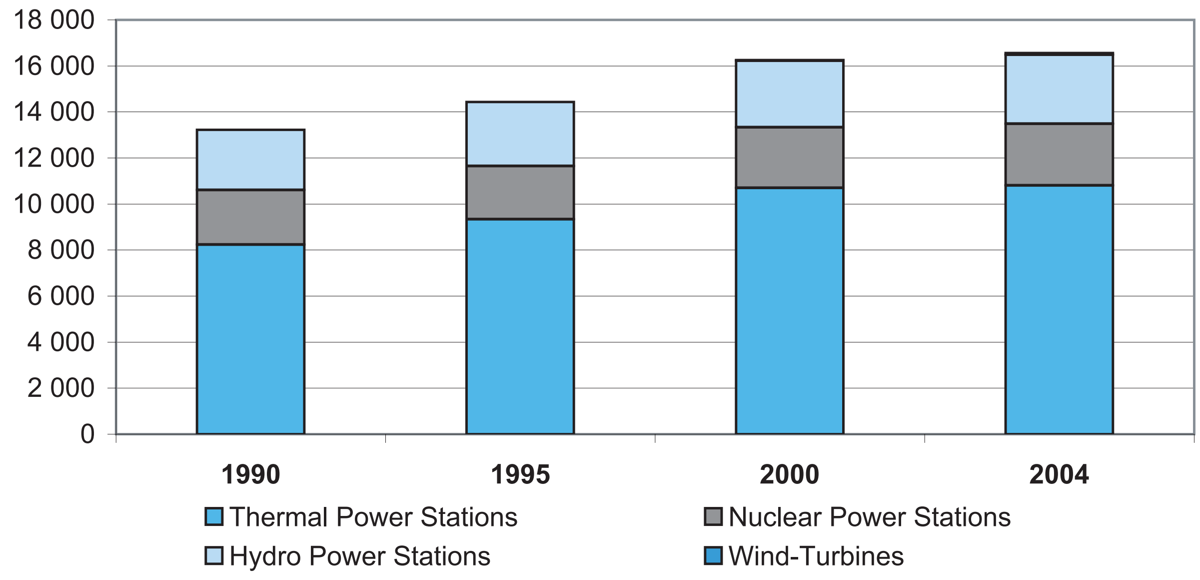
1.1.24 Finland

The Finnish energy system has a diverse resource base, although it is historically strongly tied to the development of the Finnish forest sector as an internationally competitive export industry. Several industrial sectors are major consumers and producers of biomass and/or electricity, thereby facilitating a significant increase in bioenergy and affecting the energy structure. Energy policy in Finland is coordinated by the Ministry of Trade and Industry, and is based on three key elements: security of supply, competitive energy prices, and meeting international environmental targets.

Electricity sector

The electricity market was deregulated and liberalised during 1995-1997. Electricity is traded via the spot market, financial markets and bilateral contracts. The spot and financial markets operate through the Nordic Power Exchange, *Nordpool*, which facilitates trade between Norway, Sweden, Finland and Denmark. Fluctuation in the availability of hydropower in Sweden and Norway strongly influences the level and structure of electricity production in Finland. During "wet" years, Finland is a net electricity importer; in "dry" years, Finland is a net exporter. The majority of the installed power capacity is from thermal power plants, with the remainder comprised of hydro, nuclear, and a very small amount of wind. Thermal capacity has increased by nearly a third since 1990 (Figure 1.1.66). After joining the EU in 1995, the Finnish electricity sector has been greatly influenced by the EU market opening, EU renewable energy targets and Kyoto commitments for greenhouse gas emissions reduction. The overwhelming majority of capacity is owned by only a few companies. Renewable energy contributed nearly 30% of total electricity use in 2004, which is quite close to the Renewable Energy Directive (2001/77/EC) target for 2010 of 31.5 %. However, hydro capacity was near its peak in 2004; hydro-based electricity increased by more than 50% in 2004 compared to 2003, which was a rather dry year.

Figure 1.1.66: Net installed capacity of electricity generating power plants, in MW



Hydro and other intermittent renewables

Like Norway and Sweden, Finland has significant hydro resources, which have formed an important part of the power supply mix for many decades. However, increases in hydro capacity have been marginal since 1987; construction of new generation capacity is strictly regulated for nature conservation reasons. Consequently, although hydro still represents a significant share of power production, nuclear and thermal both provide greater shares (Figure 1.1.67). More recently there have been discussions in favour of increasing hydro due to energy security and climate policy concerns.

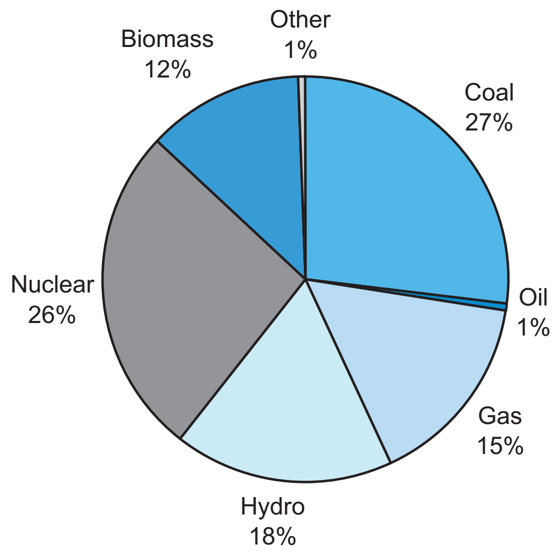
Intermittent renewables other than hydro have somewhat limited applications. The share of wind power is quite small, while solar power is not considered a significant potential power source in Finland, but it is used for small-scale remote and/or off-grid applications.

Nuclear and thermal power

Nuclear power is produced in four reactors that were built in the late 1970s. A fifth reactor is under construction in Olkiluoto. Nuclear power is generally seen as supportive of the key elements of the national energy policy, because it provides electricity at competitive prices in Finland, reduces reliance on imported energy, and does not contribute to greenhouse gas emissions (1).

Thermal power plays a major role in the Finnish energy system, with coal, biomass, natural gas and peat used as fuels. Coal is perceived as important because its price in world markets impacts the pricing of other more regionalised energy sources. The use of natural gas has increased considerably since the 1980s by extending the natural gas lines from Russia; gas has been viewed as economical and environmentally-friendly. Price increases for natural gas and coal have made wood chips and peat more competitive as fuel sources.

Figure 1.1.67: Electricity generation by source, 2004



CHP and district heating

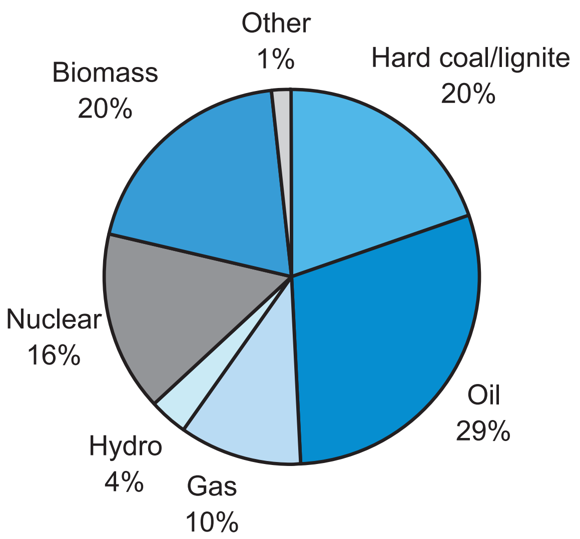
Reliance on thermal sources of power, especially from biomass, has resulted in a major role for combined heat and power (CHP), providing the overwhelming majority of heat requirements in Finland. CHP plants provide 38% of the electricity in Finland, which is the second highest in the EU; the plants have high thermal efficiency, with an average of 83% (see Section 3.1, this volume). Significant demand for heat arises from the cold climate and the existence of key industries that require heat in production processes. Industry is self-sufficient in production of heat due to efficient utilisation of waste heat. District heating expanded significantly during the 1970s and 1980s after the oil crises, and currently provides about half of the heating needs for buildings, covering a majority of apartment buildings.

Bioenergy

Finland has the highest share of biomass-based energy in Europe, accounting in 2004 for 20% of gross inland consumption (Figure 1.1.68). The by-products of the pulp and paper industry offer an economical fuel source for heat and power production. By-products from the forest industry account for almost half of the total use of renewable energy. Wood fuels account for nearly one-third of all renewable energy. In CHP, the share of biomass among input fuels is approximately 70%. National R&D funding has focused on development of bioenergy technologies, with support from a diverse array of actors-politicians, companies and regional actors (2).

Biofuels for transport have only recently received attention. Following the EU Directive on biofuels for transport, a heated debate on different options was initiated among policymakers and researchers. Despite advances on some technological options, the production of biofuels for transport remains insignificant.

Figure 1.1.68: Gross inland consumption by fuel

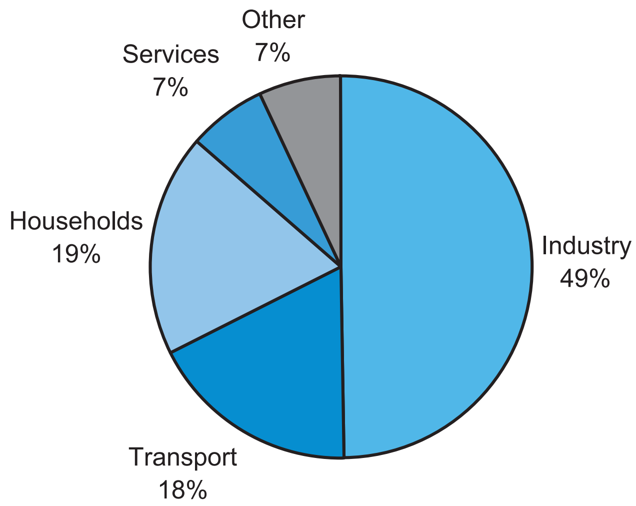


Structure of energy demand

Industry is still a major energy user (Figure 1.1.69), accounting for 49% of final energy consumption. The pulp and paper industry accounts for over half of electricity use in industry, while it also produces much of that electricity. Transport accounts for 18% of total energy demand.

Energy-intensive industrial production, long distances, low population density, and a cold climate have contributed to a significant demand for energy in Finland. Industries and households together accounted for 69% of energy consumption and 80% of electricity consumption in 2004. An energy conservation programme initiated in 1998 is estimated to have resulted in 5 TWh in annual electricity savings by 2004, which was about 6% of total electricity demand. The programme includes energy audits, energy analyses, voluntary conservation agreements, and implementation through Energy Service Companies (ESCOs). The programme was originally expected to run through 2005, but has been extended for two additional years (3).

Figure 1.1.69: Final energy consumption by sector



Renewable energy policy

Renewable energy policy is grounded in environmental objectives, but also in energy security concerns, since biomass and hydro (along with peat) are the only domestically available energy sources. The recent Finnish Action Plan for Renewable Energy includes bioenergy, hydro, wind and solar, although the main efforts thus far have been focused on biomass (4).

The main policy instruments for increasing renewable energy have included support for development and commercialisation of new technology, energy taxation, and information dissemination. Electricity tax and transport fuel tax influence demand, especially when base energy prices are high. In addition, the EU-Emission Trading Scheme has strongly influenced the functioning of energy markets; it has partly replaced electricity taxes on industry and has complemented energy conservation agreements.

Finland - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	15 502	-	780	-	-	-	-	5 860	-	8 862	-	
Recovered products	411	-	-	155	32	-	-	-	225	-	-	
Imports	27 117	5 518	-	12 662	3 978	3 951	-	-	-	6	-	1 003
Stock change	1 495	-126	1 353	-66	335	-	-	-	-	-	-	
Exports	6 311	-	7	-	5 656	-	-	-	-	63	-	584
Bunkers	506	-	-	-	506	-	-	-	-	-	-	
Gross inland consumption	37 708	5 392	2 125	12 751	-1 818	3 951	-	5 860	225	8 805	-	419
Transformation input	32 542	5 217	1 845	13 950	413	2 713	165	5 860	207	2 173	-	
of which: Public thermal power stations	*27%*	*73%*	*92%*	-	*18%*	*80%*	-	-	*3%*	*45%*	-	-
Autoprod. therm. power st.	*5%*	*0%*	*4%*	-	*15%*	*9%*	*100%*	-	*30%*	*46%*	-	-
Nuclear power stations	*18%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*3%*	*17%*	-	-	-	-	-	-	-	-	-	-
Refineries	*43%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	24 927	615	-	-	13 834	-	593	-	-	-	3 812	6 073
of which: Public thermal power stations	*23%*	-	-	-	-	-	-	-	-	-	*72%*	*51%*
Autoprod. therm. power st.	*5%*	-	-	-	-	-	-	-	-	-	*3%*	*17%*
Nuclear power stations	*8%*	-	-	-	-	-	-	-	-	-	-	*32%*
Coke-oven plants	*3%*	*100%*	-	-	-	-	*28%*	-	-	-	-	-
Refineries	*55%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	-8	-	-	1 257	-1 264	-	-	-	-	-1 306	-	1 306
Consumption of the energy branch	1 387	-	-	-	685	307	-	-	-	-	-	395
of which: Prod. and distrib. of electr.	*23%*	-	-	-	-	-	-	-	-	-	-	*80%*
Oil refineries	*75%*	-	-	-	*100%*	*93%*	-	-	-	-	-	*20%*
Distribution losses	509	-	-	-	-	-	-	-	-	-	254	254
Available for final consumption	28 189	790	281	58	9 654	930	428	-	17	5 326	3 558	7 148
Final non-energy consumption	941	-	-	-	883	58	-	-	-	-	-	
Final energy consumption	26 541	680	281	-	8 248	857	427	-	17	5 325	3 558	7 148
Industry	13 179	678	255	-	1 693	782	427	-	16	4 159	1 204	3 966
of which: Iron & steel industry	*13%*	*75%*	-	-	*26%*	*8%*	*100%*	-	-	-	-	*7%*
Chemical industry	*6%*	*7%*	*20%*	-	*10%*	*4%*	-	-	*72%*	*0%*	-	*11%*
Glass, pottery & building mat.	*2%*	*12%*	-	-	*6%*	*6%*	-	-	*15%*	*0%*	-	*2%*
Paper and printing	*54%*	*2%*	*71%*	-	*19%*	*73%*	-	-	-	*90%*	-	*57%*
Transport	4 741	-	-	-	4 678	3	-	-	-	6	-	54
of which: Road transport	*83%*	-	-	-	*84%*	*100%*	-	-	-	*100%*	-	-
Air transport	*12%*	-	-	-	*12%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	8 621	2	26	-	1 876	72	-	-	1	1 161	2 354	3 129
of which: Households	*58%*	*100%*	*51%*	-	*44%*	*36%*	-	-	-	*84%*	*59%*	*56%*
Statistical difference	707	110	-	58	523	15	0	-	-	0	-	

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(4) MTI (Ministry of Trade and Industry) (2003). Uusiutuvan energian edistämisohjelma 2003-2006: työryhmän ehdotus [Action Plan for Renewable Energy Sources: working group proposal]. Helsinki: Ministry of Trade and Industry.

1.1.25 Sweden

The energy system that has supported the Swedish economy since the 1980s draws strongly on the nation's special resource endowments in the form of plentiful water and forests. As with most OECD countries dependent on imported fossil fuels, the Swedish energy system has been evolving to meet the challenges of energy security, economic rationalisation, and environmental sustainability. Demand-side energy efficiency and climate mitigation have been incorporated as key components of energy policy-making, while at the same time market liberalisation has required a shift in the types of policy instruments employed in supporting renewable energy and energy efficiency.

Electric power sector

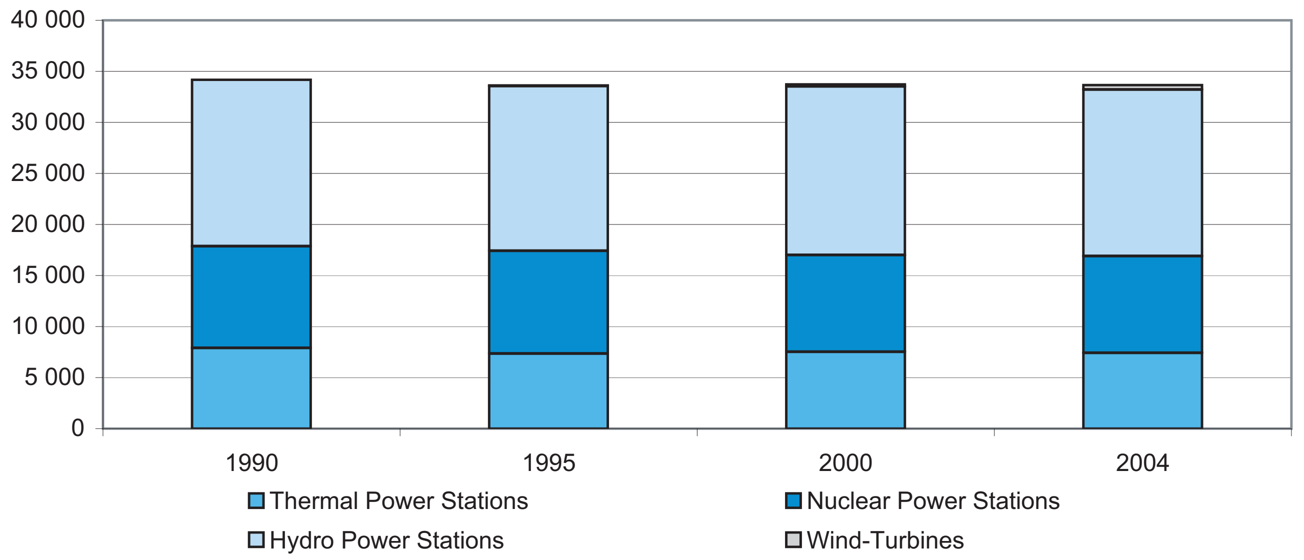
The institutions that guide the operation of today's Swedish power market evolved significantly during the mid-1990s with deregulation, integration of the Nordic power market, and Sweden's entry into the EU. The fact that all three processes were well underway at approximately the same time has helped to improve the overall efficiency of the resulting system as well as reducing the costs of the transition period itself.

Nord Pool-the Nordic Power Exchange-was the world's first international commodity exchange for electric power, connecting markets in Sweden, Norway, Finland, and Denmark. Physical trade in electricity is a key component of the Nordic power sectors, due to seasonal and annual fluctuations in hydropower availability. Sweden and Norway have considerable hydro capacity and limited thermal capacity, whereas Denmark and Finland both have a significant amount of thermal capacity. During dry years, Sweden and Norway increase their imports. Conversely, in wet years they increase their exports.

The Swedish electricity market has been liberalised for eleven years now. Although there are many small traders and suppliers of electricity to end-users, the ownership and operation of power generation has been consolidated, with three companies now responsible for over 85% of generation. Installed capacity is dominated by hydro and nuclear, a situation that has not changed much during the past 15 years (Figure 1.1.70).

About 90% of all electricity generated in Sweden comes from nuclear and hydropower. The remainder is produced from CHP plants running on either biofuels or fossil fuels, industrial back-pressure plants, and a small amount from wind power and thermal plants. In fact, ever since the most recent nuclear power plant came on line in 1985, hydro and nuclear have provided fairly equal shares, with minor fluctuations due to climatic factors that affect the availability of hydro.

Figure 1.1.70: Net installed capacity of electricity generating power plants, in MW



Nuclear power

In the early years of its development, nuclear power was seen as an inexpensive and less polluting alternative to fossil fuels while at the same time less controversial than large hydro, whose impact on wild rivers was raising concerns. A downturn in public opinion after the Three Mile Island accident in 1978 led to the well-known referendum to phase out nuclear power by 2010. The Chernobyl accident in 1986, which caused radioactive fallout in northern Sweden, confirmed these plans.

Renewable energy options

Sweden has a great natural endowment for hydropower, with thousands of lakes, many rivers, and a mountainous topography in northern Sweden. However, environmental concerns have halted further major hydropower expansion since the 1980s. Small-scale hydropower (<1500 kW) makes up about 2% of the capacity, with over 1000 plants. Small-scale plants are subject to many of the same conservation restrictions.

Bio-energy is by far the most important non-hydro source of renewable energy in Sweden, already accounting for about 17% of gross inland consumption of energy, due to Sweden's significant forest resources and a world-class program of research and development on biomass. District heating plants rely on biomass for more than half their energy inputs, and there is also a growing market in biomass briquettes and pellets for industrial and household use. Energy plantations based on willow, grasses, and other sources have been a major target for research and appear to have significant long-term potential ([1]).

Efforts on wind power were mainly focused on RD&D until the early 1990s; state incentives were created from the 1990s ([2]). Since the mid-1990s, investment in wind has accelerated significantly, with installed capacity of 452 MW in 2004, which is more than ten times as much capacity as in 1994. Offshore wind power has gained in popularity, being seen as less complicated by producers due to local land use issues ([3]).

Oil independence and biofuels

In September 2005, the government announced a new goal in its energy policy: to become "independent" of fossil fuels by 2020. It created the so-called "Commission against oil dependency" (*Kommissionen mot oljeberoendet)* in the fall of 2005 to evaluate various strategies for achieving the government's stated goal of "oil independence" by 2020, and sent its report to the government in the summer of 2006.

The goal of oil independence is reminiscent of a previous effort in the 1980s and 1990s to eliminate the use of oil in district heating systems, an effort that was quite successful. Oil and gas inputs for district heating is limited to 15% while the share of biofuels has increased to 76%.

There is now very little oil used in the power sector, district heating, or heating homes. 68% of final energy consumption of petroleum products is used in the transport sector and 17% in industrial sectors. Phasing out oil from the transport sector will obviously be much more difficult than phasing oil out from district heating.

One of the near-term strategies to phase out oil in the transport sector is to phase in biofuels, including bioethanol, biodiesel, and biogas. In Sweden, bioethanol has come the furthest, including blends of 5-15% that are now available at many service stations, as well as E85 (85% ethanol) for a number of applications. Most public buses as well as some truck fleets in the Stockholm region and elsewhere run on either ethanol or biogas.

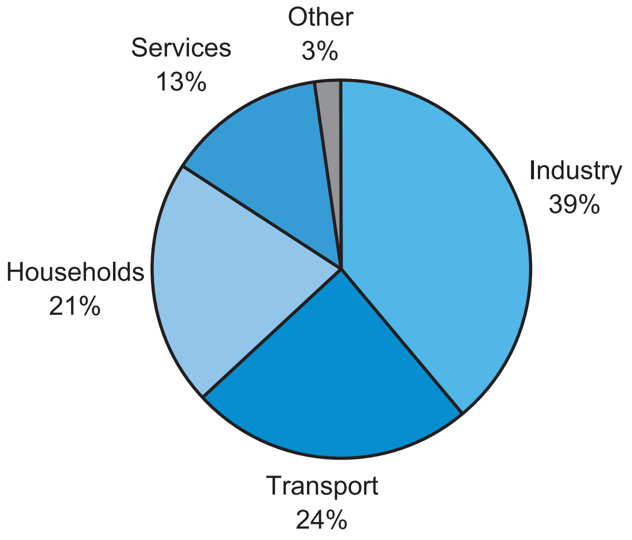
Demand-side energy efficiency

The cold climate has stimulated a considerable amount of energy efficiency and conservation efforts. Homes are well-insulated; building codes and quality controls help to maintain a high standard in manufactured homes as well as in custom-built homes and apartments. Efficient lighting and appliances have been emphasised in the buildings sector. Energy consumption in buildings (households and Service sector) is 37% of the total, in spite of the high level of economic growth that has been experienced in the Service sector (Figure 1.1.71).

The existence of key export-driven energy-intensive industries is another major factor behind energy efficiency efforts. Major industrial energy consumers, such as pulp and paper producers and iron/steel producers, have received incentives for energy efficiency investments. Nevertheless, industry remains by far the main consumer of energy in Sweden, accounting for 39% of final energy in 2004.

Overall, energy efficiency has long received high priority in Swedish energy policy. Together with climate change, both have been firmly integrated into energy policy. Only the means of implementation-rather than the fundamental goals and issues-are now the subject of debate (4). One of the most successful efficiency programmes has been the technology procurement programme, which stimulates innovation for more efficient equipment and appliances through competition for new designs (5). There is also significant reliance on conventional policy instruments such as energy and carbon taxes as well as provision of information.

Figure 1.1.71: Final energy consumption by sector



Sweden - Summary energy balance, 2004

expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	34 500	-	381	-	-	-	-	19 988	-	14 131	-	
Recovered products	23	-	-	-	-	-	-	-	23	-	-	
Imports	32 619	2 537	2	21 023	6 827	884	-	-	-	-	-	1 345
Stock change	436	50	-	12	374	-	-	-	-	-	-	
Exports	12 565	29	1	261	10 748	-	-	-	-	-	-	1 526
Bunkers	1 875	-	-	-	1 875	-	-	-	-	-	-	
Gross inland consumption	53 137	2 558	382	20 774	-5 422	884	-	19 988	23	14 131	-	-181
Transformation input	48 928	2 106	383	21 423	637	283	287	19 988	23	3 799	-	
of which: Public thermal power stations	*7%*	*18%*	*69%*	-	*55%*	*78%*	*79%*	-	*100%*	*46%*	-	-
Autoprod. therm. power st.	*3%*	*0%*	*0%*	-	*17%*	*4%*	*20%*	-	-	*29%*	-	-
Nuclear power stations	*41%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*3%*	*61%*	-	-	*0%*	-	-	-	-	-	-	-
Refineries	*44%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	33 653	934	-	-	19 972	-	687	-	-	-	4 261	7 799
of which: Public thermal power stations	*8%*	-	-	-	-	-	-	-	-	-	*50%*	*9%*
Autoprod. therm. power st.	*3%*	-	-	-	-	-	-	-	-	-	*14%*	*5%*
Nuclear power stations	*20%*	-	-	-	-	-	-	-	-	-	-	*85%*
Coke-oven plants	*3%*	*100%*	-	-	-	-	*31%*	-	-	-	-	-
Refineries	*59%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	31	-	-	389	-357	-	-	-	-	-5 243	-	5 243
Consumption of the energy branch	1 531	-	-	-	712	4	104	-	-	-	0	711
of which: Prod. and distrib. of electr.	*18%*	-	-	-	-	-	-	-	-	-	-	*39%*
Oil refineries	*51%*	-	-	-	*100%*	-	-	-	-	-	-	*10%*
Distribution losses	1 173	-	-	-	-	-	44	-	-	-	189	940
Available for final consumption	35 189	1 386	-1	-259	12 843	598	252	-	-	5 089	4 071	11 209
Final non-energy consumption	2 044	17	-	-	2 027	-	-	-	-	-	-	
Final energy consumption	33 952	1 201	12	-	11 617	480	252	-	-	5 089	4 091	11 209
Industry	13 228	1 201	12	-	2 003	314	221	-	-	4 154	405	4 918
of which: Iron & steel industry	*14%*	*72%*	-	-	*18%*	*9%*	*93%*	-	-	-	-	*9%*
Chemical industry	*8%*	-	*92%*	-	*17%*	*26%*	*0%*	-	-	*0%*	-	*12%*
Glass, pottery & building mat.	*4%*	*15%*	-	-	*8%*	*14%*	-	-	-	-	-	*2%*
Paper and printing	*47%*	*1%*	-	-	*27%*	*11%*	-	-	-	*89%*	-	*40%*
Transport	8 223	-	-	-	7 950	15	-	-	-	-	-	257
of which: Road transport	*85%*	-	-	-	*87%*	*100%*	-	-	-	-	-	-
Air transport	*10%*	-	-	-	*11%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	12 501	-	-	-	1 664	151	31	-	-	935	3 686	6 034
of which: Households	*57%*	-	-	-	*30%*	*28%*	*87%*	-	-	*62%*	*66%*	*59%*
Statistical difference	-807	168	-13	-259	-800	118	-	-	-	-	-19	

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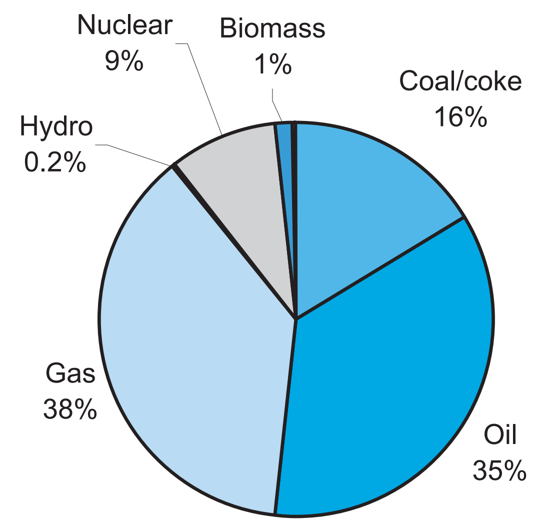
1.1.26 United Kingdom

The UK has undergone considerable restructuring and adjustment in its energy sector since the oil crises of the 1970s, marked by a number of transitions. Dependence on coal for power generation has reduced with the construction of natural gas fired combined cycle gas turbine power stations. After a rapid increase, nuclear power capacity has since stabilised. The production of North Sea oil and gas peaked in 1999 and 2000, respectively. Consequently, the UK has gone from being a net exporter to becoming a net importer of primary energy. Demand-side energy efficiency and renewable energy have received considerable support in recent years, based on the fundamental goals of reducing CO_2 emissions, ensuring security of supply, and improving the long-term competitiveness of the economy.

Figure 1.1.72: Gross inland consumption by fuel

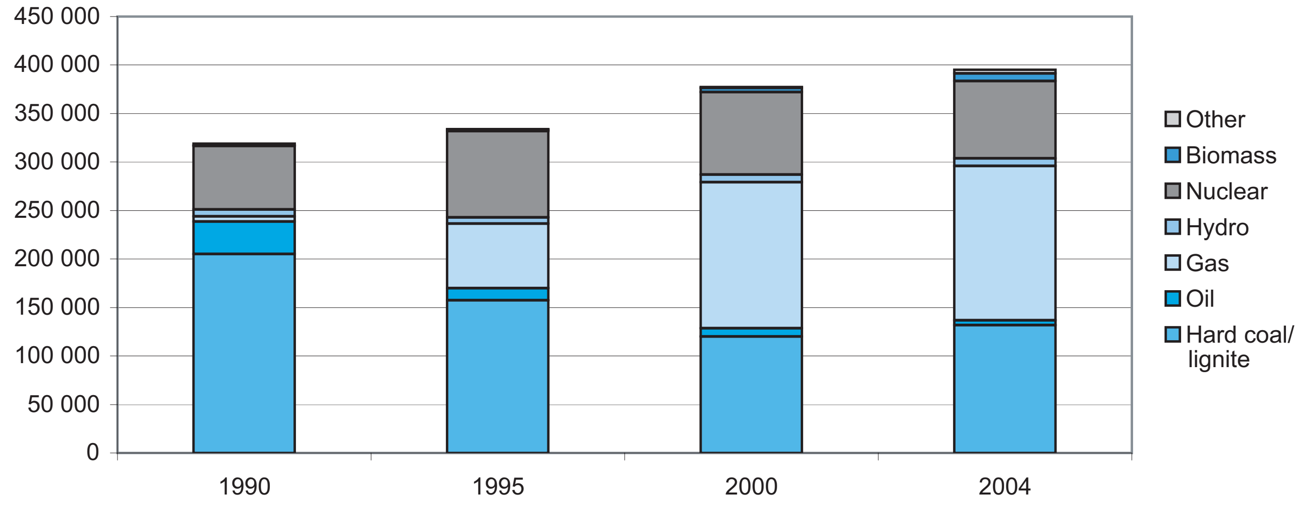


Overview of UK energy system

In 1970, coal accounted for nearly half of gross inland consumption of energy in the UK, whereas by 2004, its share had fallen to 16% (Figure 1.1.72). Much more recently, in 1990, coal accounted for almost two-thirds of electric power generation; by 2004, the share of coal in power generation had declined to 33%. Nuclear power also accounts for a significant share of power generation. Renewable energy remains small, although there has been more investment in wind power and biomass in recent years.

The fall of coal has been mirrored by a rise in the use of natural gas, which now accounts for 38% of gross inland consumption and 40% of electricity generation (Figure 1.1.73). Gas is also used directly in significant amounts for heating and cooking and in industry. The transition towards gas was accelerated by the goal of cutting carbon emissions; gas combustion turbines operate at high efficiency and with lower environmental impact than coal fired power stations.

Figure 1.1.73: Electric power generation by source (GWh)

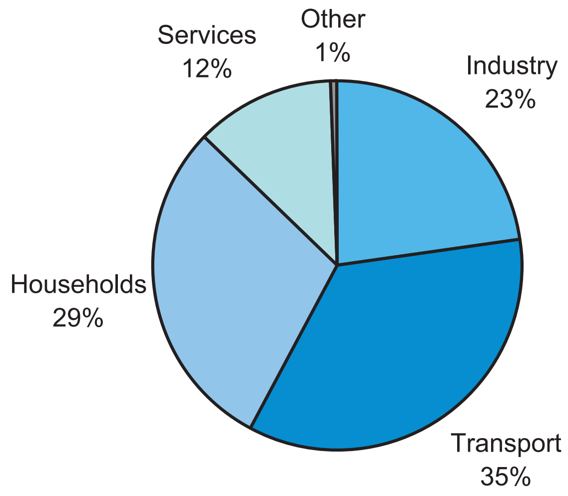


Sectoral demand for energy

Another element in the UK's energy transition has been the considerable fall in the energy intensity of industry, which now accounts for only 23% of final energy consumption, which is among the lowest in the EU. The UK economy is largely service-based and no industrial groups dominate energy consumption. The demand for energy in transport has been rising significantly in recent years and now represents the dominant sector (Figure 1.1.74).

Final consumption of electricity is shared fairly evenly between industry, households, and the service sector. The significance of gas in the UK compared to some EU countries results in a somewhat different structure for final electricity demand. In particular, households and the service sector use a significant amount of gas as well as electricity, whereas in some EU countries where gas is less dominant, the service sector often takes up greater relative demand for electricity compared with other sectors.

Figure 1.1.74: Final energy consumption by sector



United Kingdom - Summary energy balance, 2004
expressed in 1000 TOE

eurostat	Total all products	Coal & equivalents	Lignite & equivalents	Crude oil & feedstocks	Total pet. products	Natural gas	Derived Gases	Nuclear heat	Other fuels	Renew. sources	Derived heat	Electric. energy
Primary production	222 647	15 300	-	96 826	-	86 406	-	20 636	-	3 479	-	-
Recovered products	468	349	-	119	-	-	-	-	-	-	-	-
Imports	117 481	23 179	-	63 468	19 506	10 295	-	-	-	192	-	841
Stock change	-1 013	23	-	-136	-418	-483	-	-	-	-	-	-
Exports	105 388	594	-	65 485	30 281	8 831	-	-	-	-	-	197
Bunkers	2 051	-	-	-	2 051	-	-	-	-	-	-	-
Gross inland consumption	232 144	38 257	-	94 792	-13 244	87 388	-	20 636	-	3 671	-	644
Transformation input	180 098	35 976	-	91 306	216	28 636	976	20 636	-	2 352	-	-
of which: Public thermal power stations	*29%*	*81%*	-	-	*65%*	*79%*	-	-	-	*16%*	-	-
Autoprod. therm. power st.	*4%*	*3%*	-	-	-	*13%*	*93%*	-	-	*84%*	-	-
Nuclear power stations	*11%*	-	-	-	-	-	-	*100%*	-	-	-	-
Coke-oven plants	*2%*	*11%*	-	-	-	-	-	-	-	-	-	-
Refineries	*51%*	-	-	*100%*	-	-	-	-	-	-	-	-
Transformation output	131 828	3 151	-	-	91 193	-	2 061	-	-	-	2 203	33 219
of which: Public thermal power stations	*17%*	-	-	-	-	-	-	-	-	-	-	*69%*
Autoprod. therm. power st.	*3%*	-	-	-	-	-	-	-	-	-	-	*11%*
Nuclear power stations	*5%*	-	-	-	-	-	-	-	-	-	-	*21%*
Coke-oven plants	*3%*	*94%*	-	-	-	-	*34%*	-	-	-	-	-
Refineries	*69%*	-	-	-	*100%*	-	-	-	-	-	-	-
Exchanges and transfers, returns	403	-	-	-3 576	3 979	-	-	-	-	-591	-	590
Consumption of the energy branch	15 715	7	-	-	6 124	6 768	360	-	-	-	14	2 441
of which: Prod. and distrib. of electr.	*9%*	-	-	-	-	-	-	-	-	-	-	*61%*
Oil refineries	*43%*	-	-	-	*100%*	*3%*	-	-	-	-	-	*22%*
Distribution losses	3 582	-	-	-	-	633	194	-	-	-	-	2 755
Available for final consumption	164 979	5 426	-	-90	75 588	51 351	530	-	-	729	2 189	29 258
Final non-energy consumption	11 309	-	-	-	10 534	775	-	-	-	-	-	-
Final energy consumption	153 045	4 729	-	-	65 183	50 436	540	-	-	729	2 189	29 238
Industry	35 061	3 654	-	-	8 033	11 239	540	-	-	285	1 237	10 073
of which: Iron & steel industry	*13%*	*73%*	-	-	*4%*	*6%*	*96%*	-	-	-	-	*5%*
Chemical industry	*19%*	*5%*	-	-	*2%*	*27%*	-	-	-	-	*98%*	*20%*
Glass, pottery & building mat.	*6%*	*6%*	-	-	*2%*	*9%*	-	-	-	-	-	*7%*
Paper and printing	*7%*	*3%*	-	-	*1%*	*10%*	-	-	-	-	*1%*	*11%*
Transport	53 471	-	-	-	52 780	-	-	-	-	-	-	691
of which: Road transport	*74%*	-	-	-	*74%*	-	-	-	-	-	-	-
Air transport	*23%*	-	-	-	*23%*	-	-	-	-	-	-	-
Househ., commerce, pub. auth., etc.	64 513	1 075	-	-	4 370	39 197	-	-	-	444	952	18 475
of which: Households	*69%*	*96%*	-	-	*66%*	*78%*	-	-	-	*51%*	*5%*	*54%*
Statistical difference	625	696	-	-90	-130	139	-10	-	-	-	-	19

1.2 Energy prices

Ever increasing energy demand and the global geo-political situation made energy prices climb rapidly. Especially since the beginning of 2004, crude oil prices have increased to unprecedented levels.

Energy demand for the manufacturing industry cannot be changed on short- and medium term without serious disruption and consumption expenditure for energy of households is a relatively inelastic item too.

Eurostat collects a number of price statistics, of which a selection - relevant to a wide audience - is presented here. Various other Eurostat publications offer more detailed information on prices such as the short Statistic in Focus reports or the recently published Gas and electricity market statistics (Panorama-series). The CD-ROM attached to the present publication also offers additional information in this respect.

The Harmonised Index of Consumer Prices (HICP) indicates that since 1996, energy prices have been increasing at a faster pace than the all-items category, except for electricity (see Figure 1.2.1) with a fairly linear price development persistently under the all-items index. Liquid fuels show an 'agitated' development. In 2005, it topped all other items selected here and stood 85 index points higher than in 1996. Gas taken as a single commodity (as opposed to aggregated items, also visible in the figure) saw a steady price increase; from 2004 however, prices went up fast.

Figure 1.2.1: Development of harmonized indices of consumer prices (HICP) in the EU (left scale) and development of oil price (right scale) - 1996=100

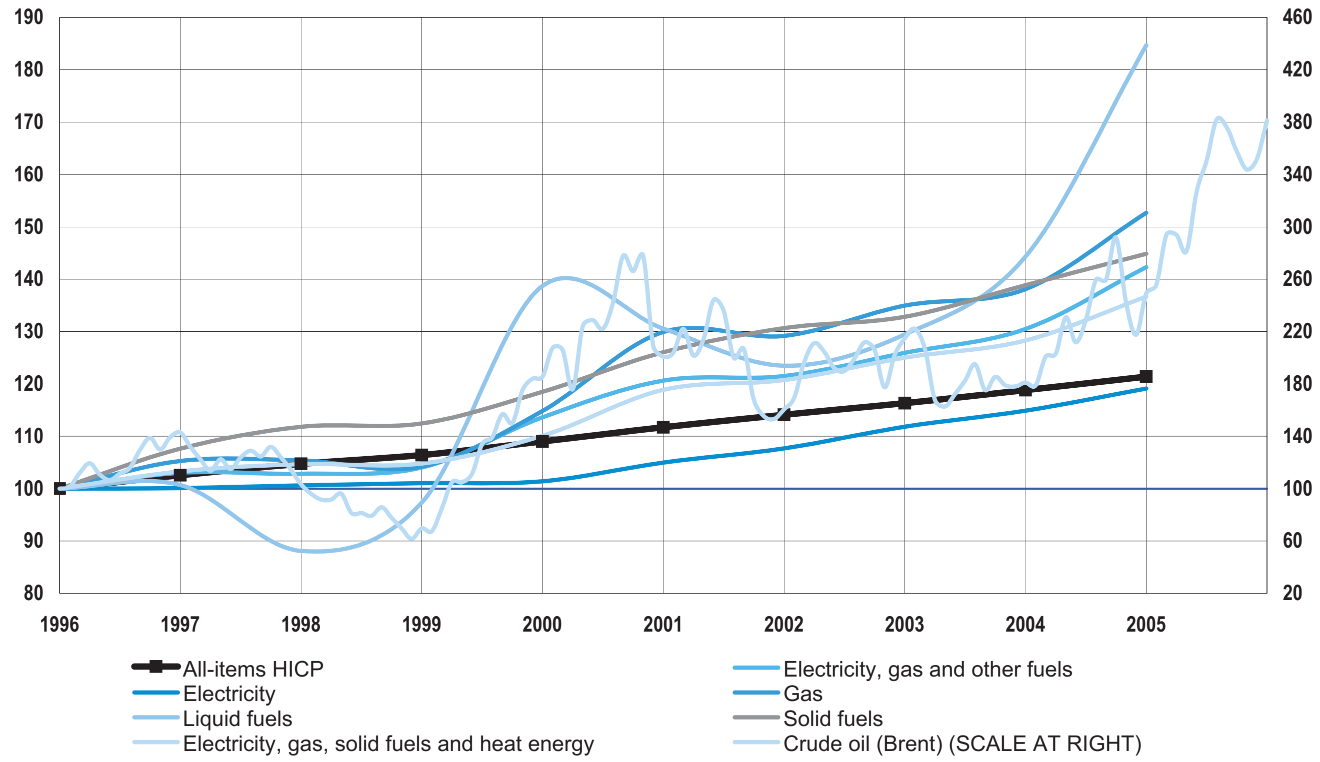


Table 1.2.2: Harmonized indices of consumer prices (HICP), selected items by country, 2001=100

Electricity

	2001	2002	2003	2004	2005
EU-25	100	102.6	106.5	109.4	113.5
EU-15	100	101.9	105.5	108.0	111.9
BE	100	99.2	96.3	98.2	98.0
CZ	100	109.5	104.2	106.2	110.5
DK	100	104.1	107.0	107.1	111.1
DE	100	104.4	109.6	114.0	118.9
EE	100	125.3	134.7	134.7	149.7
EL	100	103.9	107.0	109.3	112.4
ES	100	99.8	101.2	102.7	104.4
FR	100	100.9	102.0	103.5	103.4
IE	100	108.5	120.3	128.9	145.8
IT	100	98.5	101.3	98.1	101.9
CY	100	98.1	107.8	104.9	117.3
LV	100	100.0	100.0	115.3	115.3
LT	100	105.7	105.7	105.7	115.3
LU	100	102.4	105.3	107.8	117.2
HU	100	105.0	116.6	138.4	148.4
MT	100	108.4	108.4	108.4	133.2
NL	100	102.6	105.3	109.7	119.2
AT	100	97.0	98.0	100.7	103.7
PL	100	107.4	112.8	115.0	118.9
PT	100	102.5	105.2	107.5	109.9
SI	100	105.9	109.9	115.4	117.0
SK	100	101.2	129.7	145.2	147.4
FI	100	104.6	117.1	117.5	115.4
SE	100	106.5	132.0	131.9	129.8
UK	100	100.5	101.5	107.6	119.0
BG	100	117.9	138.8	155.7	163.7
RO	100	134.3	147.9	185.6	206.1
TR	100	145.7	154.5	154.2	155.9
IS	100	103.6	107.4	111.0	120.3
NO	100	98.6	134.6	131.4	129.2

Gas

	2001	2002	2003	2004	2005
EU-25	100	99.4	103.9	106.3	117.5
EU-15	100	98.9	102.9	104.3	115.4
BE	100	94.7	94.7	93.7	102.0
CZ	100	101.3	102.4	103.4	116.6
DK	100	92.2	95.3	101.9	118.3
DE	100	94.4	99.1	100.2	110.6
EE	100	114.8	111.0	113.6	120.1
EL	100	104.7	110.1	113.8	121.7
ES	100	97.8	97.1	96.6	104.9
FR	100	99.7	102.6	99.8	107.7
IE	100	100.4	106.2	111.3	129.5
IT	100	95.3	100.1	100.3	107.9
CY	100	100.0	130.6	174.9	211.3
LV	100	95.4	99.7	107.9	135.3
LT	100	96.7	96.6	96.4	105.9
LU	100	91.9	94.2	95.4	106.2
HU	100	105.3	111.2	122.9	131.7
MT	100	100.0	100.0	110.0	142.1
NL	100	107.8	119.1	122.8	144.4
AT	100	98.8	100.3	105.8	112.3
PL	100	104.0	107.5	112.3	121.1
PT	100	96.6	104.7	108.8	123.4
SI	100	95.2	102.0	105.5	120.9
SK	100	101.1	149.0	197.6	232.8
FI	:	:	:	:	:
SE	100	109.3	118.0	124.2	127.6
UK	100	106.2	108.4	116.0	132.6
BG	100	102.4	106.6	117.4	135.4
RO	100	136.8	163.9	221.1	296.6
TR	100	138.3	172.7	178.4	221.5
IS	:	:	:	:	:
NO	:	:	:	:	:

Liquid fuels

	2001	2002	2003	2004	2005
EU-25	100	94.6	99.2	110.6	141.5
EU-15	100	94.5	98.9	110.3	141.2
BE	100	90.9	95.8	112.9	149.5
CZ	100	102.7	107.1	118.9	124.1
DK	100	98.0	100.3	105.1	126.4
DE	100	90.9	94.2	105.0	138.5
EE	:	:	:	:	:
EL	100	99.4	104.2	111.3	150.0
ES	100	96.9	102.8	115.1	145.8
FR	100	94.0	100.7	115.5	149.9
IE	100	91.6	94.7	106.1	135.3
IT	100	99.9	102.7	108.9	127.1
CY	100	122.5	175.2	211.8	243.0
LV	:	:	:	:	:
LT	:	:	:	:	:
LU	100	90.8	94.8	112.7	150.4
HU	:	:	:	:	:
MT	100	98.0	:	:	:
NL	:	:	:	:	:
AT	100	94.9	97.8	112.6	142.3
PL	100	98.8	102.1	108.4	117.2
PT	:	:	:	:	:
SI	100	98.6	104.1	118.1	151.7
SK	:	:	:	:	:
FI	100	91.4	97.7	110.7	145.3
SE	100	99.0	109.1	119.7	146.1
UK	100	90.4	100.2	118.1	160.5
BG	100	98.9	99.5	110.4	136.1
RO	100	125.2	158.9	183.1	209.4
TR	100	150.8	195.3	210.3	279.0
IS	:	:	:	:	:
NO	100	93.7	93.3	107.1	117.5

Focusing on the price development between 2001 and 2005 in the individual Member States, electricity prices rose particularly fast in Estonia, Hungary and Slovakia, whereas it decreased by 2% in Belgium (see Table 1.2.2).

Compared to electricity, gas prices increased slightly more at EU level. Relatively stable prices in Belgium, Spain, France, Italy and Luxembourg contrast with noticeable increases in Malta and the Netherlands and, particularly, Cyprus and Slovakia (as there is no natural gas distribution in Malta and Cyprus gas prices here refer to butane/propane).

For liquid fuels, it was again Cyprus but also the United Kingdom that registered price developments clearly above the EU average whereas prices in Poland increased at a far less rapid pace.

Automotive fuels

One of the most visible signs of the development of energy prices are the prices paid at petrol stations for automotive fuel. Table 1.2.3 and 1.2.4 offer an overview of the prices of automotive fuels paid at the pump (i.e. all taxes included).

Table 1.2.3: **Premium unleaded gasoline, 95 Ron, price at the pump per 1000 liters, all taxes included, in EUR**

	2002		2003		2004		2005		2006	
	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year
BE	946.0	998.0	983.0	959.0	991.7	1 106.3	1 068.7	1 290.3	1 304.9	1 413.1
CZ	:	:	:	:	:	868.3	809.1	982.6	979.6	1 113.7
DK	1 040.0	1 123.8	1 107.3	1 103.2	1 071.4	1 175.4	1 098.0	1 246.9	1 266.5	1 392.7
DE	988.5	1 047.5	1 110.3	1 093.9	1 076.5	1 178.4	1 111.3	1 260.8	1 262.3	1 375.3
EE	:	:	:	:	:	694.0	673.6	844.9	841.6	950.1
EL	691.5	748.5	753.1	742.3	738.1	814.0	767.0	940.0	941.0	1 082.0
ES	767.8	822.4	831.5	816.7	804.7	888.5	844.1	1 000.0	1 000.8	1 130.7
FR	958.7	999.5	1 046.1	998.3	996.9	1 082.2	1 038.2	1 199.3	1 219.7	1 323.1
IE	802.4	900.0	869.0	858.0	870.0	997.0	941.0	1 054.0	1 076.0	1 166.0
IT	996.1	1 052.1	1 070.2	1 046.2	1 047.7	1 147.0	1 088.1	1 247.7	1 259.7	1 385.1
CY	:	:	:	:	:	784.8	756.8	886.2	894.5	1 010.9
LV	:	:	:	:	:	703.5	716.7	834.7	854.9	955.5
LT	:	:	:	:	:	771.0	708.1	880.8	889.9	985.3
LU	736.0	771.0	788.0	771.0	826.0	935.0	902.0	1 075.0	1 066.0	1 177.0
HU	:	:	:	:	:	995.6	957.8	1 105.0	1 053.0	1 113.0
MT	:	:	:	:	:	852.3	867.7	887.5	1 085.5	1 155.4
NL	1 102.0	1 149.0	1 159.0	1 165.0	1 188.0	1 287.0	1 248.0	1 395.0	1 407.0	1 535.0
AT	821.0	888.0	899.0	853.0	858.0	965.0	910.0	1 071.0	1 052.0	1 157.0
PL	:	:	:	:	:	864.5	875.1	1 020.4	969.9	1 078.8
PT	858.0	940.0	950.0	950.0	950.0	1 052.1	996.5	1 195.2	1 195.5	1 358.2
SI	:	:	:	:	:	834.9	820.4	936.2	918.6	1 041.1
SK	:	:	:	:	:	904.5	857.3	977.5	1 043.2	1 105.2
FI	1 003.8	1 074.0	1 084.3	1 114.1	1 052.0	1 172.7	1 143.0	1 202.0	1 232.4	1 400.5
SE	953.7	993.7	1 021.7	1 019.0	1 019.0	1 123.3	1 103.1	1 227.3	1 207.2	1 366.0
UK	1 133.7	1 154.5	1 140.8	1 063.2	1 100.9	1 206.9	1 129.8	1 287.9	1 297.5	1 408.5
NO	1 104.7	1 222.2	1 249.2	:	:	:	:	:	:	:

Table 1.2.4: **Automotive diesel oil, price at the pump per 1000 liters, all taxes included, in EUR**

	2002		2003		2004		2005		2006	
	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year
BE	721.0	715.0	737.0	696.5	731.0	814.7	853.7	1 047.5	1029.1	1066.7
CZ	:	:	:	:	:	781.5	815.3	976.0	969.7	1056.4
DK	796.5	808.9	858.4	776.3	823.0	882.3	908.5	1 051.2	1074.9	1148.8
DE	812.8	825.5	903.7	874.5	875.8	939.5	969.5	1 109.3	1093.5	1148.0
EE	:	:	:	:	:	639.6	696.6	831.5	859.8	883.8
EL	597.3	618.1	656.5	618.1	642.0	730.0	774.0	925.0	919.0	1011.0
ES	673.4	678.9	722.9	670.2	701.0	753.0	808.1	935.0	929.9	1003.4
FR	745.2	743.6	818.0	761.1	790.5	875.0	914.5	1 066.5	1054.3	1117.2
IE	741.5	797.0	787.0	790.0	796.0	910.0	949.0	1 052.0	1078.0	1126.0
IT	835.6	845.4	894.6	851.8	876.2	935.4	1 004.3	1 133.4	1157.0	1207.3
CY	:	:	:	:	:	708.7	721.8	868.8	869.3	943.2
LV	:	:	:	:	:	635.2	702.3	836.1	854.9	912.4
LT	:	:	:	:	:	678.0	715.1	865.1	878.4	923.0
LU	620.0	626.0	652.0	602.0	622.0	676.0	724.0	875.0	881.0	953.0
HU	:	:	:	:	:	890.8	937.0	1 068.6	1019.6	1049.0
MT	:	:	:	:	:	680.9	830.6	854.9	943.4	1015.6
NL	770.0	781.0	803.0	776.0	826.0	878.0	909.0	1 049.0	1043.0	1136.0
AT	695.0	720.0	748.0	701.0	727.0	794.0	836.0	990.0	1052.0	1048.0
PL	:	:	:	:	:	697.0	830.3	934.0	965.2	1003.5
PT	648.0	690.0	700.0	690.0	699.9	767.4	834.0	983.0	1195.5	1082.6
SI	:	:	:	:	:	730.3	815.8	929.1	914.5	976.4
SK	:	:	:	:	:	835.9	874.5	990.3	1039.4	1086.0
FI	783.1	773.0	818.1	762.7	776.0	811.1	875.5	970.0	997.0	1067.2
SE	800.9	793.0	860.1	817.6	849.3	884.1	976.0	1 101.0	1133.1	1210.8
UK	1 210.7	1 179.9	1 162.7	1 093.2	1 125.8	1 219.2	1 201.4	1 347.8	1358.4	1435.6
NO	1 030.2	1 077.7	1 142.8	:	:	:	:	:	:	:

Looking at the development of the fuel prices in the individual countries, the two tables show that these have been fluctuating within a certain margin for until the first semester of 2005. The second semester of the latter year saw a rapid increase that continued for 2006.

The price range for 1000 liters of automotive fuel varied considerably across the Member States: on the basis of average prices of the second half year of 2006, the range for unleaded gasoline was between EUR 955 (in Latvia) and EUR 1 535 (in the Netherlands). For diesel, the price ranged between EUR 884 (in Estonia) and 1 436 (in the United Kingdom). Persistent price differences between gasoline and diesel influence the choice of engine technology when it comes at buying a car. But whereas this difference is low in countries such as Ireland, Latvia and Slovakia (under 5%), they can be as high as 35% in the Netherlands around 30% in Belgium and Finland and between 20 % and 25 % in Denmark, Luxembourg and Portugal (based on 2nd half-year 2006 prices). The United Kingdom is the only country where the price for automotive diesel is higher (+2%) than gasoline.

Obviously, fuel taxation has quite an influence. Figure 1.2.5 and Figure 1.2.6 show how the automotive fuel prices were composed during the second semester of 2005. As could be expected, the base price for fuels does not present large differences in the various national markets. It is the taxes (VAT and other taxes) that make the difference: the proportion of taxes added to the base price of unleaded gasoline varies between 42% (Malta) and 66% (United Kingdom). The equivalent range for diesel is from 39% (Cyprus and Malta) to 60% (United Kingdom).

Furthermore, prices at the petrol stations often suggest that the basic price of diesel must be inferior to those of gasoline. This perception is wrong as the price of diesel before taxes are applied is often higher than those of gasoline, especially in the Czech Republic, Ireland, Slovenia, Sweden and the United Kingdom. The cheaper automotive diesel can thus largely be attributed by a far more favorable tax regime, except for the United Kingdom.

Figure 1.2.5: **Composition of price for 1000 liters of premium unleaded gasoline 95 Ron; 2nd semester 2006, in EUR**

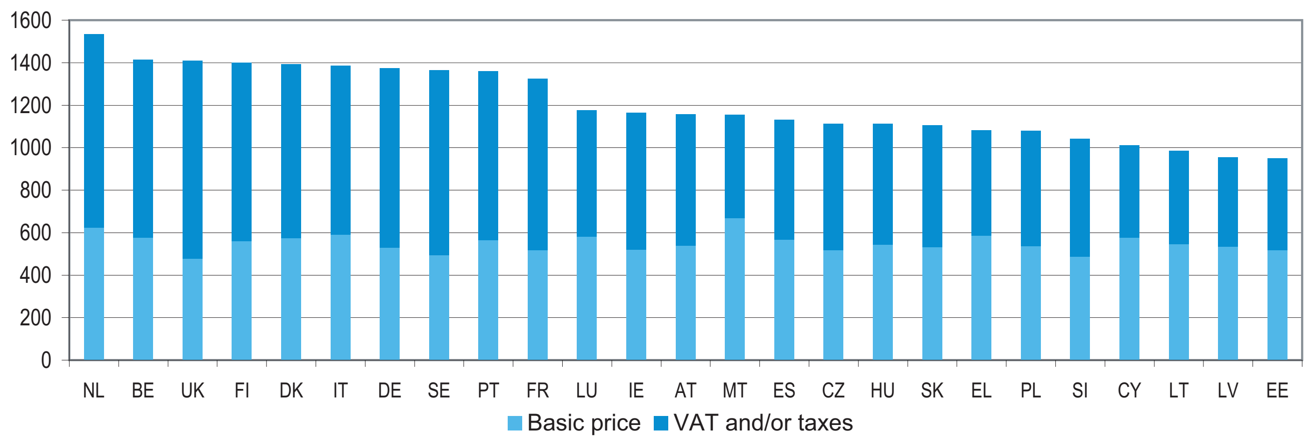
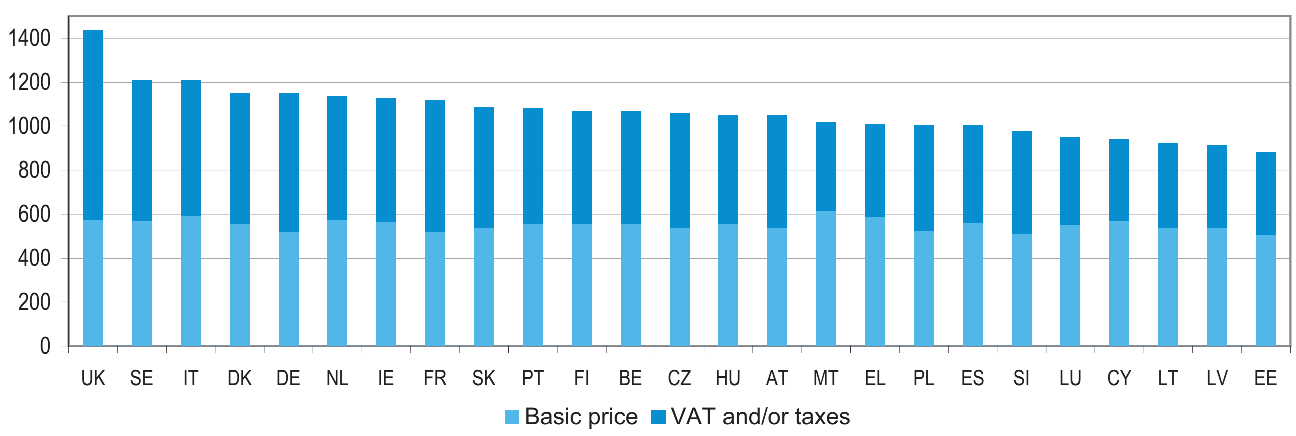


Figure 1.2.6: **Composition of price for 1000 liters of automotive diesel oil; 2nd semester 2006, in EUR**



Heating gasoil for households

Maybe less visible than the price fluctuations at the fuel pump are those of heating gasoil. Indeed, tenants of dwellings with heating systems using gasoil often 'bunker' once a year. The timing could reveal as important as prices often climb when demand is up - usually in October or November. But whereas short term fluctuations of heating gasoil prices are not reported to Eurostat, Table 1.2.7 outlines the prices for the period 2002 to 2006.

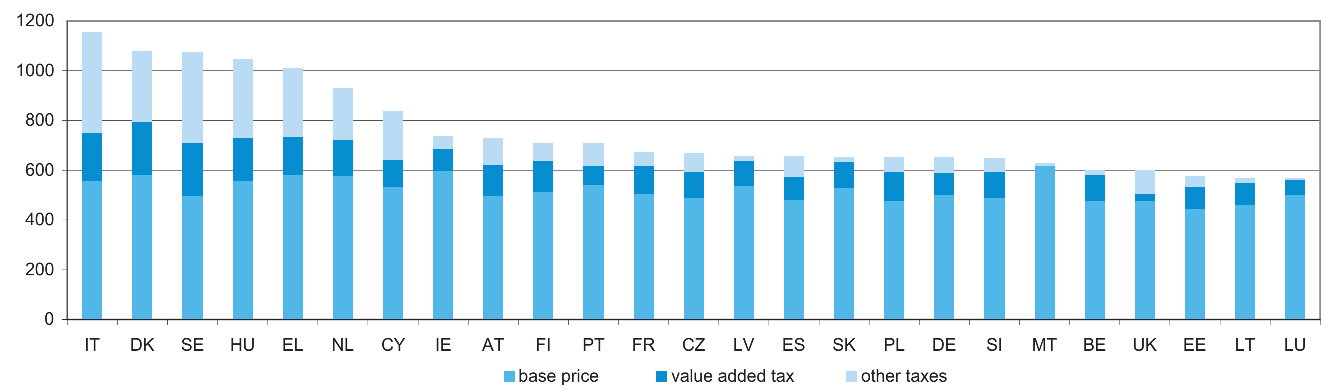
Table 1.2.7: **Average price for heating gasoil delivered to households (deliveries between 2000 and 5000 liters annually), in EUR per 1000 liters, all taxes included**

	2002		2003		2004		2005		2006	
	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year
BE	273.0	283.4	318.8	275.0	302.7	350.0	372.4	526.7	549.4	600.0
CZ	:	:	:	:	:	458.0	492.0	641.7	610.7	670.4
DK	664.9	682.0	725.5	687.7	719.9	789.6	837.9	987.5	1 002.4	1 077.3
DE	312.9	349.7	401.2	338.5	334.4	385.6	430.9	589.9	587.7	652.0
EE	:	:	:	:	:	327.6	431.4	483.8	541.1	576.5
EL	302.9	618.1	348.2	659.4	329.3	730.0	415.0	925.0	589.0	1 011.0
ES	339.0	368.8	428.5	355.7	374.2	413.4	446.2	599.9	584.8	656.5
FR	314.1	343.7	419.1	356.8	393.4	433.9	477.6	613.0	632.4	673.3
IE	397.5	424.2	465.2	422.9	443.8	513.9	525.7	670.9	685.1	737.7
IT	816.0	826.3	875.0	820.4	851.1	904.8	952.4	1 072.7	1 102.1	1 153.2
CY	:	:	:	:	:	703.0	622.8	762.6	720.3	839.8
LV	:	:	:	:	:	393.8	473.5	581.8	600.6	658.1
LT	:	:	:	:	:	330.2	376.5	502.5	521.3	570.3
LU	260.0	287.0	324.0	280.0	300.0	347.0	377.0	519.0	504.0	570.3
HU	:	:	:	:	:	890.8	937.0	1 068.6	1 019.6	1 049.0
MT	:	:	:	:	:	234.8	370.2	421.6	556.7	631.3
NL	552.0	571.0	622.0	580.0	608.0	658.0	700.0	837.9	854.0	929.0
AT	371.7	371.6	422.4	371.8	427.1	465.1	492.7	647.2	644.8	727.9
PL	:	:	:	:	:	372.4	431.0	570.9	600.8	652.1
PT	359.0	380.0	465.0	400.0	425.0	470.0	500.0	652.0	649.0	709.0
SI	:	:	:	:	:	419.8	487.1	580.4	583.8	648.5
SK	:	:	:	:	:	343.1	428.1	521.6	583.5	654.6
FI	334.0	348.0	397.5	368.9	381.6	437.8	449.0	613.4	621.0	709.9
SE	648.4	657.6	698.2	697.3	777.7	826.2	853.4	978.1	992.5	1 074.4
UK	251.9	279.2	278.0	250.8	273.8	321.7	372.8	526.9	538.7	599.2
NO	634.0	713.0	753.0	:	:	:	:	:	:	:

There is a wide price range between the different Member States: on the basis of the latest dataset available (2nd half-year of 2006), the lowest price was paid in Lithuania and Luxembourg (EUR 570.3 per thousand liters, all taxes included) and the highest price in Italy (EUR 1153.2). Over time, quite marked price fluctuations can be observed. More recently, and common to nearly all countries (only Latvia, Malta and Poland experienced a slight increase), a price decrease was registered between the 2nd half year of 2004 and the 1st half year of 2005 (up to -8 %). The second half year of 2005 then saw high increases for most countries: in five Member States, these increases even exceeded 20% (Belgium, Czech Republic, Estonia, Greece and Lithuania). In the following first half-year of 2006, prices remained rather stable, except for Estonia and Malta, where prices increased by around 12%. In Greece, the price of heating gasoil decreased by over 36%. Latter country shows very marked price differences (often by factor 2) between the first and second half-year, throughout the period observed. Finally, the second half-year of 2006 displays higher prices in all countries, often around 10% compared to the previous period.

But as for automotive fuels, it is less the basic price for heating gasoil that makes the difference but rather taxation. Value added tax remains the main component but other levies and duties can take a noticeable proportion (see Figure 1.2.8). 'Other taxes' account for as much as 30% to 35% of the end price in Italy, Hungary and Sweden. On the other extreme, these taxes are of 3% or less in Belgium, Latvia, Luxembourg, Malta and Slovakia. Malta is the only country where no VAT is applied to heating gasoil.

Figure 1.2.8: Composition of the price for 1000 liters of heating gasoil, 2nd half-year of 2006, in EUR



Residual fuel oil for industry

From a refiner's perspective, residual fuel is a "leftover." Refineries are run with a focus on the higher valued products, such as gasoline and distillate. Between 1978 and 1985, the demand for this low environmental quality fuel has been decreasing substantially. Even export markets are disappearing as countries worldwide add more environmental restrictions to fuel combustion, including transportation use of residual fuels (bunker fuels).

This market situation has an effect on price. Table 1.2.9 is restricted to industrial use of residual fuel oil, the largest market for this type of fuel (mostly for heating purposes), and shows the prices paid for one tonne, expressed in euro, excluding VAT (as value-added tax is often deductible for industrial users).

In general, prices have remained at a fairly constant level from the beginning of the period observed (2002) until the first half of 2005. Only Denmark saw a noticeable increase in the 2nd half of 2003. This was solely due to a massive increase in taxes (other than VAT).

The situation changed in the second half of 2005, when all energy prices increased substantially. Indeed, residual fuel oil made no exception but price increases were generally not as steep as for other hydrocarbon products. Remarkably, the price remained stable in certain countries: in Luxembourg, little or no change was registered; in Estonia, the price did even slightly decrease. The first half-year of 2006 shows further price increases for all countries for which data are available, especially in Germany, the Netherlands, Slovenia, Slovakia and the United Kingdom (all countries between 20% and 24%) and in the Czech Republic (+41%).

On the basis of country data available, the average price for a tonne of residual fuel oil without taxes paid during the second half of 2006 varied between EUR 247 in Belgium and EUR 401 in Finland (data not shown). Denmark and Sweden applied a particularly high tax rate (other than value-added tax), amounting to 109% and 104% respectively. The United Kingdom, and Austria applied taxes between 20% and 30% whereas the remaining countries apply rates of well under 20%. The lowest taxation other than VAT was applied in Spain and Portugal (both countries at around 4%).

Table 1.2.9: Prices of residual fuel oil for the industry (monthly deliveries of less than 2 000 tons or annual deliveries of less than 24 000 tons), price for 1 tonne, VAT excluded, in EUR

	2002		2003		2004		2005		2006	
	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year	1st half-year	2nd half-year
BE	141.0	162.7	199.6	173.6	147.8	155.6	166.2	232.0	264.4	262.0
CZ	:	:	:	:	:	156.9	164.0	186.5	262.0	280.6
DK	229.9	240.1	258.2	518.0	480.7	513.6	530.5	604.3	652.8	638.6
DE	169.5	171.6	202.5	176.8	165.1	184.7	169.9	240.3	286.0	290.4
EE	:	:	:	:	:	111.0	113.3	111.0	:	:
EL	196.4	220.6	250.9	250.5	209.5	235.8	201.8	314.9	336.8	356.7
ES	210.6	229.7	253.0	228.4	200.4	220.4	213.4	323.6	349.9	364.0
FR	190.9	195.4	217.8	212.0	173.1	196.3	193.4	275.2	302.8	325.4
IE	:	:	:	268.6	255.8	279.4	259.2	352.1	404.2	401.9
IT	202.6	203.7	239.3	253.1	218.0	243.2	245.9	325.3	361.7	360.6
CY	:	:	:	:	:	:	:	:	:	:
LV	:	:	:	:	:	:	:	:	:	:
LT	:	:	:	:	:	212.0	224.2	232.9	:	:
LU	145.4	182.9	208.9	196.9	176.4	177.5	170.6	170.6	:	:
HU	:	:	:	:	:	196.2	213.0	298.3	316.5	300.8
MT	:	:	:	:	:	:	:	:	:	:
NL	202.0	222.0	237.0	237.0	237.0	230.0	223.0	273.4	338.0	338.0
AT	168.4	186.0	233.0	195.0	179.0	216.7	216.7	295.0	337.7	337.7
PL	:	:	:	:	:	167.3	168.9	229.1	263.3	284.3
PT	247.0	288.0	254.0	243.8	224.1	254.5	235.3	329.5	379.9	374.6
SI	:	:	:	:	:	259.9	253.1	299.2	362.7	372.2
SK	:	:	:	:	:	193.0	194.4	200.6	245.4	271.0
FI	277.4	279.6	318.7	299.7	261.0	299.2	307.9	398.6	433.9	460.7
SE	469.3	512.6	551.0	550.2	580.4	600.3	623.9	700.4	750.8	778.1
UK	:	:	243.9	268.3	202.5	229.3	227.8	328.3	400.2	418.7
NO	:	:	:	:	:	:	:	:	:	:

Electricity

At EU-level, electricity prices have remained fairly stable over the last couple of years. This is confirmed in Table 1.2.2 at the beginning of this section where the indexed price for electricity remained below the all-item index (period 1996-2005).

Prices in the individual countries essentially vary according to the quantity consumed. Eurostat collects price information for a number of 'standard consumers', separately for domestic customers and industrial users. Whereas the CD-ROM attached to this publication gives ample information on average prices paid by several 'standard consumers', the information below is limited to what is considered the most representative consumers of both categories in Central Europe: consumer Dc (Household consumer with a consumption of 3 500 kWh per year) and consumer Ie (Industrial consumer with a consumption of 2000 MWh per year).

Table 1.2.10 displays the average prices paid by household consumers (standard consumer Dc). Against the background of the liberalisation, the individual countries reported these figures as being representative for the period in question; individual prices may however vary depending on the retailer and the type of contract (long- or short-term, 'green' electricity only, etc..).

Looking at the prices inclusive of all taxes in the individual countries, and limiting the view to the prices of 2006, the price for one kWh ranged between 7.0 cents in Greece to 23.6 cents in Denmark. In other words: Danish consumers paid more than three times the price of that paid by Greek customers. This should however be seen against the differences in price and income levels in the various countries. The EU average price was double the Greek value.

The relative price changes in the last two reference years shows a mixed image. Whereas countries such as the Czech Republic, Malta and Poland registered considerable price increases for two consecutive years, Ireland, Lithuania and especially Latvia saw their prices go up considerably between 2004 and 2005 and remain relatively stable between 2005 and 2006. In Cyprus and the United Kingdom, a large increase was noted only between 2005 and 2006. In the remaining Member States, price increases have generally been more equally spread. Only two Member States (Belgium and Austria) saw a price decrease in 2006; in the case of Austria, this decrease was quite marked (-5.2%). Austrian households paid the same price in 2006 they were paying in 2002.

Table 1.2.10: Electricity for households - average price of one kWh, all taxes included - in cent

	1996	2001	2002	2003	2004	2005	2006	Change 2004-2005 (%)	Change 2005-2006 (%)
EU-25	:	:	:	:	13.20	13.54	14.16	2.6	4.6
EU-15	13.40	13.17	13.36	13.55	13.58	13.85	14.44	2.0	4.3
BE	15.14	14.50	13.94	13.76	14.22	14.81	14.42	4.1	-2.6
CZ	:	6.58	7.83	7.97	8.07	8.68	9.85	7.6	13.5
DK	16.11	20.66	22.02	23.03	22.62	22.78	23.62	0.7	3.7
DE	15.18	15.99	16.70	17.08	16.98	17.85	18.32	5.1	2.6
EE	:	:	5.39	6.49	6.49	6.78	7.31	4.5	7.8
EL	7.19	6.09	6.30	6.54	6.71	6.88	7.01	2.5	1.9
ES	12.67	10.48	10.47	10.63	10.79	10.97	11.47	1.7	4.6
FR	13.40	11.54	11.65	11.62	11.94	11.94	12.05	0.0	0.9
IE	8.06	8.94	9.94	11.79	12.56	14.36	14.90	14.3	3.8
IT	20.19	20.21	19.01	19.84	19.50	19.70	21.08	1.0	7.0
CY	:	10.90	9.29	10.52	10.88	10.74	14.31	-1.3	33.2
LV	:	:	:	:	5.75	8.28	8.29	44.0	0.1
LT	:	:	:	:	6.32	7.18	7.18	13.6	0.0
LU	11.55	12.42	12.91	13.35	13.65	14.78	16.03	8.3	8.5
HU	4.17	7.10	8.09	8.21	9.92	10.64	10.75	7.3	1.0
MT	4.76	6.17	6.31	6.85	6.68	7.64	9.49	14.4	24.2
NL	10.21	17.03	16.60	17.58	18.27	19.55	20.87	7.0	6.8
AT	12.35	13.23	13.39	13.52	14.16	14.13	13.40	-0.2	-5.2
PL	:	8.66	10.66	10.05	9.04	10.64	11.90	17.7	11.8
PT	13.24	12.62	12.86	13.22	13.50	13.81	14.10	2.3	2.1
SI	7.70	9.96	10.29	10.00	10.10	10.33	10.49	2.3	1.5
SK	:	:	:	:	12.18	13.38	14.48	9.9	8.2
FI	9.39	8.62	9.36	9.91	10.79	10.57	10.78	-2.0	2.0
SE	:	10.28	11.33	13.49	14.40	13.97	14.35	-3.0	2.7
UK	9.45	10.44	10.83	10.06	8.78	8.77	10.20	-0.1	16.3
BG	:	:	:	:	5.83	6.44	6.60	10.5	2.5
HR	:	:	:	:	:	8.48	9.22	:	8.7
RO	:	:	:	:	:	7.79	10.23	:	31.3
NO	8.81	11.47	12.95	21.06	13.60	15.71	15.33	15.5	-2.4

Note: Price paid by Standard Household Consumer Dc (3500 kWh/year) on 1 January of each year.

Large industrial (or commercial) customers obviously pay less for electricity. Prices shown in Table 1.2.11 are exclusive of value-added tax (as it is often deductible) but include other levies and duties that may apply.

Looking at the long-term evolution between 1996 and 2006, Hungary registered the most important increase (+123 %). On the contrary, prices in France decreased during the second half of the 1990s and remained stable for the last five years. When looking at the last two reference years, it was in Cyprus and the United Kingdom where the most important increase was registered (+40.2 % and +38.6 % respectively). However, the price in Cyprus shows quite some fluctuations and the price of one kWh in 2006 (11.4 cent) stood 8.2 % over that paid in 2001 (10.5 cent).

In absolute terms, the price span registered in 2006 was not as wide as for households but nevertheless ranged from 4.09 cent in Latvia to 12.08 cent in Italy.

Table 1.2.11: Electricity for the industry: average price of one kWh, without VAT but incl. other taxes - in cent

	1996	2001	2002	2003	2004	2005	2006	Change 2004-2005 (%)	Change 2005-2006 (%)
EU-25	:	:	:	:	7.04	7.45	8.65	5.8	16.1
EU-15	7.21	6.95	6.76	7.34	7.21	7.60	8.78	5.4	15.5
BE	7.75	7.52	7.61	7.68	7.71	7.75	9.69	0.5	25.0
CZ	:	4.73	5.18	4.99	4.92	6.01	7.31	22.2	21.6
DK	5.54	6.25	7.07	7.64	6.98	7.15	8.01	2.4	12.0
DE	9.06	7.17	7.21	8.20	8.63	9.03	9.94	4.6	10.1
EE	:	:	4.65	4.55	4.55	4.72	5.11	3.7	8.3
EL	5.71	5.71	5.90	6.14	6.30	6.45	6.68	2.4	3.6
ES	7.56	5.78	5.47	5.55	5.66	7.21	7.57	27.4	5.0
FR	6.50	5.57	5.62	5.62	5.78	5.78	5.78	0.0	0.0
IE	6.15	6.62	7.68	7.76	8.12	9.30	10.11	14.5	8.7
IT	8.61	10.87	10.12	10.78	10.26	10.93	12.08	6.5	10.5
CY	:	10.50	9.03	9.62	8.41	8.10	11.36	-3.7	40.2
LV	:	:	:	:	4.31	4.09	4.09	-5.1	0.0
LT	:	:	:	5.50	5.13	4.98	4.98	-2.9	0.0
LU	7.47	6.74	7.09	7.35	7.56	8.51	8.95	12.6	5.2
HU	3.41	5.20	5.95	6.04	6.61	7.09	7.61	7.3	7.3
MT	5.78	6.83	6.98	6.36	6.20	7.06	7.11	13.9	0.7
NL	6.08	7.04	:	:	:	8.99	9.57	:	6.5
AT	8.14	:	:	:	7.59	8.27	8.63	9.0	4.4
PL	:	4.92	5.85	5.66	4.88	5.55	6.33	13.7	14.1
PT	7.56	6.51	6.65	6.73	6.84	7.13	8.17	4.2	14.6
SI	5.86	6.03	5.99	5.82	6.09	6.11	6.51	0.3	6.5
SK	:	:	:	:	6.83	7.03	7.73	2.9	10.0
FI	4.81	4.15	4.44	6.11	5.89	5.73	5.63	-2.7	-1.7
SE	4.13	3.13	3.10	6.66	5.20	4.68	5.93	-10.0	26.7
UK	5.44	6.61	6.40	5.63	5.01	5.93	8.22	18.4	38.6
BG	:	:	:	:	4.09	4.29	4.60	4.9	7.2
HR	:	:	:	:	:	5.56	5.96	:	7.2
RO	:	:	:	4.42	5.10	7.69	7.04	:	-8.5
NO	3.22	3.44	4.33	5.60	5.42	6.49	6.46	19.7	-0.5

Note: Price paid by Standard Industrial Consumer Ie(2000 MWh/year) on 1 January of each year.

Natural gas

The use of natural gas as a relatively clean fuel spreads continuously but still remains heterogeneous among the Member States. For instance, whereas the majority of dwellings are heated with natural gas in the Benelux countries and the United Kingdom, houses in Finland and Sweden often use electricity for heating. In these latter countries, the gas distribution network is often limited to larger urban areas and the bulk of the quantities consumed go to the account of industries.

This should be kept in mind when looking at the prices paid by household consumers (Standard domestic consumer D3 - 83.70 GJ/year) in 2006 (see Table 1.2.12). The average price of one Gigajoule (all taxes included) at EU-level amounted to EUR 13.02 in 2006, ranging from EUR 29.82 in Denmark and EUR 25.95 in Sweden - about twice the average EU price - to EUR 4.63 in Estonia. The three Baltic States, i.e. Estonia, Latvia and Lithuania, reported the lowest prices among the Member States. It should be mentioned that taxation in Denmark and Sweden is particularly high.

Limiting the view to the development of the prices between 2005 and 2006, it appears that all countries (except for Finland, which does not report any household sector gas-prices due to the fact of a unsignificant gas market for this sector) reported price increases. In six Member States (Czech Republic, Ireland, Luxembourg, Poland, Slovenia and Slovakia) the increase exceeded 25%. Denmark reported an increase of around 5 %, but prices were raised by close to 50% a year earlier. In Estonia, the price remained low.

Table 1.2.12: Natural gas for households - average price of one Gigajoule (GCV), all taxes included - in EUR

	1996	2001	2002	2003	2004	2005	2006	Change 2004-2005 (%)	Change 2005-2006 (%)
EU-25	:	:	:	:	10.84	11.26	13.02	3.9	15.6
EU-15	8.84	11.65	11.43	11.49	11.34	11.68	13.42	3.0	14.9
BE	8.73	11.84	10.51	10.78	10.54	11.16	13.50	5.9	21.0
CZ	:	5.50	7.08	6.35	6.57	7.49	10.03	14.0	33.9
DK	:	22.00	17.98	18.98	19.12	28.44	29.82	48.7	4.9
DE	8.48	12.32	11.85	12.13	12.33	13.56	15.98	10.0	17.8
EE	:	:	:	4.64	4.64	4.63	4.63	-0.2	0.0
ES	10.76	12.82	12.14	12.09	11.55	11.90	13.63	3.0	14.5
FR	8.77	9.91	10.81	10.65	:	10.57	12.72	:	20.3
IE	7.85	8.19	8.18	8.25	9.00	9.98	12.51	10.9	25.4
IT	14.09	18.42	17.15	16.77	14.92	15.34	16.02	2.8	4.4
LV	:	:	:	:	4.22	4.54	5.34	7.6	17.6
LT	:	:	:	:	5.45	5.41	6.24	-0.7	15.3
LU	5.96	8.09	7.04	7.33	7.07	8.14	10.33	15.1	26.9
HU	2.41	3.58	4.35	4.41	5.77	6.19	7.40	7.3	19.5
NL	7.52	10.55	11.55	13.08	13.19	15.17	16.92	15.0	11.5
AT	10.33	11.84	11.84	12.26	13.71	13.36	15.65	-2.6	17.1
PL	:	6.45	8.10	7.20	6.34	7.55	9.46	19.1	25.3
PT	:	14.37	13.85	13.34	12.05	12.34	14.52	:	17.7
SI	5.44	10.57	9.81	9.87	9.64	10.33	12.99	7.2	25.8
SK	:	:	:	:	7.27	8.14	10.88	12.0	33.7
FI	6.41	:	:	:	:	:	:	:	:
SE	:	16.11	17.26	18.32	19.57	22.18	25.95	13.3	17.0
UK	5.96	6.58	6.97	6.89	6.83	7.26	8.24	6.3	13.5
BG	:	:	:	:	6.75	6.73	7.70	-0.3	14.4
HR	:	:	:	:	:	7.99	8.18	:	2.4
RO	:	:	:	:	:	4.79	5.52	:	15.2

Note: Price paid by Standard Household Consumer D3 (83.70 GJ /year) on 1 January of each year.

The evolution of industrial gas prices follow the same pattern as those of households, however, the percentage changes were over twice as large in magnitude.

Based on the data in Table 1.2.13, industry in the EU-25 paid an average EUR 8.70 at the beginning of 2006 (without VAT, as most industrial consumers are exempt from paying this tax) for one Gigajoule of natural gas. Recalling the prices paid by households (EU-25: EUR 13.02 - all taxes included), industry was paying one third less than household consumers.

Looking at the available data for the individual Member States, prices in 2006 ranged from just EUR 2.84 in Estonia to more than four times that amount in Sweden (EUR 12.26). Sweden, Austria and Germany have the highest industrial gas prices. As for electricity, prices in the Baltic States (Estonia, Latvia, Lithuania) are the lowest.

The last column of Table 1.2.13 reveals that three countries reported price increases above 50%: Spain (54.7%), the United Kingdom (51.0%) and Slovakia (50.6%). At the opposite end of the scale, rises of less than 6% were reported by Denmark (2.7%, keeping in mind that a 30% increase took place a year earlier), Estonia (3.3%) and Italy (5.4%).

Table 1.2.13: Natural gas for the industry: average price of one Gigajoule (GCV), without VAT - in EUR

	1996	2001	2002	2003	2004	2005	2006	Change 2004-2005 (%)	Change 2005-2006 (%)
EU-25	:	:	:	:	5.80	6.71	8.70	15.7	29.7
EU-15	3.88	6.46	6.16	6.03	5.93	6.86	8.85	15.7	29.0
BE	3.97	6.32	5.25	5.42	5.28	5.32	7.11	0.8	33.6
CZ	:	3.88	4.68	4.14	4.20	5.11	7.34	21.7	43.6
DK	3.77	6.59	5.10	5.87	5.21	6.79	6.97	30.3	2.7
DE	4.94	8.35	7.90	7.84	7.50	8.87	11.58	18.3	30.6
EE	:	:	:	2.91	2.91	2.75	2.84	-5.5	3.3
ES	3.14	5.54	4.34	4.81	4.41	4.68	7.24	6.1	54.7
FR	3.57	6.13	5.13	5.66	5.32	6.42	8.27	20.7	28.8
IE	2.93	4.65	4.88	4.94	:	:	:	:	:
IT	3.96	7.07	6.33	5.80	6.19	6.64	7.00	7.3	5.4
LV	:	:	:	:	3.47	3.48	4.05	0.3	16.4
LT	:	:	:	4.21	3.83	3.61	4.45	-5.7	23.3
LU	4.86	6.89	5.90	6.17	5.94	6.95	9.01	17.0	29.6
HU	2.25	4.09	4.91	5.20	5.63	6.03	7.88	7.1	30.7
NL	3.73	6.14	:	:	6.69	7.47	9.37	11.7	25.4
AT	4.84	6.62	6.71	6.42	7.64	8.19	10.82	7.2	32.1
PL	:	5.60	6.15	5.59	4.26	5.30	6.77	24.4	27.7
PT	:	6.88	6.26	6.39	5.68	6.03	7.63	6.2	26.5
SI	3.64	8.37	7.28	5.28	4.80	5.89	7.96	22.7	35.1
SK	:	:	:	:	5.33	5.08	7.65	-4.7	50.6
FI	3.39	7.54	6.69	6.85	6.73	6.91	7.79	2.7	12.7
SE	:	10.81	9.14	7.87	7.65	9.20	12.26	20.3	33.3
UK	2.60	4.01	5.91	5.18	4.99	6.10	9.21	22.2	51.0
BG	:	:	:	:	3.50	3.78	4.50	8.0	19.0
HR	:	:	:	:	:	6.73	6.88	:	2.2
RO	:	:	:	2.29	2.83	3.68	4.59	30.0	24.7

Note: Price paid by Standard Industrial Consumer I 3-1 (41 860 GJ /year) on 1 January of each year.

Chapter 2
European Union energy policies

Introduction

European energy policies have evolved considerably during the past 5-10 years, resulting in sweeping changes in energy markets on a scale that has not been seen since the energy crises of the 1970s. A number of policy initiatives, institutional changes, and shifts in economic power have substantially transformed EU energy markets, including: liberalisation of electricity and gas markets, ratification of the Kyoto climate treaty, the rapidly increasing market share of renewable energy, and the emergence of Russia as a global energy power. Enlargement of the EU has brought with it additional opportunities and challenges to the goal of unifying EU energy policy. As emphasised in the recent Green Paper, EU energy policy has converged on the basic goal of providing sustainable, competitive, and secure energy for its citizens.

The subject of EU energy policies has many aspects and a long history and it could well fill a book on its own, but that is not the intention of this publication. What this chapter will offer is only a synthesis but one that will nonetheless demonstrate the place of energy statistics in making policies or in monitoring policy impact on the energy situation in the European Union.

2.1 Overview and historical background

International cooperation on energy policies and markets has always been at the core of the European Union and its predecessor institutions; historically the evolution of the EU is inextricably linked to the energy systems and the expansion of energy markets. The formation of the European Coal and Steel Community in 1951 was based on the common interests among six member states with respect to Europe's main energy source and the industry that was the largest energy user. In 1957, the creation of the European Atomic Energy Community (EURATOM) accompanied the formation of the European Economic Community as laid out in the Treaties of Rome. International cooperation aimed at expanding the peaceful use of nuclear energy was recognised as a key priority for European development.

In spite of the early cohesiveness around energy issues and the need for internal supplies, economic growth became increasingly linked to the availability of cheap imported oil in the 1950s and 60s. Furthermore, the rapid growth in energy supply did not face major environmental constraints as it does today. The pattern of unrestrained growth in both imports and overall consumption began to change with the oil shocks of the 1970s. Many European states initiated policies to rapidly phase out oil from non-transport sectors, while energy efficiency programmes aimed to cut demand without reducing energy services.

The oil price shocks of the 1970s exposed the vulnerability of European states to imported energy sources and the effects of runaway energy consumption, and as a result stimulated a number of initiatives on renewable energy development and demand-side energy efficiency. Such efforts witnessed a downturn in the mid-1980s when oil prices plummeted and another downturn in the 1990s as the move towards deregulation of electricity and gas markets was gaining momentum.

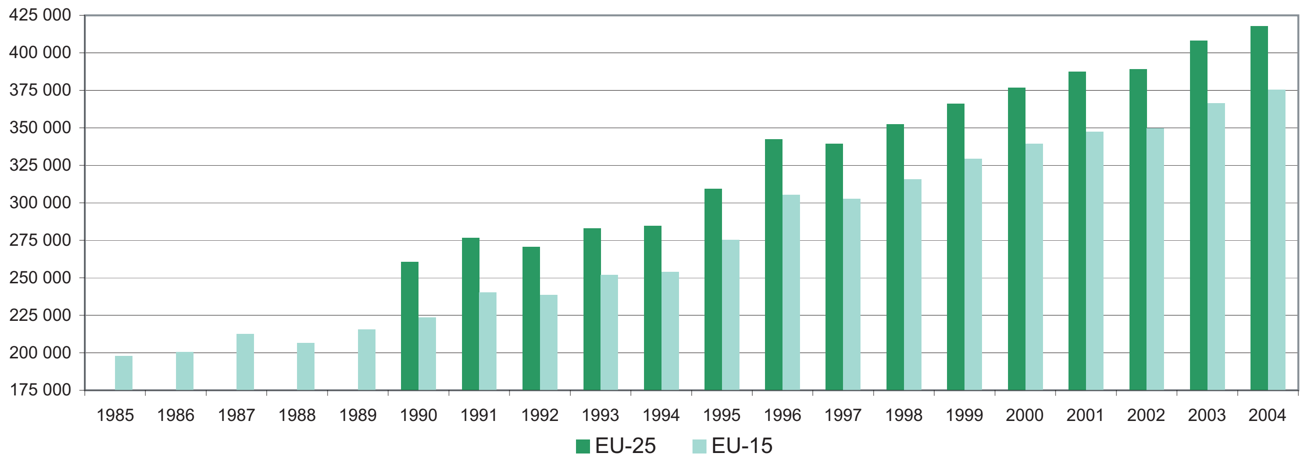
Although cooperation on energy policies and markets was increasing in the early 1990s, it was also clear that national interests were in some cases diverging, presenting challenges to the goal of a common EU energy policy. Until the mid-1990s, electricity and gas markets were highly regulated in nearly all Member States. Historical supply choices have differed due to differing objectives and natural resource endowments: some Member States invested heavily in nuclear power, others continued a reliance on coal, and others made significant investments in renewables. In the transport sector, low oil prices again contributed to a lack of concerted action.

The heterogeneous collection of European support mechanisms for renewables and efficiency that existed in the 1980s and early 1990s have gradually been replaced by more integrated and comprehensive EU policy platforms, with respect to both research and development as well as implementation, deployment, and non-technical barriers. Non-nuclear R&D support for energy, environment, and climate amounts to EUR 4.2 billion, or about 13% of the thematic research budget in the proposed Seventh Framework Programme for 2006-2013. Intelligent Energy Europe (IEE), which supports energy implementation issues and non-technical barriers, will now be a key part of the overall Competitiveness and Innovation Programme that is aimed at achievement of the re-launched Lisbon Strategy. The IEE budget has been significantly increased compared to the previous programme, underlining the importance of new energy systems in creating jobs and fostering competitive economies across the EU.

The development of the internal market in electricity and gas has advanced considerably in the past 5-10 years, with market liberalisation, efforts at regulatory consistency and improved technical integration. Climate policy evolved from tentative engagement in the early 1990s to serious commitment, with the EU as the world leader, finally achieving ratification of the Kyoto climate treaty in 2005. The Commission has also advanced ambitious Directives for increasing renewable energy and improving energy efficiency. Some Member States have become world leaders in technology development and/or deployment, such as wind energy in Denmark and Germany, and bioenergy in Sweden.

In the early 1990s, as environmental sustainability was emerging as a major driver in EU energy policy, energy security issues were re-emerging, first with the Gulf War in 1991 and later in the former Soviet Union and Eastern Europe, especially the growing strategic importance of Russian gas. The European dependence on energy imports was once again strongly linking energy policy to foreign policy, with the reliance on Russian gas now seen as a major policy issue of similar magnitude to the longstanding dependence on oil from the Middle East.

Figure 2.1: **Gross inland consumption of natural gas, in 1000 tons of oil equivalent**



At the same time, it is well-established that security in supply addresses only half of the problem: demand-side approaches are firmly recognised as key elements of EU energy policy. A number of recent programmes are aimed at reducing demand and improving the robustness of energy systems through energy efficiency, land use planning, and other measures. Energy efficiency programmes address sustainability and competitiveness as well as energy security. The innovation that accompanies energy efficiency programmes contributes to new jobs and new interfaces within the knowledge-based economy, while the accompanying energy demand reductions help to address both energy imports and energy-related emissions.

The three essential elements of sustainability, competitiveness and energy security provided the foundations for the Energy Green Paper recently published by the Commission. A number of key challenges were put forward, including completion of the internal energy market, diversification and sustainability in the power sector, stable and secure energy supply, climate stabilisation, alternative transport fuels, competitiveness and technical innovation, and coherent external policy.

Finally, in January 2007 the Commission presented its Strategic Review *An Energy Policy for Europe*(1), in which it critically looks at how energy challenges are handled under existing policies, proposes a strategic objective which should be the guiding point for all future energy policy decisions, and sets out a broad-ranging action plan which describes what needs to be done to reach that objective.

Key issues and challenges are considered in further detail in the sections below.

(1) Commission Communication of 10 January 2007 "An Energy Policy for Europe" [COM (2007)-1]

2.2 Completing the Internal energy markets

The internal energy markets are aimed at achieving competitive energy supply and insuring that transmission and distribution systems allow equal access to all potential suppliers. Competitive energy markets will lead to improved supply conditions for consumers and facilitate cross-border investment and trade. EU energy markets for electricity and gas will be essentially open for competition by July 2007.

Market Opening

Two Directives were aimed at the market opening - one for the electricity market (2003/54/EC) - and one for the natural gas market (2003/55/EC). The Directives gave specific deadlines for the opening of these markets: 1 July 2004 for all business customers and 1 July 2007 for households. The Directives also establish common rules for generation, transmission, distribution and supply of electricity and gas, including market access and public procurement. National regulators are required to monitor the development of competition and report regularly to the Commission.

Regulatory structures for electric and gas providers in the past often gave rise to vertically integrated companies in many Member States, in which ownership of generation was combined with ownership of distribution and/or transmission facilities. Unbundling of generation from distribution and transmission is required in order to prevent discrimination against third parties. The two Directives have provisions requiring unbundling in reference to Transmission System Operators and Distribution System Operators. A separate decision of the Commission(2) established the European Regulators Group for Electricity and Gas, in order to monitor the progress in the market opening and recommend further actions.

In the process of market liberalisation, the notion of Public Service Obligation has been maintained. The electricity Directive notes that "Member States may impose on undertakings operating in the electricity sector, in the general economic interest, public service obligations which may relate to security, including security of supply, regularity, quality and price of supplies and environmental protection, including energy efficiency and climate protection. Such obligations shall be clearly defined, transparent, non discriminatory, verifiable and shall guarantee equality of access for EU electricity companies to national consumers." (Article 3).

Cross-border exchanges

In order to improve the security of electricity supply and take advantages of complementarities across Member States, the procedures for cross-border exchanges need to be streamlined and made more internally consistent. A recent regulation(3) provides for a compensation mechanism for transit flows of electricity, harmonised cross-border transmission charges, and the allocation of available interconnection capacities between national transmission systems. The regulation also provides guidelines on compensation mechanisms for electricity flows originating or ending in countries outside the European Economic Area (EEA). The Commission has proposed the development of similar regulations to facilitate cross-border trade in natural gas.

Taxation Framework

The Community system of minimum taxation rates that was previously confined to mineral oils was extended to include coal, natural gas and electricity(4). Extending the minimum taxation levels reduces the potential for distortions resulting from competition between mineral oils and other energy sources, thereby improving the operation of the internal market. Minimum taxation levels for all energy sources also addresses sustainability and security concerns by encouraging more efficient use of energy, reducing dependence on imported energy, and limiting greenhouse gas emissions. The taxation framework is consistent with Community objectives relating to competition and the greenhouse gas reduction targets of the Kyoto Protocol.

The Directive aims to avoid both double taxation and non-taxation, but also to provide Member States with flexibility in balancing competitiveness, sustainability, and security goals. It also allows for differentiated rates of taxation due to differences in product quality, differences in consumption levels for heating purposes, energy usage for public services and between business and non-business uses. Exemptions or partial exemptions from the taxation framework are allowed for electricity inputs, public use of aviation and maritime fuels, energy inputs for research, biofuels, renewable sources other than hydro, energy use for public transit and fuels used for navigation on inland waterways or as propellants. The Directive also provides that Member States may apply full or partial refunds on taxes paid by businesses that have invested in energy efficiency and/or greenhouse gas emission reductions.

(2) Commission Decision 2003/796/EC of 11 November 2003 on establishing the European Regulators Group for Electricity and Gas.
(3) EC Regulation 1228/2003 on Conditions for Access to the Network of Cross-Border Exchanges in Electricity.
(4) Council Directive 2003/96/EC Restructuring the Community framework for the taxation of energy products and electricity," 27 October 2003.

2.3 Towards a sustainable power sector

The energy mix in the power sector in the EU has been undergoing a transition towards renewable sources and greater efficiency, including an expansion in combined heat and power. A more diverse and efficient energy mix will improve the security of supply, while the move towards renewable energy will contribute to Kyoto targets. The question of maintaining and/or expanding nuclear power has returned due to concerns over increasing prices and the need to reduce greenhouse gas emissions. Low electricity prices are viewed as important for maintaining the competitiveness of energy-intensive industries and avoiding job losses in these industries. However, public opinion shows that support for nuclear power is not based on price alone, but is contingent on solving nuclear waste storage problems. Issues such as these are addressed in further detail below.

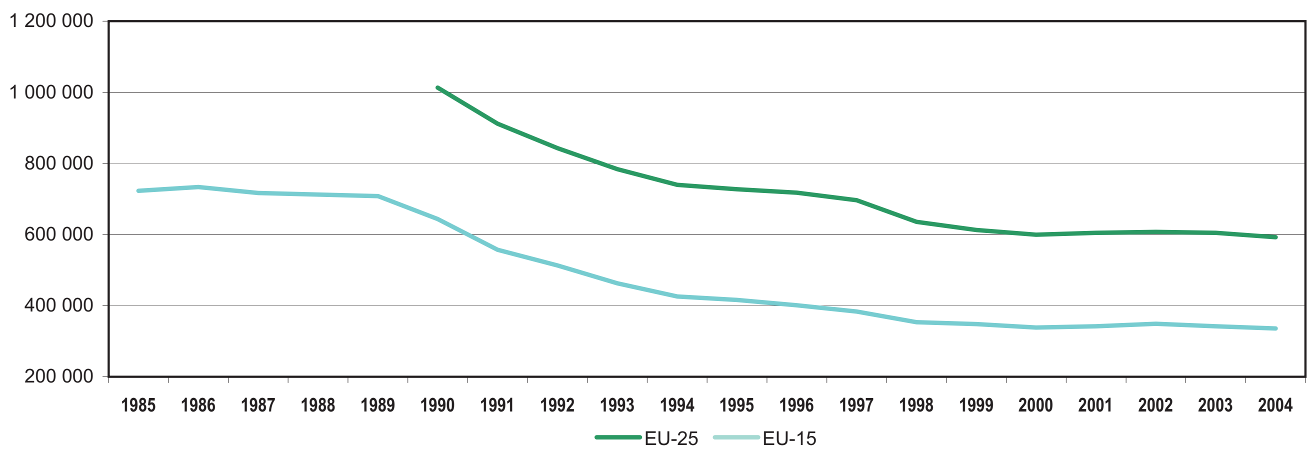
Diversifying the energy mix

Increased diversity in the mix of energy sources for power production will help to offset the impacts of seasonal and annual fluctuations in availability, improve the reliability of energy supply and dampen the impact of price increases experienced for a particular source. Heavy reliance on coal in some Member States increases carbon price exposure, i.e. a significant rise in carbon offset prices will have disproportionate impacts on coal-dependent regions. Reliance on hydropower in the Nordic countries contributes to fluctuations in price and availability. Reliance on nuclear power exposes some regions to potential supply disruptions in the event of safety problems at one or more major plants. The recent rise in gas prices has demonstrated the exposure of power markets to rapid price rises, since gas is a major energy source for new generation at the margin.

Coal is the primary indigenous source of energy in the EU. The prominence of coal in the EU has two major implications for future developments of energy policy for the power sector. The first issue is technical and stems from the fact that continued use of coal will require implementation of carbon sequestration and storage, if Kyoto and post-Kyoto targets are to be achieved. carbon sequestration and storage will add considerable cost to the use of coal; it is estimated that this will cost nearly twice as much as the cost of fuel per kWh of electricity produced(5).

The second issue relates to economic restructuring and state aid. Despite considerable restructuring in the past several decades, EU coal production is likely to remain uncompetitive compared to imported coal, resulting in continuing calls for State aid. The managing of State aid at European level ensures that no discrimination is raised in the internal coal market. However, the current system of State Aid in energy sectors forecasts a transition to renewable energy sources: "The digression of aid to the coal industry will enable the Member States, in accordance with their budgetary constraints, to reallocate the aid granted to the energy sector on the basis of the principle of a gradual transfer of aid normally given to conventional forms of energy, in particular the coal sector, to renewable energy sources."(6)

Figure 2.2: Primary production of solid fuels 1985-2004, in 1000 tons



(5) "A European Strategy for Sustainable, Competitive, and Secure Energy," Commission of the European Communities, Brussels, 8.3.2006, SEC(2006) 317.
(6) Council Regulation 1407/2002 on state aid to the coal industry.

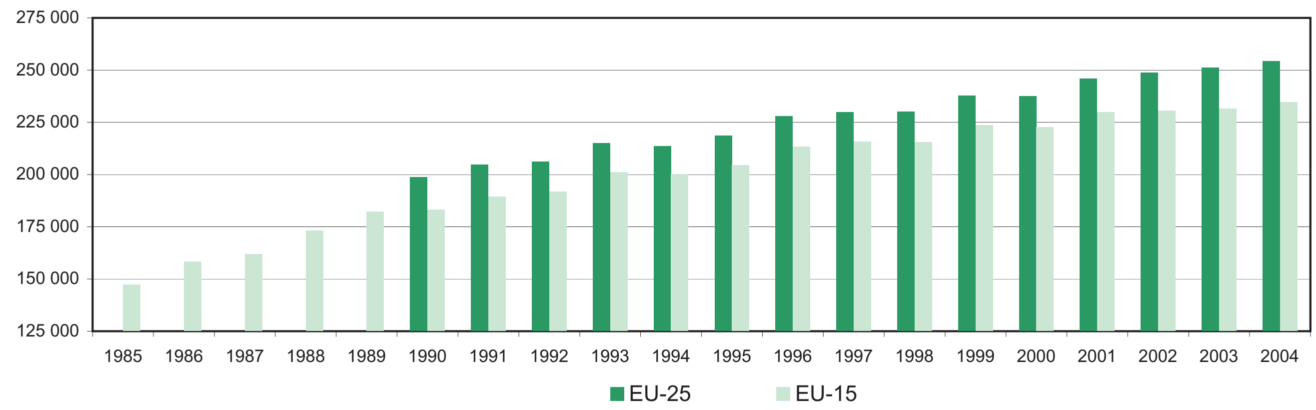
Nuclear Power

Nuclear power presents some of the most complex and divisive energy policy issues within the EU as well as globally. Public opinion is divided in some Member States, while in others public opinion has come nearly full circle since the Chernobyl accident of 1986, with nuclear power viewed as inexpensive and carbon-free.

A major impediment to nuclear power is the lack of long-term solutions to the storage of radioactive waste; a recent Eurobarometer survey showed that support for nuclear power is strongly linked to concerns about radioactive waste. During 2003 and 2004, the Commission proposed a package of legislation related to nuclear safety, including a Community-wide approach to the handling of spent nuclear fuel and radioactive waste. The proposed Directive includes recommendations for long-term geological disposal sites to be identified by 2008 and authorised for operation by 2018(7).

A second issue is to insure that funds are available for the safe decommissioning of nuclear plants at the end of their lifetime. In 2004, the Commission recommended that the Member States take the necessary measures to ensure that sufficient financial resources are set aside during the operating period of nuclear power plants with a view to maintaining a high level of nuclear safety during decommissioning work(8).

Figure 2.3: Production of nuclear heat, in 1000 tons of oil equivalent



(7) Amended proposal for a Council Directive (Euratom) on the management of spent nuclear fuel and radioactive waste. COM(2004) 526 final.

(8) Report on the use of financial resources earmarked for the decommissioning of nuclear power plants, Communication from the Commission to the European Parliament and the Council. COM(2004) 719 final.

Promotion of renewable sources of energy

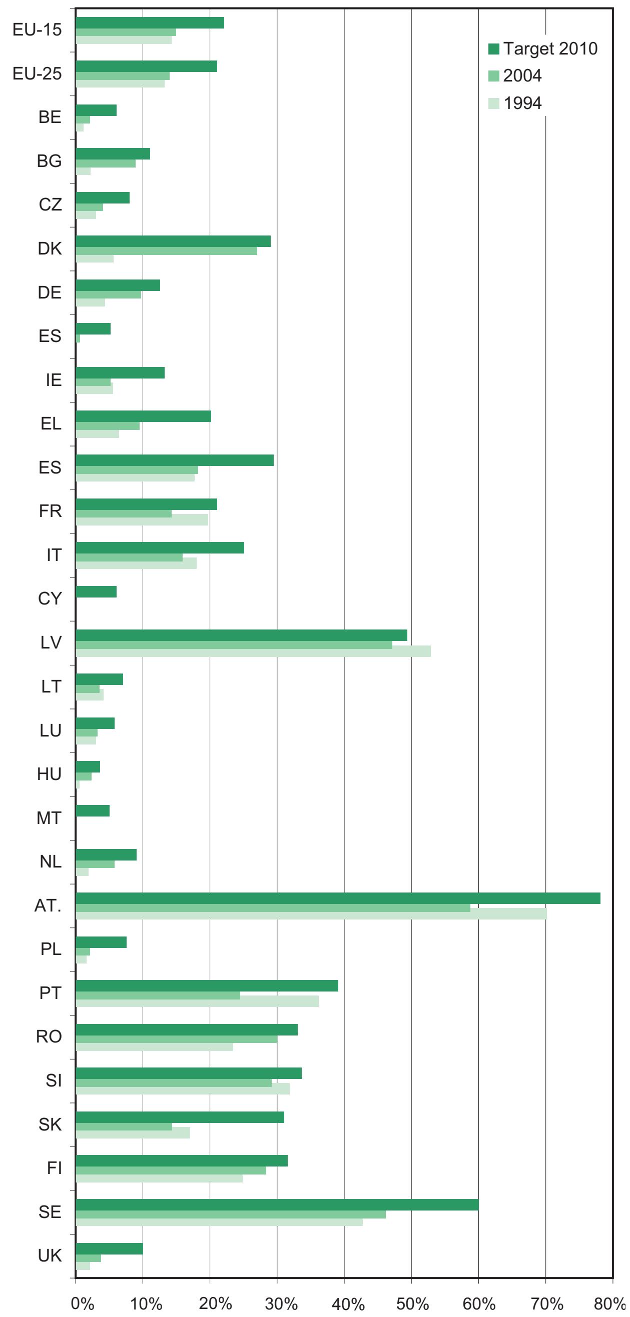
The EU has emerged as the world's leading region in developing and implementing renewable energy technologies, particularly in wind power and energy from biomass and wastes. Rapid movement along the technology learning curve has resulted in near-competitive generation costs for wind and biomass, even without considering environmental impacts. The use of indigenous renewable resources stimulates innovation, creates jobs, contributes to Kyoto commitments, and reduces the need for energy imports. The number and quality of businesses and jobs created is generally much greater for small-to-medium scale renewable sources than for the capital-intensive, large-scale options (i.e. hydro, coal, and nuclear). Renewable energy is thus recognised as being fundamental to the goals of competitiveness, sustainability, and security.

In conjunction with renewable energy directives and policies, legislation was developed to allow exemptions in the taxation of energy sources(9). The Directive allows Member States to apply exemptions or reductions in the level of taxation on renewable energy sources, including solar, wind, tidal, geothermal, biomass, and waste. These tax concessions are considered state aids, which may not be implemented without prior Commission authorization, in order to avoid undue distortion of competition and over-compensation.

In order for renewables to become fully competitive, continued market expansion is needed to induce learning effects and bring down costs. Innovation in technology development and deployment is also needed. The Renewables Directive sets a target of 21% of electricity generated in 2010 to come from renewable energy sources in the EU(10). Indicative targets for Member States are specified in the Directive, and Member States must report on progress achieved each year. A section in Chapter 3 of this publication offers further details on renewable energy statistics.

Renewable energy has been promoted through the DG-TREN programme ALTENER, which has operated for nearly 15 years and ended its third phase in 2006. The goal of ALTENER projects is to expand markets for new and renewable energy sources for electricity and heat production by addressing non-technical barriers. ALTENER is focused on dissemination of information on renewable energy technologies and implementation, harmonisation of renewable energy products and equipment, support for renewables infrastructure, and improvement of operating practices. In its third phase (2002-2006), ALTENER was one of four components within the Intelligent Energy for Europe (IEE) Programme.

Figure 2.4: Share of electricity from renewable energy to gross electricity consumption (with indicative targets for 2010)



(9) Council Directive 2003/96/EC: Restructuring the Community framework for the taxation of energy products and electricity," 27 October 2003.

(10) Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.

Combined Heat and Power (CHP)

The high overall system efficiency of CHP systems makes them attractive in improving the economics and reducing environmental impacts of the power sector. CHP plants are sometimes associated with large industrial users that are also self-producers. CHP plants can also be installations designed for central supply of heat, steam, and/or hot water, as is the case with District Heating systems, which supply residential and commercial customers with heat and hot water. Where there is sufficient geographical density of demand, central supply of heat and hot water is more efficient than electricity in delivering the equivalent energy services.

The heat directive of 2004 was aimed at improving consistency across installations, addressing coordination across networks, completing the process of market liberalisation, and promoting efficient CHP systems. More information about CHP and notably the statistical returns stemming from the statistical annex of Directive 2004/8 /EC (on the promotion of CHP) can be found in a section of Chapter 3 of this publication.

Biomass and Bioenergy

Biomass plays a special role as the only renewable form of energy available in all carriers - heat, electricity, gas, and liquid - as well as being the only one that is available continuously. Bioenergy conversion technologies have reached economic maturity, while biomass supply offers special opportunities for new jobs and rural development. Consequently, bio-energy production and trade in the EU is developing quickly across several intersecting markets. Biomass already accounts for about half of all renewables in the EU, and the Biomass Action Plan calls for biomass use to more than double by 2010([11]). Liquid biofuels for transport are a key component in the Action Plan, and are discussed in more detail in the next section.

Biomass is becoming an important fuel source for CHP, in the form of waste residues, dedicated biomass production systems, and compacted sources (e.g. pellets) that facilitate transport and trade. In a few countries (Sweden, Finland), biomass has become the main fuel source for CHP. Furthermore, compacted biomass used in the CHP sector is also available for direct use (e.g. in wood stoves used for heating) to the residential and commercial sectors. Biogas from waste residues is also being used for CHP, as well as direct use for heating, as a transport fuel, and even as feed-in to natural gas, after the appropriate gas clean-up.

([11]) Commission Communication of 9 February 2005 "Winning the battle against global climate change" [COM(2005) 35 - Official Journal C 125 of 21 May 2005].

2.4 Energy for transport

Whereas there has been considerable progress in industry and buildings sectors, the transport sector has been the most stubborn with respect to efforts at reducing energy consumption and greenhouse gas emissions. There are many factors that impact energy use and emissions in transport, including overall economic growth, the efficiency of transport modes, switching among transport modes, alternative transport fuels, land use practices, and changing lifestyles. The energy dimensions of transport tend to be limited to the efficiency of transport modes and the use of alternative fuels, which are discussed briefly below.

Efficiency and alternative transport modes

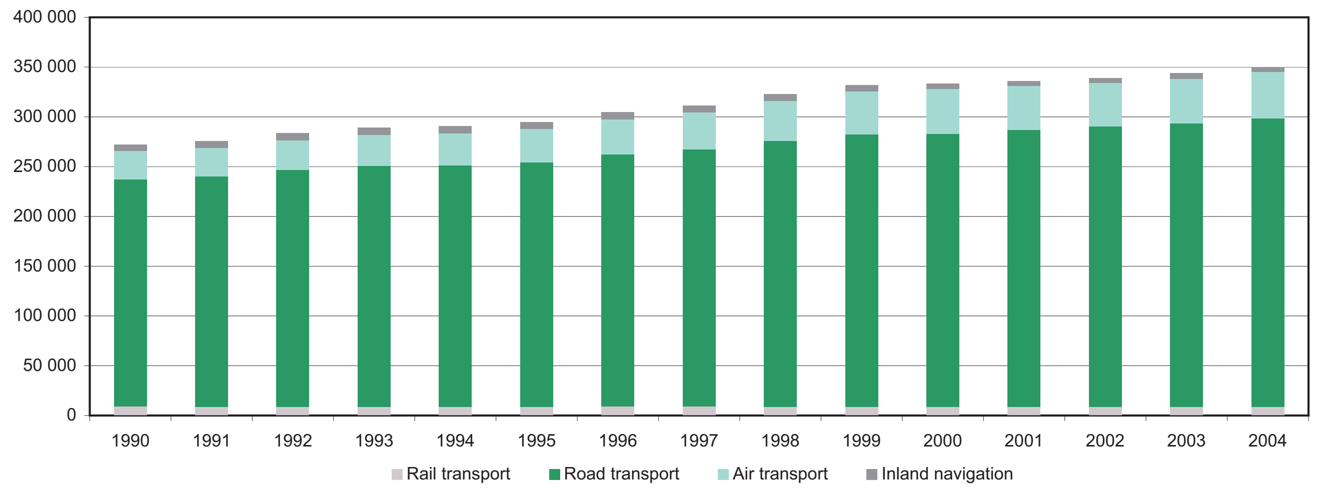
The transport sector, particularly road transport, has been increasing its share of energy consumption and greenhouse gas emissions compared to other sectors. Consequently, the Commission has been vigorously pursuing the implementation of the agreements reached with automakers in 1998, which provided for average emissions from new cars to decrease to 140 grams of CO_2 per kilometre by 2008. The ultimate target for EU, as agreed by heads of state, is to reach an average of 120 g/km for all new passenger cars by 2010. As of 2004, the EU-15 average was 163 g/km and most forecasts show that it will be difficult for automakers to reach the targets. The Commission is therefore undertaking an evaluation on the targets and recommend further measures in a report to be completed by the end of 2006(12).

The transition to a sustainable transport sector will require a significant amount of innovation, not only in technology development, but also in implementation issues and in the impact of policy instruments on choices among alternative transport modes. STEER, one of four components of the Intelligent Energy for Europe programme, aims to promote innovative approaches to transport, including biofuels, hydrogen, fuel cells, and other technology platforms. The STEER projects promote more sustainable energy use in transport, including increased energy efficiency, new and renewable fuel sources, and the take-up of alternatively propelled vehicles).

Biofuels for Transport

Expanding markets for biofuels serve not only to reduce import dependence and environmental impacts, but also to promote agricultural diversification and stimulate technical innovation. In 2001, the Commission launched its policy to promote biofuels for transport, which is market-based, but includes targets and financial incentives. The targets were to be based on the percentage of biofuels in the transport market, which was only 0.6% in 2002. The EU Directive on biofuels came into force in May 2003, under which Member States shall ensure a minimum 2% share for biofuels by 31 December 2005 and 5.75% by December 2010(13). The targets are indicative, i.e. not binding, and in fact nearly all Member States have had difficulty meeting the 2005 target. The Commission launched a public consultation process in April 2006 as part of a progress report on the Biofuels policy, which will be completed before the end of the year.

Figure 2.5: Transport: final energy consumption, EU-25 (in 1000 tons of oil equivalent)



(12) "Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Sixth annual Communication on the effectiveness of the strategy," Communication from the Commission to the Council and the European Parliament. COM(2006) 463 final, Brussels, 24.8.2006.

(13) Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport.

2.5 Stable and secure energy supply

Major disruptions in energy supply due to technical, economic or political reasons could have significant impacts on the well-being of the entire Community. There are several sources of concern with respect to preserving the stability and security of energy supply, of which three are particularly noteworthy. First, the infrastructure for power generation, transmission, and distribution is aging in some regions; the ability to manage transfers on the grid must be maintained. Second, increasing demand and trade means that transit countries for energy supply, particularly in the case of natural gas, can become a source of supply constraints or disruptions. Third, the increasing dependence of the EU on imported oil and gas exposes the Community to potential shortfalls in the event of rapid external market changes. These concerns have necessitated a more coordinated response, and each is discussed briefly below.

Physical infrastructure

In order to replace or renovate aging generation facilities, increase the reliability of energy distribution, and facilitate cross-border trade, more investment is needed in the electricity and gas infrastructures, including increases in interconnection levels. At the Barcelona Council in 2002, Member States agreed on minimum power interconnection levels of 10%. Interconnection increases and improvements are important for enhancing both security and competition.

Natural Gas Markets

Natural Gas has emerged as a key alternative for new electricity generating plants within the EU, due to a reliable supply, incremental scale and associated low capital cost, and relatively low environmental impacts compared with other non-renewable options. However, imports have been increasing rapidly and consequently there has been increasing concern about the security of gas markets. The gas security Directive establishes a common framework for Member States to establish security measures that are non-discriminatory and consistent with the single market in gas(14). The Directive calls for Member States to establish safeguards for household and small business natural gas users, as well as for suppliers to create storage capabilities and other measures that may be needed to avoid interruptions. The Commission will also review gas supply agreements and long-term contracts with respect to their adequacy in the event of shortages.

The Ukraine-Russia gas dispute at the end of 2005 illustrated clearly the need for comprehensive agreements. As a result of the dispute, gas supplies to certain EU countries were briefly interrupted for the first time in history, illustrating the strategic importance of the trilateral relationship between a key supplier, a key transit country and a key customer. The option to promote a wide range of measures must be maintained, including diversification in sources of supply, demand reduction strategies, substitution of other energy sources, and the establishment of liquefied natural gas (LNG) terminals to facilitate imports from beyond the pipelines. However, longer-term strategies will also have to recognise that as LNG becomes more popular, the creation of global, rather than regional gas markets, may also push up demand beyond sustainable levels, as occurred with oil.

Oil Stocks

The maintenance of strategic stocks of oil in order to insure security of supply dates back nearly four decades, to 1968, when a Directive was issued with minimum levels of stocks for each Member State(15). The recent Council Directive(16) obliges Member States to maintain minimum stocks of crude oil and/or petroleum products ('crises depot'). The new Directive includes comprehensive definitions, creates transparent guidelines, emphasises shared responsibilities and addresses the overall coordination of supplies across the EU in a way that is consistent with the internal market. The supply difficulties could be due to physical disruptions, price shocks, and market dislocations.

The Directive stipulates that Member States have to maintain their stocks of petroleum products at a level corresponding "to at least 90 days' average daily internal consumption in the preceding calendar year." Three categories of petroleum products are concerned. Category I includes motor spirit and aviation fuel; Category II includes gas oil, diesel oil, kerosene and jet-fuel; Category III covers fuel oils. Stocks may be maintained in the form of crude oil and intermediate products, as well as in the form of finished products.

(14) Council Directive 2004/67/EC "concerning measures to safeguard security of natural gas supply", 26 April 2004.
(15) Council Directive 68/414/EEC of 20 December 1968 imposing an obligation on Member States of the EEC to maintain minimum stocks of crude oil and/or petroleum products.
(16) Council Directive 2006/67/EC of 24 July 2006 imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products (replacing the 1968 Directive and the associated legislation).

2.6 Managing Energy Demand

One major difference between today's energy security policies and those that prevailed in the past is the recognition of an important demand-side component rather than an exclusive focus on securing supply. The strengthening of energy efficiency is now firmly recognised in EU energy policy as one of the few ways to address both sustainability and security concerns; by reducing energy demand, both energy imports and energy-related emissions will decrease. Furthermore, energy efficiency improves the competitiveness of European industry and reduces the vulnerability of European infrastructure to sudden changes in weather or in energy prices.

Enlargement has further underlined the opportunities for efficiency, as the new Member States adopt improved end-use technologies and open their markets up for new innovations. In the enlarged EU, policy-makers attempt to find the right balance between supply and demand - and between security and sustainability - to address the growing and diverse needs of 450 million citizens. The new Member States face a number of challenges in addressing changes in physical infrastructure as well as in energy management practices and the institutions that guide them. At the same time, there are also new business opportunities as Member States pool their knowledge on how to formulate effective energy efficiency programmes and policies.

A Eurobarometer survey on attitudes towards energy, conducted in 2005, revealed a substantial need for information on the efficient use of energy. According to this survey, 43% of the European citizens are expecting their national government to provide them with more information on the efficient use of Energy. The information gap is not surprising, given the tremendous potential variation in energy intensity and energy use profiles resulting from the interactions between energy management practices and energy-using equipment, as well as with the behaviour of the energy users themselves. Furthermore, energy efficiency programmes must address the transaction costs and measurement costs associated with managing energy demand, which are much more significant than is the case with energy supply.

A key policy instrument for providing information to consumers about energy efficiency are energy consumption labels, which have been applied to a variety of products, including freezers, refrigerators, dishwashers and washing machines. Labelling has been pursued through a number of Directives([17]) and has aimed at allowing consumers to easily compare the energy efficiency of like appliances or equipment. A more holistic approach has now been adopted through the Eco-design Directive([18]), which addresses energy consumption of components as well as entire products. The Directive also places the energy-using characteristics within the broader context of environmental performance, including the entire product life cycle, and creates incentives to address environmental performance from the design stage onward.

Energy consumption in buildings also requires a holistic approach, due to the complex interactions between energy users and energy-using equipment and appliances. Energy consumption in buildings accounts for over one-third of final energy demand in the EU, and more than 30% of the CO_2 emissions. The Energy Performance in Buildings Directive laid out a consistent framework for evaluating and improving energy performance, including an integrated methodology, setting of standards, certification systems, and inspections of heating and cooling systems([19]). Member States have responsibility for determining the minimum standards.

End-use efficiency policies have been comprehensively integrated in a recent Directive([20]) which sets indicative targets for efficiency improvements, specifies policy instruments to remove market barriers to efficiency, creates the necessary conditions to develop a market for energy services, and establishes delivery mechanisms for efficiency measures, such as public procurement.

Non-technical issues are addressed through the SAVE programme, which has operated since 1991. SAVE has promoted energy efficiency by supporting studies of energy efficiency and energy pricing, pilot actions aimed at improving energy use patterns, knowledge exchange, monitoring and evaluation, and regional energy management actions. The fourth phase of SAVE was integrated into the Intelligent Energy Europe (IEE) Programme, aimed at promoting sustainable solutions to energy and transport needs within the Community.

([17]) *Inter alia*: Directive 79/530/EEC on the indication by labelling of the energy consumption of household appliances. Directive 94/2/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations.

([18]) Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council.

([19]) Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings [Official Journal L 001 of 04.01.2003].

([20]) Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.

2.7 Climate Change Policy

The EU led the world during the long process of approval for the Kyoto Protocol, ultimately succeeding in February 2005, when Russia ratified the Treaty and it entered into force. The process had started long before that, beginning with the UN Framework Convention on Climate Change, which was adopted in New York in May 1992 and entered into force in March 1994. At the fourth meeting of the Conference of the Parties in Berlin in March 1995, the Parties to the Convention entered negotiations to create a Protocol containing measures to reduce emissions for the period beyond 2000, and the Protocol was adopted in December 1997 in Kyoto. The EU is committed to achieving an 8% reduction in emissions compared to 1990 levels, with differentiated reduction targets for each Member State. Within the EU-25, there are two Member States that do not have Kyoto reduction commitments: Malta and Cyprus.

The EU Emissions Trading Scheme (ETS) was launched in 2005 to cap CO_2 emissions from a number of energy-intensive industries. Covering almost half of all EU CO_2 emissions, it is the major tool for the EU to achieve its CO_2 reduction commitment. Given that the EU reductions are a critical part of the overall Kyoto commitments, the success or failure of the ETS is strongly linked to the success or failure of Kyoto itself. The facilitation of trade in emission allowances creates a reference price for reducing CO_2 and has formed a market worth tens of billions of Euro annually. Putting a price on carbon has been a key development in implementing Kyoto.

2.8 External policy

The strategic importance of energy policy relations between the EU and other states has increased significantly in the past 5-10 years. With an increasingly global economy and the emergence of climate change as the world's major environmental challenge, it is neither possible nor desirable for the EU to act unilaterally in developing and implementing its energy policy. The Community actions and legislation are more and more tied into international developments, leading to interdependence that must in turn, be incorporated into new policies. The significance of security of supply and climate policy has already been addressed in the preceding sections. Other issues that are particularly noteworthy relate with respect to external relations are regional energy cooperation, international energy trade, and development cooperation.

Regional energy cooperation

A legal framework to promote long-term cooperation in the energy field was established through the Energy Charter Treaty and the Energy Charter Protocol on energy efficiency and related environmental aspects, which entered into force in 1998 with 51 signatories([21]). The Treaty includes provisions for investment protection, trade in energy materials and products, transit and dispute settlement. Parties are to work towards insuring competition in energy markets, promoting transparency in contracts and legislation, maintaining sovereignty over resources, and implementing the "polluter pays" principle.

The Energy Community Treaty implies South Eastern European countries (negotiated since 2004 and approved in 2006 - parties involved: the EU, Albania, Bulgaria, Bosnia-Herzegovina, Croatia, Macedonia, Montenegro, Romania, Serbia and the Kosovo region). This treaty provides for the creation of an integrated market in natural gas and electricity in South-East Europe, with a stable regulatory and market framework that is capable of attracting investment in gas networks, power generation and transmission networks. The Energy Community Treaty also aims to enhance the security of supply by extending access and allowing for mutual assistance in the event of a disruption in service.

Regional cooperation with the Mediterranean countries in the field of energy is mainly based on the Euro-Med Energy Ministerial Conferences and the EURO-MED partnership. The Commission's long-term objective is the establishment of a Euro-Maghreb Energy Community Treaty.

More linked to statistical reporting issues, the MEDSTAT II programme (2003-2009), with its sectoral subtheme MED-Ener, aims at developing the information systems and improving the quality of existing services provided by the 12 Mediterranean Partners statistical systems. Statistical co-operation comprises technical assistance including training, statistical developments (preparation, collection, analysis, production, and dissemination of data) and information technology.

([21]) Council and Commission Decision 98/181/EC, ECSC, Euratom of 23 September 1997 on the conclusion, by the European Communities, of the Energy Charter Treaty and the Energy Charter Protocol on energy efficiency and related environmental aspects.

Energy Trade

Maintaining smooth relations in the trade in energy with external partners is critical for the EU, since half of all energy used is imported. Russia, Norway, and the Middle East are the major suppliers of oil and/or gas. The dependence between Russia and the EU has increased in recent years and this dependence is mutual; Russia is its largest energy trading partner and the EU is Russia's largest customer. A dialogue([22]) with Russia on energy trade and investment was initiated in 2000; the dialogue has assisted government policy-makers and business investors in clarifying some aspects of market access and market operation in Russia.

International trade in liquid biofuels has been increasing significantly in recent years, although starting from an extremely low level, partly as a way to help satisfy the targets set in the Biofuels Directive. Trade in biofuels would offer special opportunities for developing countries while offering environmental benefits and also reducing the dependence on imported oil.

Development Cooperation

EU cooperation on energy with developing countries facilitates technology transfer, allows exchange of knowledge, stimulates investment, and creates new opportunities for advancing sustainable development, particularly through new platforms for renewable energy. The objectives of EU development cooperation include the integration of energy as a horizontal element of EU development aid programmes, enhancing institutional capacity, and providing technical assistance. Regional cooperation along the lines of the EU model is promoted so that smaller developing countries can benefit from more competitive markets, cross-border investment opportunities, and the standardisation of energy technologies and products.

The SYNERGY programme of DG-TREN (1998-2002) and the COOPENER programme (2002-2006) of Intelligent Energy Europe have supported projects in transition and developing countries. One major difference with COOPENER was that it was focused on poverty alleviation through energy services, rather than energy cooperation per se. The COOPENER programme therefore had a particular concentration in sub-Saharan Africa. The PHARE and TACIS programmes have supported cooperation with Eastern European countries and the countries of the former Soviet Union in the transition to market-oriented democracies, and this cooperation has included some energy and environmental projects.

The European Union launched a European Union Energy Initiative at the World Summit on Sustainable Development in Johannesburg in 2002([23]). The initiative supports the Millennium Development Goals of halving the number of people in extreme poverty by 2015. One of the key elements linked to the initiative is the Energy Facility for African, Pacific and Caribbean countries, which will be a catalyst for energy initiatives, act as a clearing house for projects, and build institutional capacity for research and project/programme management.

([22]) Communication from the Commission to the Council and the European Parliament "The Energy Dialogue between the European Union and the Russian Federation between 2000 and 2004" COM(2004) 777.

([23]) EUEI - European Union Energy Initiative - at: http://ec.europa.eu/development/body/theme/energy/initiative/index_en.htm.

Chapter 3
Recent development in EU Energy Statistics

Introduction

The previous chapters of this publication show how energy has undergone sweeping changes over the last few decades. In response to this changing energy situation important developments in EU energy policies have emerged, which in turn generate new requirements such as the need for more detailed statistical analyses and for the monitoring of new objectives.

To illustrate this development work in energy statistics, the following pages will report on some recent significant accomplishments.

3.1 Combined Heat and Power (CHP) generation

Preliminary remarks

Combined Heat and Power (or co-generation) refers to heat and electricity produced simultaneously in one process. The main advantage lies in thermal efficiency: whereas the conversion efficiency of electricity generation alone (i.e. the proportion of the calorific potential of the fuel that is actually used) is between 35-55%, the overall efficiency of CHP plants can be as high as 80-90%. This shows the potential of CHP in saving energy and in reducing greenhouse gas emissions.

Promoting combined heat and power production is considered an important part of Community energy policy and plays an important role in helping to meet the commitments under the Kyoto Convention. In the mid-1990s, the Commission's target was to increase the share of CHP electricity generation in total electricity generation in the EU from 9% in 1994 to 18% in 2010. It should be borne in mind, however, that this target has been modified following the establishment of a common CHP calculation methodology.

For a long time, the statistical system did not permit the correct assessment of CHP production at European level. EU Directive 2004/8/EC on the promotion of cogeneration then obliged Member States to submit statistics on CHP to the Commission (Eurostat). However, Eurostat had already started collecting CHP statistics at the beginning of the 1990s (in the course of pilot projects). Since then, a common methodology for CHP data collection has been developed and assistance given to Member States in setting up the required statistical reporting system. Further work is under way on incorporating CHP statistics into the overall system of energy statistics in the EU.

The following paragraphs present the main results of Eurostat's assessment of CHP statistics in the various Member States, in particular the key figures needed to understand the situation of CHP generation in 2002.

What is a CHP unit?

A CHP unit is a unit that can produce both heat and power. In technical terms, it is a thermal installation in which the energy released from fuel is transmitted to an intermediate fluid. This fluid is partly used for driving a generator to produce electricity and partly to supply heat for various purposes such as industrial uses, district heating, etc. The essential characteristic of the unit is that it is self-contained.

The most common types of CHP units are:

- Combined-cycle gas turbine - steam turbine with simultaneous heat recovery (one or more gas turbines whose exhaust gases are fed into a waste-heat boiler to generate steam, which in turn drives a steam turbine)
- Steam backpressure turbine (steam is extracted at a high temperature and pressure)
- Steam condensing extraction turbine (part of the steam is extracted from the turbine at a high temperature and pressure)
- Gas turbine with heat recovery (at the exhaust or another point in the cycle)
- Internal combustion engine with heat recovery.

The compilation of statistical data on the output of CHP plants is complex, as in many cases the share of electrical power they produce can be changed on demand or operation can be switched completely between cogeneration mode and electricity generation only. As CHP plants are seldom equipped with any device to monitor CHP electricity generation, indirect methods have been developed to calculate output.

The overall efficiency of a CHP unit is used as a measure to determine whether electricity generation is fully CHP or not. If overall efficiency is above a threshold set at 75% (85% for steam condensing extraction turbines and combined-cycle units), all the electricity generated is considered to be CHP electricity. On the other hand, if the overall efficiency is below the threshold, the amount of CHP electricity (E_{CHP}) is calculated as follows:

$$\mathbf{E_{CHP} = C \,.\, H}$$

Where **C** is the power-to-heat ratio characteristic to the plant and **H** is the CHP heat generation of the plant.

Share of 9.9% at EU-25 level

Table 3.1 shows, for the reference year 2002, total CHP electricity generation by type of CHP unit, along with the proportions generated by power stations for public supply and by autoproducers.

Just under 300 TWh of CHP electricity was generated within the EU-25 in 2002. This corresponded to 9.9% of total gross electricity generation. In absolute terms, Germany was the largest producer (56.2 TWh) followed by the Netherlands and Finland, both with around 28.5 TWh.

Of more relevance is the share of CHP in total gross generation: here, Denmark stood out with a share of 49%, well ahead of Latvia and Finland (both 38%) and the Netherlands (30%).

Whereas in Greece, Spain, Ireland, Luxembourg and the United Kingdom, CHP electricity generation was largely or completely in the hands of autoproducers, the opposite was true in Denmark, Estonia, Latvia, Lithuania and Hungary, where public supply plants were responsible for at least 85% of the total. In the other Member States, the picture is more balanced.

Table 3.1: CHP electricity generation in 2002, in GWh

	EU-25	EU-15	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV
Combined cycle	70 148	66 736	176	854	3 827	10 594	0	0	5 654	0	0	6 890	-	0
Steam : backpressure turbine	94 772	78 038	2 261	4 471	2 303	30 868	530	230	2 954	6 009	74	5 224	-	113
Steam : condensing turbine	55 010	27 108	316	7 418	7 610	0	366	0	656	1 206	0	3 427	-	1 238
Gas turbine with heat recovery	46 362	43 823	2 990	102	1 496	7 641	0	826	4 783	11 101	405	4 253	-	1
Internal combustion engine	28 005	27 180	427	219	4 055	2 463	43	0	5 269	4 262	145	1 205	-	139
Others	4 866	4 781	0	0	0	4 663	0	0	0	0	0	0	-	0
Total CHP electricity generation	**299 163**	**247 667**	**6 170**	**13 064**	**19 291**	**56 228**	**939**	**1 057**	**19 316**	**22 578**	**624**	**20 999**	-	**1 491**
of which:														
Public supply (% of total)	55	51	71	72	86	59	89	0	0	51	0	44	-	97
Autoproducers (% of total)	45	49	29	28	14	41	11	100	100	49	100	56	-	3
Share in total electr. generation, %	**9.9**	**9.2**	**7.5**	**17.1**	**49.1**	**9.8**	**11.0**	**1.9**	**7.8**	**4.0**	**2.5**	**7.4**	-	**37.5**

	LT	LU	HU	MT	NL	AT	PL	PT	SI	SK	FI	SE	UK
Combined cycle	0	167	1 032	-	16 298	2 579	662	0	0	863	8 640	198	11 713
Steam : backpressure turbine	153	0	1 226	-	1 246	2 617	7 817	1 188	384	2 040	13 183	8 522	1 359
Steam : condensing turbine	1 573	0	156	-	828	2 993	14 217	999	385	2 549	5 175	1 101	2 797
Gas turbine with heat recovery	0	0	1 981	-	5 230	13	307	669	54	94	1 317	110	2 988
Internal combustion engine	0	123	345	-	5 070	320	0	1 642	49	29	134	45	2 020
Others	0	0	0	-	0	0	0	104	1	84	0	14	0
Total CHP electricity generation	**1 726**	**291**	**4 741**	-	**28 673**	**8 521**	**23 003**	**4 603**	**873**	**5 659**	**28 448**	**9 990**	**20 877**
of which:													
Public supply (% of total)	99	0	91	-	69	41	67	51	65	58	63	57	8
Autoproducers (% of total)	1	100	9	-	31	59	33	49	35	42	37	43	92
Share in total electr. generation, %	**9.7**	**7.9**	**21.5**	-	**29.9**	**13.6**	**16.0**	**10.0**	**5.9**	**17.5**	**38.0**	**6.8**	**5.4**

Half of CHP heat production in three Member States

Table 3.2 shows CHP heat production in 2002, expressed in terajoules (10^9 kJ). In the EU-25, 2 844 PJ (10^{12} kJ) was generated; corresponding to 790 TWh, more than two and a half times the electricity produced by CHP (299 TWh - see Table 3.1). The highest figure was registered in Germany (545 PJ), followed at a considerable distance by Poland (308 PJ) and France (263 PJ). Taken together, these three Member States accounted for nearly half of EU-25 CHP heat production.

Table 3.2: CHP heat generation in 2002, in TJ

	EU-25	EU-15	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV
Combined cycle	346 400	332 144	821	4 405	15 739	45 564	0	0	38 807	0	0	35 378	-	0
Steam : backpressure turbine	1 420 642	1 165 375	25 897	75 627	34 113	391 653	7 561	5 215	43 275	161 871	1 740	78 492	-	3 389
Steam : condensing turbine	567 326	265 467	5 097	72 343	42 514	0	3 574	0	7 876	22 380	0	44 337	-	8 654
Gas turbine with heat recovery	324 978	310 500	13 995	697	9 636	56 862	0	4 208	38 638	61 627	3 038	32 015	-	7
Internal combustion engine	141 899	136 819	2 142	1 872	20 660	13 824	169	0	31 610	17 549	624	6 283	-	450
Others	42 922	39 983	0	0	0	36 844	0	0	0	0	0	0	-	0
Total CHP heat production	**2 844 166**	**2 250 285**	**47 954**	**154 944**	**122 661**	**544 744**	**11 304**	**9 423**	**160 206**	**263 426**	**5 403**	**196 505**	-	**12 500**
of which:														
Public supply (% of total)	42	38	55	65	78	47	80	0	0	31	0	32	-	94
Autoproducers (% of total)	58	62	45	35	22	53	20	100	100	69	100	68	-	6

	LT	LU	HU	MT	NL	AT	PL	PT	SI	SK	FI	SE	UK
Combined cycle	0	1 278	5 516	-	88 155	12 299	2 509	0	0	1 825	35 717	2 198	56 187
Steam : backpressure turbine	3 396	0	27 997	-	38 041	40 556	109 442	25 179	7 696	20 159	193 242	102 433	23 668
Steam : condensing turbine	12 096	0	2 445	-	12 159	28 369	192 924	18 258	6 571	3 254	37 759	10 198	36 520
Gas turbine with heat recovery	0	0	9 601	-	56 146	99	2 702	4 079	312	1 160	7 066	1 876	21 214
Internal combustion engine	0	819	2 139	-	26 616	1 796	0	3 744	193	257	520	206	10 425
Others	0	0	0	-	0	0	0	3 104	35	2 904	0	35	0
Total CHP heat production	**15 492**	**2 097**	**47 698**	-	**221 118**	**83 119**	**307 577**	**54 364**	**14 806**	**29 559**	**274 304**	**116 946**	**148 014**
of which:													
Public supply (% of total)	93	0	80	-	51	31	45	27	41	83	40	46	5
Autoproducers (% of total)	7	100	20	-	49	69	55	73	59	17	60	54	95

Table 3.3: CHP electricity and heat capacity (all technologies), 2002 - in MW

	CHP Electricity capacity, MW	CHP Heat capacity, MW
EU-25	**91 634**	**236 136**
EU-15	**73 878**	**171 243**
Belgium	1 444	4 243
Czech Republic	5 012	20 916
Denmark	5 399	10 605
Germany	26 445	48 659
Estonia	450	1 541
Greece	234	861
Spain	3 324	12 331
France	6 497	22 965
Ireland	123	550
Italy	4 380	13 765
Cyprus	-	-
Latvia	580	1 231
Lithuania	2 479	2 301
Luxembourg	88	359
Hungary	1 434	4 341
Malta	-	-
Netherlands	6 738	16 000
Austria	2 902	5 946
Poland	6 268	24 812
Portugal	1 018	4 331
Slovenia	339	1 211
Slovakia	1 104	8 540
Finland	5 812	15 365
Sweden	3 216	7 527
United Kingdom	6 260	7 736

Unsurprisingly, as these power units are the same as those used for electricity generation, the split between public supply and autoproducers follows roughly the same pattern.

Turning now to the capacity of CHP plants, Table 3.3 shows that total heat production capacity was, with 236 136 MW, far higher than that for electricity generation (91 634 MW), confirming the fact noted above that CHP heat production outweighs CHP electricity generation by a factor of 2.6.

Higher capacities for heat, except in Lithuania

Looking at CHP capacities in the individual Member States, heat capacity was particularly high in Slovakia, where it was close to 8 times the capacity for electricity generation. In the Czech Republic, Ireland, Luxembourg, Poland and Portugal, heat capacity surpassed electricity-generating capacity by a factor of 4. Conversely, Lithuania was the only country where electricity-generating capacity was higher.

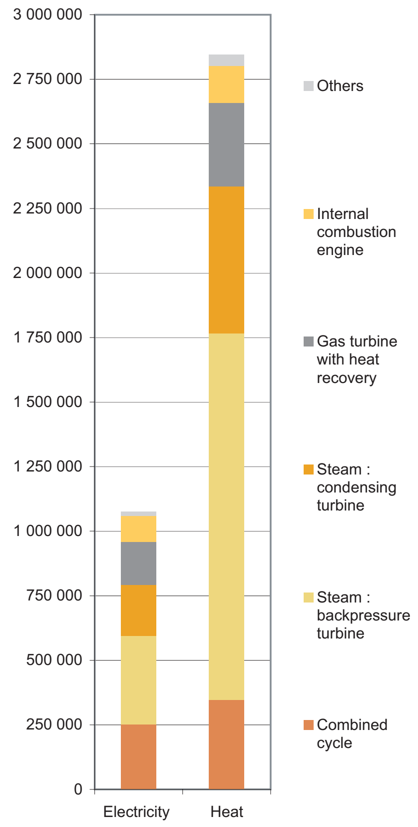
As mentioned at the beginning of this section, five basic technologies are used for combined heat and power generation. Graph 3.4 shows that the largest share for both electricity (32% - corresponding to 341 thousand TJ) and heat (50% - corresponding to 1 421 thousand TJ) was generated by steam backpressure plants. Combined-cycle plants generated 23% of CHP electricity and 12% of CHP heat. For heat, units with steam condensing turbines held a higher share (20%).

Steam condensing turbines widespread in new Member States

Tables 3.1 and 3.2 provide a detailed view of the CHP production figures by type of plant. Not all Member States have different CHP types. Steam backpressure units were responsible for 85% of Swedish CHP electricity production (8 522 GWh out of a total of 9 990 GWh) and combined-cycle plants had a particularly high share in the Netherlands, Luxembourg and the UK (around 55%). In the new Member States, steam condensing turbines are quite widespread: in CHP electricity generation, their share was 91% in Lithuania, 83% in Latvia and around 60% in Poland and the Czech Republic.

The split between public supply and autoproducers has been noted above. At EU level, 45% of CHP electricity generation and 58% of CHP heat production were accounted for by autoproducers, i.e. companies that, in addition to their main activities, generate electricity and heat for own use.

Figure 3.4: CHP energy generation in TJ: Share by type of technology, EU-25, 2002



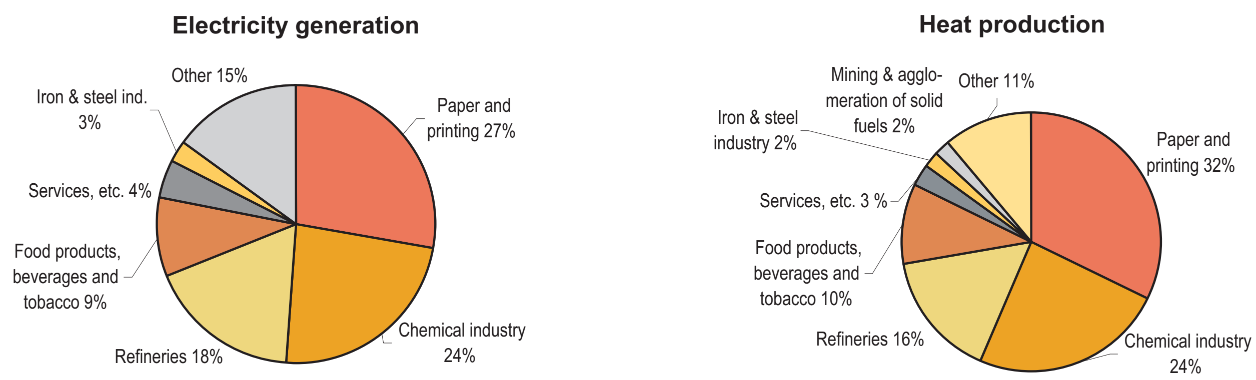
Paper and printing industry the largest CHP autoproducer

The share of autoproducers in total CHP production varies widely among the Member States. In Greece, Spain, Ireland and Luxembourg, all CHP units were operated by autoproducers. Conversely, the greater part of CHP output in the new Member States was produced by public supply operators, with the exception of heat production in Poland and Slovenia, where autoproducers have a higher proportion (55% and 59% respectively - see Table 3.2).

Graph 3.5 shows, separately for electricity generation and heat production, the main autoproducers in 2002.

Both for electricity and heat, the paper and printing industry, the chemical industry and refineries held the largest shares. However, not only industrial autoproducers were involved: the services sector accounted for 4% of CHP electricity generation and 3% of CHP heat production.

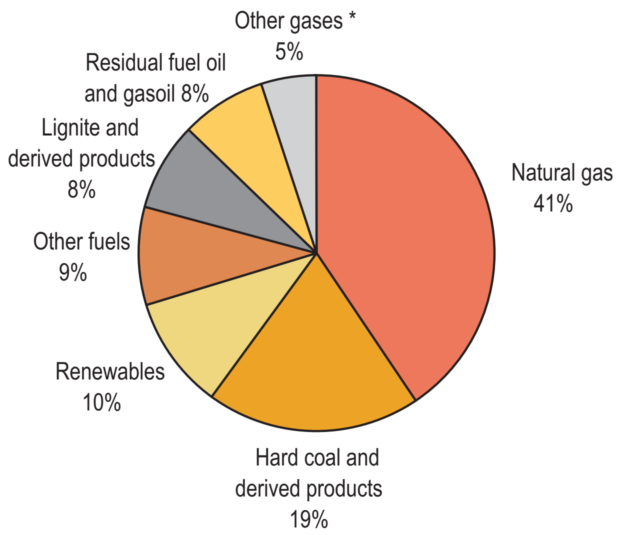
Figure 3.5: **CHP production by autoproducers, EU-25, 2002: share by economic activities**



Natural gas: Main fuel for CHP stations

CHP plants are thermal power plants and can be operated with a variety of fuels. Member States have provided data on fuel input by type of CHP plant.

Figure 3.6: **Fuel input in CHP plants, EU-25, 2002 - share in percent**



* Refinery gas, coke-oven gas, blast-furnace gas.

The information in Figure 3.6 is confined to the EU-25. It shows the proportions of fuels that entered CHP units in 2002, regardless of the technology used. Natural gas took the lion's share with 41% (based on the net calorific value expressed in TJ). Solid fuels are important too, with hard coal accounting for 19% and lignite for an additional 8%. 10% of the fuel input consisted of renewables.

Noticeable differences in thermal efficiency according to type of CHP plant

As mentioned at the beginning of this section, the main interest of CHP plants lies in their thermal efficiency and hence their potential to save energy and reduce emissions of greenhouse gases. Thermal efficiency is calculated by summing gross electricity generation and heat production and dividing the result by the fuel consumed.

The overall thermal efficiency of CHP plants at EU-25 level was 70% in 2002 (EU-15: 73% - see Table 3.7). Steam backpressure units and gas turbines with heat recovery were the most efficient with 76%, although the figure ranged from 37% to 88% across the individual Member States.

The lowest efficiency (57% at EU-25 level) was calculated for combined-cycle plants and steam condensing plants. Values in the individual Member States ranged from 34% for steam condensing plants to 92% for combined-cycle plants.

Table 3.7: **Thermal efficiency of CHP plants, 2002 - in percent**

	EU-25	EU-15	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV
Combined cycle	**57**	**68**	67	63	82	87	-	-	74	-	-	52	-	
Steam : backpressure turbine	**76**	**80**	77	58	87	77	68	69	77	82	74	86	-	81
Steam : condensing turbine	**57**	**63**	54	51	61	-	48	-	75	70	-	56	-	79
Gas turbine with heat recovery	**76**	**80**	79	53	85	86	-	74	75	78	76	78	-	88
Internal combustion engine	**71**	**75**	75	68	87	80	68	-	69	75	76	74	-	70
Others	**62**	**74**	-	-	-	83	-	-	-	-	-	-	-	-
All CHP plants	**70**	**73**	**74**	**59**	**71**	**79**	**60**	**72**	**74**	**79**	**76**	**61**	-	**79**

	LT	LU	HU	MT	NL	AT	PL	PT	SI	SK	FI	SE	UK
Combined cycle	-	92	57	-	74	62	63	-	-	51	87	85	68
Steam : backpressure turbine	81	-	83	-	88	68	83	73	37	42	82	82	77
Steam : condensing turbine	58	-	61	-	47	62	72	82	75	34	84	84	69
Gas turbine with heat recovery	-	-	78	-	83	83	60	79	82	61	85	82	73
Internal combustion engine	-	86	75	-	81	75	-	61	60	78	74	84	69
Others	-	-	-	-	-	-	-	67	90	:	-	80	-
All CHP plants	**61**	**89**	**75**	-	**71**	**65**	**74**	**74**	**50**	**36**	**83**	**82**	**69**

3.2 Renewable energy

Political framework for the development of statistics on renewable energy sources

In the late 1980s, the few statistics collected on renewable energy were often limited to the electricity generated in large hydro-electric power plants. To respond to the needs following Council Recommendation 88/349/EEC, the EU Member States were asked to establish, in collaboration with Eurostat, a data collection on renewable energy sources. A first collection was launched in 1990, funded by the EU.

Throughout the 1990s, Eurostat and the Member States proceeded to set up a harmonised system for renewables. Statistics continued to be collected, partially financed by Commission programmes.

In 2000, Member States agreed to undertake the data collection at their own cost and report the results to Eurostat. This was done through a new questionnaire, used in conjunction with other questionnaires on conventional fuels. The questionnaire on renewable energy sources is also used for data collection in countries beyond the EU Member States (joint questionnaire of the IEA, Eurostat and UNECE).

Specific targets

The European Commission's white paper on renewable energy (COM(97) 599 final), presented in 1997, called for the doubling of the share of renewable energy in national gross energy consumption from 6% in 1995 to 12% in 2010 (EU-15).

EU Directive 2001/77/EC aims to increase the share of electricity from renewable energy sources in total electricity consumption from 14% in 1997 to 21% in 2010. The Directive specifies indicative targets for each Member State (including those that were candidate countries at the time).

What is included under Renewable Energy Sources (RES)?

Renewable energies can be divided into the following categories:

- Hydropower
- Wind energy
- Solar energy
- Biomass and wastes
  - i.e.: municipal solid waste
    - wood and wood waste
    - other solid waste
    - liquid biofuels
    - biogas
- Geothermal energy

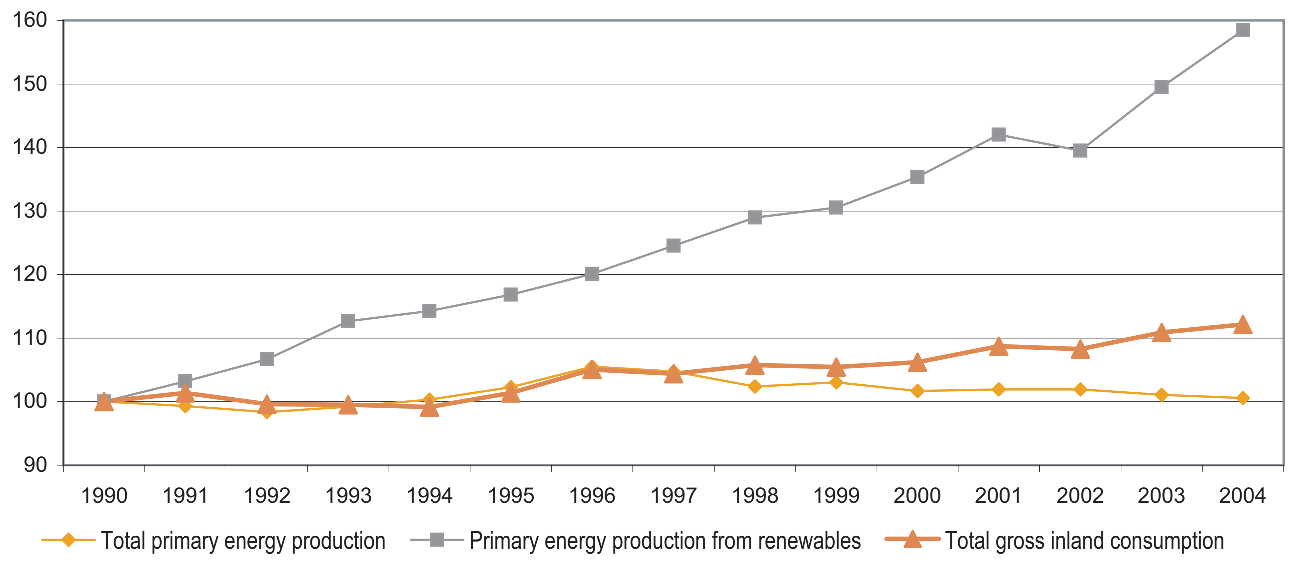
While hydro and wind are nearly exclusively used for electricity generation, biomass and solar and geothermal energy are mainly used for heat production. Most Member States use the incineration of municipal waste for electricity generation, but heat production is also quite widespread in France, Germany, Denmark and Sweden.

Electricity from hydro, wind and solar sources is considered to be primary energy production.

Figure 3.8 outlines the development (1990-2004) of the primary production of energy from renewable sources compared with total primary energy production and gross inland consumption.
Total primary energy production has remained quite stable, as in 2004 it was only 0.6% higher than in 1990, despite a relative peak in 1996.

However, primary production from renewables increased throughout the period under review. This increase is hardly reflected at all in the curve for total primary energy production.
Total gross inland energy consumption largely followed the same pattern as primary energy production up to 1997. The gap gradually widened in the following years, however, meaning that growing demand was largely covered by increasing energy imports.

Figure 3.8: Primary energy production 1990-2004, EU-25 (1990=100)



Impressive growth in Hungary, Lithuania and the Czech Republic

Table 3.9 shows primary energy production from renewable sources in the individual Member States, expressed in thousands of tonnes of oil equivalent (TOE). In 2004, the 108.8 million TOE produced from renewables at EU-25 level corresponded to 12% of total primary energy production and 6% of gross inland consumption. As mentioned earlier, primary production from renewables has increased by nearly 60% since 1990 and by 17% since 2000. Starting at a low level in absolute terms, relative growth since 2000 has been spectacular in the Czech Republic and Cyprus, but also in Hungary.

France was the largest producer of primary energy from renewables with 17.4 million TOE, followed by Sweden (14.1 million), Germany (13.7 million) and Italy (11.9 million).

In Cyprus, Latvia, Luxembourg and Portugal, renewable energy sources are the only indigenous source of energy production as their share in total primary production amounted to 100%. In the other countries, the situation varies considerably, depending on the existence of fossil fuel reserves and influenced by geographical specificities and national policies.

Table 3.9: Primary energy production 1990-2004, EU-25 (1990=100)

	1990	1995	2000	2002	2003	2004	2004: share in total primary energy prod.	2004: share in gross inland consumption	2004: share in EU-25 total
EU-25	**68 672**	**80 238**	**92 979**	**95 797**	**102 698**	**108 811**	**12**	**6**	**100**
EU-15	**64 032**	**71 611**	**84 037**	**85 363**	**91 787**	**97 145**	**13**	**6**	**89.3**
Belgium	649	599	641	666	896	955	7	2	0.9
Czech Republic	100	598	595	851	1 156	1 498	5	3	1.4
Denmark	1 198	1 533	2 044	2 305	2 564	2 734	9	14	2.5
Germany	5 716	6 342	9 735	11 599	12 293	13 755	10	4	12.6
Estonia	450	487	500	543	610	687	17	12	0.6
Greece	1 105	1 289	1 403	1 396	1 548	1 560	15	5	1.4
Spain	6 256	5 602	7 029	7 108	9 642	8 977	28	6	8.3
France	15 778	17 903	17 558	16 539	17 053	17 385	13	6	16.0
Ireland	168	165	258	288	261	325	17	2	0.3
Italy	6 391	7 540	8 548	8 631	10 134	11 882	42	6	10.9
Cyprus	6	42	45	45	42	97	100	4	0.1
Latvia	1 062	1 405	1 527	1 797	1 975	2 137	100	47	2.0
Lithuania	321	501	656	697	705	742	15	8	0.7
Luxembourg	47	47	57	56	60	73	100	2	0.1
Hungary	523	626	516	888	920	965	10	4	0.9
Malta	-	-	-	-	-	-	-	-	-
Netherlands	956	899	1 622	1 744	2 079	2 364	3	3	2.2
Austria	5 010	5 862	6 500	6 741	6 369	6 769	71	21	6.2
Poland	1 597	3 924	3 809	4 141	4 158	4 325	6	5	4.0
Portugal	2 692	2 602	3 109	3 643	4 336	3 894	100	15	3.6
Slovenia	254	542	788	757	714	822	24	12	0.8
Slovakia	328	503	506	715	632	392	7	2	0.4
Finland	5 272	6 132	7 803	7 847	7 944	8 862	57	24	8.1
Sweden	11 740	13 147	15 132	13 936	13 440	14 131	41	27	13.0
United Kingdom	1 054	1 950	2 599	2 864	3 168	3 479	2	1	3.2
Bulgaria	161	369	780	832	952	1 009	10	5	
Croatia	864	719	879	757	800	977	25	11	
Romania	2 606	2 797	4 040	3 748	4 061	4 661	16	12	
Turkey	9 658	10 776	10 149	10 077	10 036	10 783	45	13	
Iceland	1 400	1 390	2 306	2 462	2 457	2 519	100	72	
Norway	11 469	11 574	13 291	12 539	10 367	10 665	4	39	

Share of renewables in gross inland consumption: from 1% to 30%

Looking at the contribution of renewables to gross inland consumption, the proportion was 6.2% at EU-25 level in 2004 (1990: 4.4% - 2000: 5.6%). Here too, the shares in the various Member States varied considerably, ranging from only 1% or 2% in Belgium, Ireland, Luxembourg, Slovakia and the United Kingdom to 20 to 30% in Austria, Finland and Sweden. Latvia registered the highest proportion with 47%.

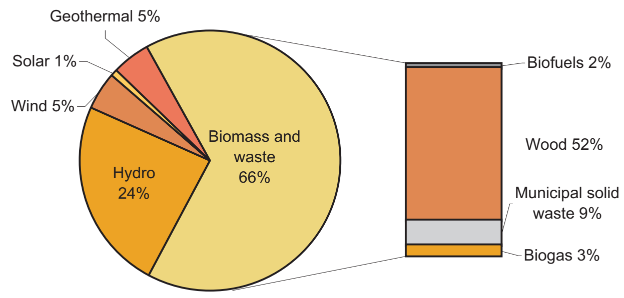
A breakdown of the 108.8 million TOE of primary energy produced by renewables within the EU-25 in 2004 is shown in Figure 3.10. Biomass and waste is clearly the most important category, contributing close to two thirds of the total, well ahead of hydro resources at slightly less than a quarter (24%).

Within the biomass and waste category, wood has by far the largest share (52%) followed by municipal solid waste (9%). Biogas and liquid biofuels have only minor shares (3% and 2% respectively).

Electricity generation from renewable sources: target of 21% by 2010 for EU-25

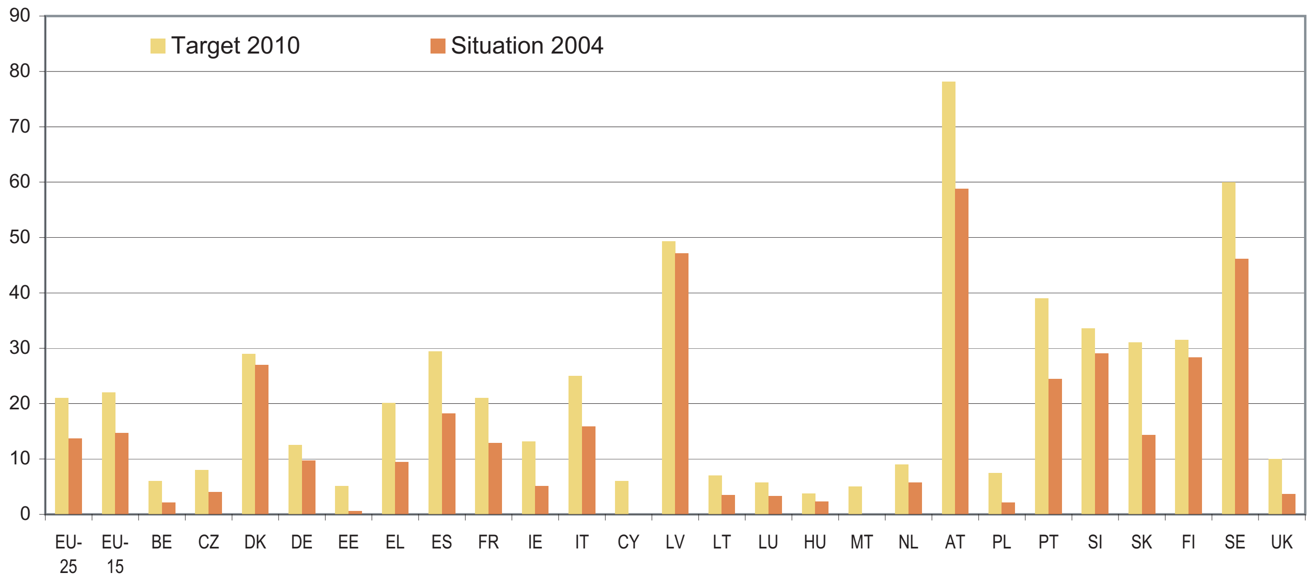
Heat production is mainly through the burning of biomass. Electricity generation from renewable energy sources is of far greater importance, especially in countries with major hydro sources.
Figure 3.11 looks at the share of electricity from renewable energy sources in total electricity consumption in 2004. The Figure also indicates what the share of electricity generated from renewable energy sources should be by 2010, as outlined in EU Directive 2001/77/EC (left column). This shows where countries stand compared to the targets fixed in the Directive.

Figure 3.10: Primary energy production from renewable energy sources - breakdown by individual source, 2004, EU-25



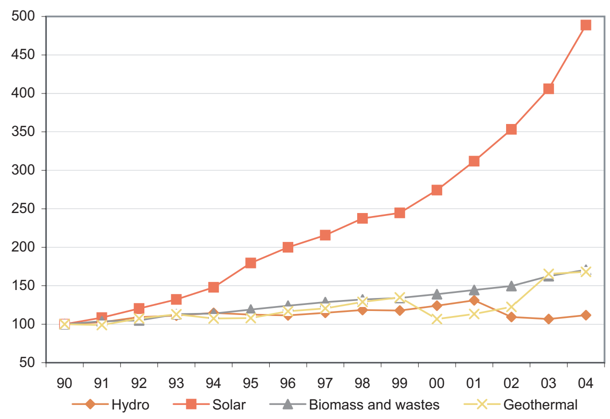
Looking at the shares of individual renewable sources, generation from hydro sources accounted for over 90% in six Member States (France, Austria, Latvia, Lithuania, Slovakia and Slovenia). In Denmark, Ireland and Germany, a substantial share of 'green' electricity was generated by wind turbines (65%, 48% and 43% respectively). Belgium, the Netherlands and Hungary reported substantial proportions produced by biomass (between 70% and 80%). Electricity from geothermal sources was of significant importance only in Italy (share of 10%) and from solar energy (photovoltaic power) only in Luxembourg (share of 4%).

Figure 3.11: Share of electricity from renewable energy sources in gross national electricity consumption in 2004 and target shares for 2010



Note: Cyprus and Malta reported no electricity generation from renewables in 2004.

Figure 3.12: Development of primary production from renewables 1990-2004, EU-25 (1990=100), basis: production in TOE



Note: Development of wind not covered in this graph.

Looking at the long-term development of primary production from individual resources, solar energy saw significant growth: in 2004, solar energy stood nearly five times higher than in 1990, corresponding to743 thousand TOE at EU-25 level, of which 36% was generated in Germany, 15% in Greece and 12% in Cyprus.

Nearly all geothermal energy in Italy

More than seven times the volume of solar energy was generated by geothermal sources (5.4 million TOE), but Italy was the only country where this source was relevant as it was responsible for 91% of the EU total (4.9 million TOE). The main increase was noted between 2002 and 2003, when geothermal energy production in Italy increased by nearly 40%.

70% of EU wind energy in only two Member States

The most noticeable increase was registered in primary production from wind energy (essentially electricity generated by wind turbines). Production at EU level increased from 67 thousand TOE in 1990 to 5.0 million TOE in 2004, a rise of 7 500%, which is why the curve cannot be displayed on the scale of Figure 3.12. Germany and Spain are the Member States largely responsible for this remarkable development, accounting respectively for 43% and 27% of the EU total in 2003. Denmark, still the leader in wind energy generation in absolute terms during the early 1990s, steadily increased its output throughout the period observed and was responsible for 11% of EU production in 2004.

As noted above, hydro power is responsible for nearly one quarter of primary energy production from renewables. Figure 3.12 shows that hydro energy generation saw only a limited increase throughout the 1990s. A significant decrease was registered in 2002 and 2003, but production increased again in 2004. In that year, production figures stood twelve index points above those for 1990.

Low hydro production figures reflect dry years

Hydro power generation is particularly subject to climatic conditions. Years with little rainfall will limit the production potential of hydro-electric power plants and will require 'compensation' from other energy sources or higher imports. The years 2002 and 2003 were particularly dry in large parts of Europe and noticeable decreases in hydro-power generation were observed in a number of Member States (see Table 3.13). Indeed, primary production from hydro sources at EU-25 level decreased by 16% in 2002 compared to 2001. 2003 saw yet another decrease of 2% compared to 2002. Germany, Italy, Austria, Slovakia and the Scandinavian Member States registered noticeable drops in production figures.

Figure 3.10 shows that at EU level hydro power accounted for 24% of primary energy production from renewables in 2004. In Member States with abundant hydro energy resources, however, this share was much higher. This was particularly the case in Slovakia (90%), Austria (46%) and Slovenia (43%).

The last column in Table 3.13 looks at the energy volume produced in absolute terms and shows the share of the individual Member States in primary energy production from hydro sources in 2003. France and Sweden were both responsible for close to 20% of the total hydro energy produced, followed by Italy (14%), Austria (12%) and Spain (12%).

Primary energy produced from biomass and wastes exceeded that from hydro resources by a factor of 2.7 in 2004 (71.6 million TOE as against 26.1 million TOE - see Table 3.14). Compared with 1990, the energy obtained from biomass and wastes increased steadily by 71%. In absolute terms, France had the largest share with 17% of the EU total, followed by Germany (13%) and Sweden (12%). In relative terms, Belgium, Latvia, the Netherlands and Portugal, but especially the Czech Republic, Italy and Hungary, have considerably increased their production since 2000.

Table 3.13: Primary energy production from hydro sources, in 1000 TOE

	1990	2000	2004	2004: share in total prim. energy prod. from RES	2004: share in EU-25 total
EU-25	**23 365**	**29 000**	**26 128**	**24**	**100**
EU-15	**22 274**	**27 645**	**24 748**	**25**	**94.7**
BE	23	39	27	**3**	**0.1**
CZ	100	151	174	**12**	**0.7**
DK	2	2	2	**0**	**0.0**
DE	1 385	1 995	1 812	**13**	**6.9**
EE	0	0	2	**0**	**0.0**
EL	152	318	402	**26**	**1.5**
ES	2 184	2 534	2 713	**30**	**10.4**
FR	4 635	5 823	5 179	**30**	**19.8**
IE	60	73	54	**17**	**0.2**
IT	2 719	3 812	3 671	**31**	**14.1**
CY	-	-	-	-	**0.0**
LV	387	242	267	**12**	**1.0**
LT	36	29	36	**5**	**0.1**
LU	6	10	9	**12**	**0.0**
HU	15	15	18	**2**	**0.1**
MT	-	-	-	-	**0.0**
NL	7	12	8	**0**	**0.0**
AT	2 709	3 598	3 132	**46**	**12.0**
PL	139	181	179	**4**	**0.7**
PT	787	974	849	**22**	**3.2**
SI	254	330	352	**43**	**1.3**
SK	162	406	353	**90**	**1.4**
FI	934	1 261	1 296	**15**	**5.0**
SE	6 234	6 757	5 170	**37**	**19.8**
UK	436	437	424	**12**	**1.6**
BG	161	230	272	**27**	
HR	322	505	598	**61**	
RO	1 460	1 271	1 420	**30**	
TR	1 990	2 655	3 963	**37**	
IS	361	547	613	**24**	
NO	10 437	11 945	9 353	**88**	

Table 3.14: Primary energy production from biomass and wastes, in 1000 TOE

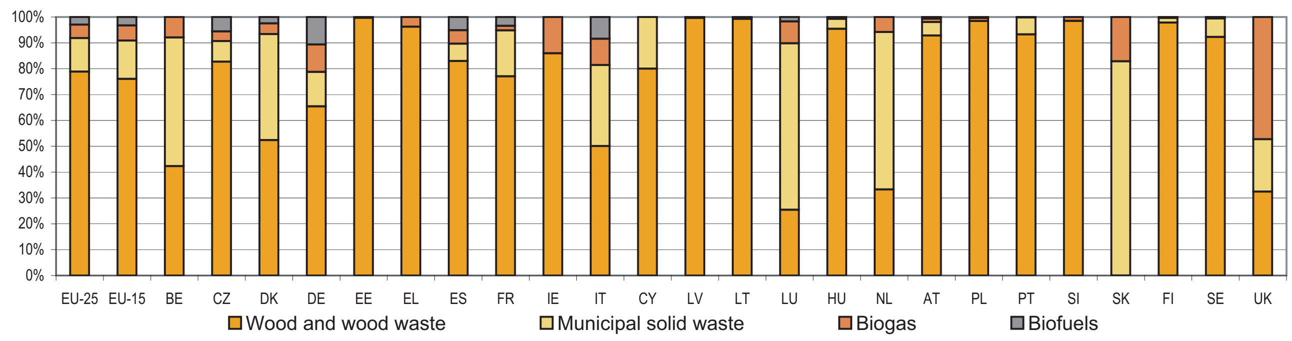
	EU-25	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV	LT	LU	HU	NL	AT	PL	PT	SI	SK	FI	SE	UK
1990	41898	623	0	1140	4307	450	893	4047	11014	108	696	6	675	285	41	422	942	2283	1458	1891	0	166	4338	5502	611
1995	49879	567	426	1423	4447	486	898	3563	11434	102	1115	11	1153	469	39	526	860	2636	3762	1831	263	76	5021	7277	1494
2000	58246	596	444	1668	6830	500	946	4049	11579	164	1572	9	1284	627	44	415	1529	2819	3625	2053	458	100	6536	8330	2069
2002	62725	627	637	1872	7929	542	996	4328	11134	176	1637	10	1584	666	44	784	1642	3204	3933	2838	465	260	6915	8174	2327
2003	68059	864	1036	2073	8643	608	945	5018	11739	170	2012	6	1776	677	51	818	1940	3411	3996	2842	460	331	7112	8773	2759
2004	71547	913	1324	2154	9367	685	953	4853	12007	214	3145	5	1866	706	59	860	2175	3452	4126	2877	470	35	7556	8883	2863
Share in EU-25 total (%)																									
2004	*100*	*1.3*	*1.9*	*3.0*	*13.1*	*1.0*	*1.3*	*6.8*	*16.8*	*0.3*	*4.4*	*0.0*	*2.6*	*1.0*	*0.1*	*1.2*	*3.0*	*4.8*	*5.8*	*4.0*	*0.7*	*0.0*	*10.6*	*12.4*	*4.0*

Benelux: mainly municipal solid waste

The picture is more interesting when we look at the various elements that make up the 'biomass and wastes' category (see Figure 3.15). While bearing in mind the large differences in actual energy produced, wood and wood waste (burned either in households or in district-heating or electricity generating power plants) is clearly the most important element in the mix, except for the Benelux countries, where municipal solid waste took the highest share.

The large production figures registered in Finland and Sweden were mainly achieved with wood and wood waste, widely available in those countries. Biogas and biofuels generally play a minor role, except in the United Kingdom, where biogas had a share of 42%.

Figure 3.15: Primary energy production from biomass and wastes: share by category, 2004 - in %



3.3 Temperature correction for final energy consumption

Outdoor temperatures directly affect energy consumption for space heating purposes, particularly in the domestic sector. Natural gas or heating oil bills for instance will be noticeably higher in severe winters, and air conditioning units will boost electricity bills during hot summers, especially in southern European countries.

Correct measurement of policy goals

Temperature-corrected energy consumption data are useful as they allow the correct interpretation of energy consumption trends and provide an accurate basis for designing and measuring policy goals.

In 1996, the European Commission asked for an assessment of climatic correction methods applied in various Member States (carried out by the *Deutsches Institut für Wirtschaftsforschung*). Eurostat presented the findings to the Energy Statistics Committee in 1998 and proposed a common method for heating-temperature correction, which was approved in principle by the Member States (the 'constant heating share approach').

In order to implement a temperature correction for final energy consumption, the following elements must be known:

- Actual final energy consumption (available from the regular annual data collections)

- The share of energy used for space heating (ratio between the energy consumed for space heating in a specific sector and the energy consumed for all uses in the same sector)

- The number of heating degree-days (severity of the cold in a specific time period, taking into account the outdoor temperature and the room temperature).

The constant heating share approach is based on the following formula:

$$E_{nt} = E_t / (b \cdot d_t + 1 - b)$$

or equivalent

$$E_{nt} = E_t / [1 + b (d_t - 1)]$$

where

E_{nt} : temperature-corrected energy consumption

E_t : actual energy consumption

b : heating share

d_t : relative degree-days

Space heating shares

The space heating share has in most cases been calculated on the basis of supplementary information supplied by the Member States.

Heating degree-days

To ensure a common and comparable basis, the following method is used to calculate heating degree-days:

(18°C - T_m) x d if T_m is lower or equal to 15°C and are nil if T_m is greater than 15°C

where 15°C is the heating threshold and Tm is the mean (T_{min} + T_{max} / 2) outdoor temperature over a period of d days.

Relative heating degree-days are in turn defined as the ratio of actual degree-days to long-term average degree-days.

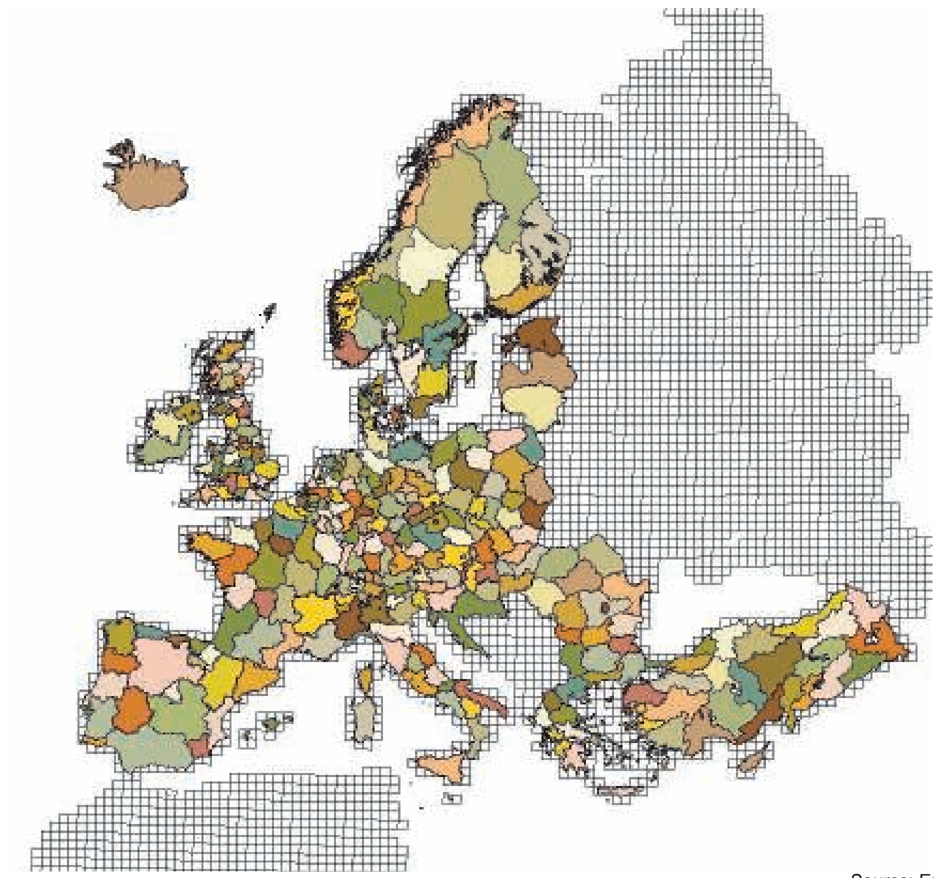
A relatively long base period is desirable to balance out the influence of short-term changes in mean temperatures.

Furthermore, the degree-days and relative degree-days have to be calculated at regional level (temperature data sets from a large number of individual weather stations). Finally, the relative degree-days are weighted by population. A case study (United Kingdom) allowed us to measure the precision of two different regional levels. Although the observed differences were not significant, the more detailed regional level was finally chosen, as many public, private and academic users expressed their interest in obtaining such figures.

Collaboration with the Joint Research Centre

The raw temperature data from 1500 weather stations are collected and processed by the Joint Research Centre (JRC) - IPSC / Agrifish Unit / MARS-STAT Action. Using a fine grid (50 km x 50 km), the JRC applies a meteorological model to establish the best set of weather stations for the interpolation of temperature data (see Map 3.16) at regional level (according to NUTS - Nomenclature des unités territoriales statistiques). Once this selection has been made, the actual interpolation consists of a simple average, corrected for altitude difference.

Map 3.16: Overlay of administrative regions (according to NUTS nomenclature) on the JRC fine grid



Source: Eurostat / JRC IPSC

After the calculation of representative daily temperature data (maximum, minimum and mean temperature) for each grid cell, daily temperature sets are compiled for all the relevant administrative regions to produce area-weighted averages. A further refinement through weighting by population is than made using the average annual regional population data available to Eurostat.

The result is the calculation of the monthly and annual actual degree-days for the country aggregate on the basis of administrative regions weighted by population, together with the calculation of relative degree-days weighted by population, taking as a reference period the years 1980 to 2004.

Calculation of temperature-corrected energy consumption

The temperature-corrected consumption figures, broken down individually for each type of fuel/product used, cover only three sectors: industry, households and services, since, under the model hypothesis, these are the only sectors influenced by temperature variations as regards energy consumed for space heating purposes. Consumption in the transport and other sectors is not corrected.

Taking the final energy consumption of solid fuels in the industrial sector as an example, the following formula is applied:

$$FEC_{TempCorrIndSolids} = FEC_{IndSolids} / (b_{Indsolids} \times d_t + 1 - b_{IndSolids})$$

where $FEC_{IndSolids}$ is the actual solid fuel energy consumed in the industry sector, $b_{IndSolids}$ is the space heating share for solid fuels in the industry sector and d_t the relative weighted heating degree-days.

It should be noted that the category 'solid fuels' comprises various products (such as hard coal, brown coal, peat, etc.) and that the formula is individually applied to each product.

Similar calculations as in the box above are performed for the other fuels such as gas, heating oil, electricity, derived heat, renewables, etc. At the end of this process, the temperature-corrected energy consumption for the industry sector is obtained by adding together the individual values. An identical approach is used for the final energy consumption of the services sector and that of households.

By adding the temperature-corrected energy consumption values for industry, services and households to those (non-corrected) for transport and other sectors, the overall temperature-corrected final energy consumption is obtained.

Space heating shares: highly individual by country

The data for the space heating shares were requested only as a one-off effort. For the time being, the figures obtained are considered constant heating shares, as the values are not likely to change much over time. Nevertheless, a revision of the data should be considered after a couple of years.

The data in Table 3.17 are the result of a formal consultation of the Member States launched by Eurostat at the beginning of 2006. However, it should be noted that in a few cases, Eurostat has estimated the space heating shares. Those are marked as such in the table.

Within the 'households' category in Belgium, the share of natural gas has a value of 0.78. This means that 78% of the total quantity of natural gas used by Belgian households is used for space heating. The remaining 22% is used for other purposes such as cooking or hot water supply. Again for Belgian households, solid fuels register a value of 0.98, i.e. 98% of the solid fuels used by Belgian households are used for space heating.

In the 'services' category, 3% of the electricity used in the services sector in Denmark was for space heating purposes, but the equivalent value for Austria was 19% and that for Greece 54%.

Table 3.17: Space heating shares, average values, by energy source

	BE	CZ	DK	DE	EE	EL	ES	FR	IE	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	SI	SK	FI	SE	UK
Households																									
Fuel oil/gas oil	0.93	1.00	0.81	0.91	1.00	0.98	0.75	0.89	0.80	0.94	*0.00*	0.00	0.78	0.92	1.00	*0.00*	0.83	0.93	0.90	0.35	0.90	0.00	0.70	0.61	0.73
Natural gas	0.78	0.83	0.77	0.85	0.28	0.86	0.27	0.81	0.70	0.80	*0.00*	0.21	0.48	0.82	0.76	*0.00*	0.77	0.76	0.45	0.00	0.58	0.85	0.70	0.67	0.70
Electricity	0.27	0.26	0.18	0.18	0.32	0.16	0.14	0.39	0.13	0.03	*0.10*	0.06	0.02	0.23	0.14	*0.10*	0.05	0.16	0.07	0.06	0.23	0.10	0.30	0.38	0.18
Solid fuels	0.98	0.97	0.87	0.94	0.75	0.98	0.86	0.98	0.87	0.87	*0.00*	0.96	0.82	0.76	0.91	*0.00*	0.82	0.94	0.91	0.56	0.88	0.96	0.70	0.00	0.77
Wood	0.98	0.93	0.87	0.87	0.57	0.87	1.00	0.91	0.86	1.03	*0.00*	0.91	0.86	0.83	0.78	*0.00*	1.00	0.91	0.89	0.36	0.78	0.91	0.70	0.67	0.64
LPG & manuf. gas	0.48	0.43	0.60	0.24	0.19	0.20	0.25	0.34	0.25	0.61	*0.10*	0.00	0.00	0.33	0.07	*0.10*	0.83	0.93	0.05	0.01	0.12	0.02	0.20	0.61	0.00
District heating	1.00	0.81	0.81	0.89	0.90	0.00	0.00	0.88	0.00	0.00	*0.00*	0.80	0.90	1.00	0.81	*0.00*	0.87	0.81	0.85	0.00	0.84	0.81	0.70	0.56	0.00
Other fuels	0.00	0.00	0.81	0.00	0.00	0.00	1.00	0.00	0.00	0.93	*0.00*	0.00	0.00	1.00	0.00	*0.00*	0.00	0.58	0.00	0.00	0.00	0.00	0.70	0.00	0.00
All fuels	0.77	0.77	0.67	0.77	0.72	0.76	0.55	0.75	0.68	0.68	*0.00*	0.78	0.75	0.73	0.71	*0.00*	0.68	0.74	0.75	0.18	0.72	0.00	0.59	0.51	0.60
Services																									
Fuel oil/gas oil	1.00	1.00	0.61	0.72	0.23	0.89	0.72	0.82	0.87	0.91	*0.00*	0.76	0.85	*0.72*	0.76	*0.00*	0.89	0.92	0.95	0.90	*0.91*	0.95	0.80	0.76	0.84
Natural gas	0.84	0.80	0.76	0.66	0.58	0.90	0.53	0.74	0.87	0.83	*0.00*	0.94	0.95	*0.66*	0.79	*0.00*	0.85	0.83	0.70	0.00	*0.83*	0.89	0.80	0.57	0.76
Electricity	0.04	0.20	0.03	0.10	0.00	0.54	0.09	0.20	0.08	0.08	*0.10*	0.01	0.02	*0.10*	0.01	*0.10*	0.06	0.19	0.10	0.14	*0.08*	0.13	0.09	0.11	0.18
Solid fuels	1.00	1.00	0.83	0.92	0.60	1.00	0.23	0.00	0.90	0.00	*0.00*	0.96	0.93	*0.92*	0.99	*0.00*	0.85	0.88	0.95	0.00	*0.00*	0.96	0.80	0.37	0.98
Wood	0.00	1.00	0.83	0.00	0.45	1.00	0.26	0.00	0.00	0.00	*0.00*	0.98	0.97	*0.00*	0.75	*0.00*	1.00	0.89	0.90	0.90	*0.00*	0.93	0.80	0.37	0.98
LPG & manuf. gas	1.00	0.40	0.53	0.00	0.41	1.00	0.00	0.00	0.00	0.60	*0.10*	0.15	0.20	*0.87*	0.82	*0.10*	0.85	0.87	0.20	0.90	*0.60*	0.40	0.20	0.00	0.00
District heating	0.00	0.80	0.85	0.87	0.90	0.90	0.00	0.00	0.00	0.90	*0.00*	0.95	0.96	*0.00*	0.88	*0.00*	0.89	0.99	0.90	0.00	*0.90*	0.86	0.80	0.85	0.00
Other fuels	1.00	0.00	0.73	0.00	0.00	0.00	0.54	0.73	0.00	0.60	*0.00*	0.00	0.00	*0.00*	0.00	*0.00*	1.00	0.85	0.00	0.36	*0.60*	0.00	0.80	0.43	0.00
All fuels	0.69	0.75	0.45	0.47	0.41	0.63	0.20	0.55	0.61	0.62	*0.00*	0.91	0.58	*0.47*	0.68	*0.00*	0.81	0.62	0.75	0.36	*0.62*	0.61	0.64	0.47	0.57
Industry																									
Fuel oil/gas oil	0.00	0.10	0.25	0.34	0.13	*0.44*	*0.44*	0.44	0.25	0.44	*0.00*	0.59	0.31	*0.34*	0.10	*0.00*	0.04	0.56	0.01	*0.44*	0.25	0.29	0.50	0.39	0.19
Residual fuel oil	0.00	0.00	0.07	0.64	0.58	*0.07*	*0.07*	0.07	0.00	0.07	*0.00*	0.25	0.07	*0.64*	-	*0.00*	0.04	0.15	0.20	*0.07*	0.30	0.02	0.15	0.01	0.00
Natural gas	0.10	0.30	0.15	0.15	0.25	*0.16*	*0.16*	0.16	0.26	0.16	*0.00*	0.22	0.22	*0.15*	0.19	*0.00*	0.09	0.15	0.02	*0.16*	0.14	0.54	0.02	0.41	0.17
Electricity	0.00	0.01	0.01	0.01	0.00	*0.00*	*0.00*	0.00	0.00	0.00	*0.00*	0.01	0.01	*0.01*	0.01	*0.00*	0.02	0.02	0.01	*0.00*	0.00	0.03	0.05	0.08	0.04
Solid fuels (excl. coke	0.00	1.00	0.00	0.01	0.21	*0.00*	*0.00*	0.00	0.00	0.00	*0.00*	0.16	0.03	*0.01*	0.04	*0.00*	0.01	0.01	0.15	*0.00*	0.00	0.33	0.02	0.00	0.22
Coke	0.00	0.00	0.00	0.00	0.00	*0.00*	*0.00*	0.00	0.00	0.00	*0.00*	0.00	0.00	*0.00*	0.00	*0.00*	0.00	0.00	0.01	*0.00*	0.00	0.01	0.00	0.00	0.00
Wood	0.00	1.00	0.26	0.00	0.63	*0.00*	*0.00*	0.00	0.00	0.00	*0.00*	0.34	0.22	*0.00*	0.00	*0.00*	0.50	0.06	0.20	*0.00*	0.10	0.57	0.01	0.01	0.22
LPG & manuf. gas	0.00	0.00	0.06	0.00	0.72	*0.24*	*0.24*	0.24	0.00	0.24	*0.00*	0.10	0.01	*0.00*	0.05	*0.00*	0.01	0.03	0.01	*0.24*	0.42	0.12	0.01	0.02	0.00
District heating	0.00	0.00	0.37	0.50	0.90	*0.00*	*0.00*	0.00	0.00	0.00	*0.00*	0.34	0.26	*0.50*	0.24	*0.00*	0.06	0.48	0.10	*0.00*	0.30	0.65	0.80	0.44	0.00
Other fuels	0.00	0.00	0.06	0.03	0.00	*0.00*	*0.00*	0.00	0.00	0.00	*0.00*	0.00	0.00	*0.03*	0.06	*0.00*	0.01	0.01	0.35	*0.00*	0.19	0.00	0.02	0.00	0.00
All fuels	0.10	0.37	0.11	0.10	0.34	*0.12*	*0.12*	0.12	0.14	0.12	*0.00*	0.29	0.16	*0.10*	0.13	*0.00*	0.10	0.07	0.05	*0.12*	0.00	0.30	0.18	0.05	0.13

Note: The data included in this table have been obtained/calculated on the basis of Member State replies to Eurostat's formal request in 2006. Eurostat estimates are in italics.

Heating degree-days: range from 564 to 5 823

Following the assessment of the climatic data according to the methodology described above, the annual number of heating degree-days over a long-term observation period (1980-2004) was found to be 3 386 at EU-25 level (see Table 3.18). Unsurprisingly, the individual figures for the Member States vary considerably: the highest number of degree-days was found in Finland with a long-term average of 5 823 degree-days, followed by Sweden (5 423) and Estonia (4 420). The lowest numbers were seen in Malta (564), Cyprus (787) and Portugal (1 302).

Table 3.18 shows the individual heating degree-days for the 25 Member States from 2000 to 2004 along with the long-term average. It may be recalled that the relative degree-days are calculated as the ratio between the actual degree-days and the long-term average degree-days. This ratio indicates whether a given year was colder or warmer compared to the average.

Figure 3.19 shows the relative heating degree-days for the EU-25, together with the two 'extreme cases' Finland and Malta, for the period 1980 to 2004. Values under 1 indicate a relatively mild year whereas values over 1 point to 'colder than average' years.

The more 'up-and-down' pattern for Malta shows that, in relative terms, climatic fluctuations around the long-term average are indeed stronger for that country than in Finland.

eurostat

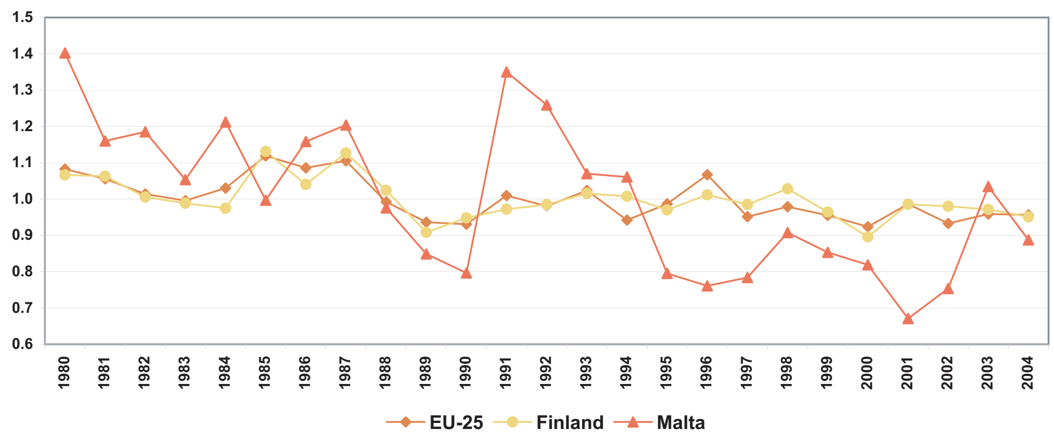
Table 3.18: Heating degree-days

	Actual heating degree days					Long-term average 1980-2004
	2000	2001	2002	2003	2004	
EU-25	**3 128**	**3 340**	**3 159**	**3 247**	**3 239**	**3 386**
Belgium	2 534	2 736	2 552	2 711	2 798	2 882
Czech Republic	3 096	3 553	3 262	3 455	3 472	3 559
Denmark	3 080	3 424	3 130	3 287	3 274	3 479
Germany	2 797	3 124	2 974	3 135	3 186	3 244
Estonia	3 906	4 345	4 271	4 421	4 306	4 420
Greece	1 565	1 542	1 519	1 732	1 567	1 698
Spain	1 814	1 750	1 629	1 770	1 915	1 856
France	2 242	2 385	2 187	2 361	2 480	2 494
Ireland	2 823	2 834	2 739	2 665	2 730	2 916
Italy	1 959	1 833	1 820	1 971	2 010	2 085
Cyprus	800	586	658	728	763	787
Latvia	3 739	4 157	4 052	4 245	4 213	4 243
Lithuania	3 571	3 935	3 829	4 076	4 047	4 071
Luxembourg	2 793	3 046	2 843	2 953	3 172	3 216
Hungary	2 482	2 814	2 648	3 078	2 872	2 917
Malta	462	378	425	583	500	564
Netherlands	2 492	2 726	2 602	2 766	2 774	2 905
Austria	3 183	3 507	3 248	3 474	3 561	3 569
Poland	3 094	3 580	3 347	3 602	3 518	3 605
Portugal	1 291	1 264	1 162	1 261	1 368	1 302
Slovenia	2 567	2 856	2 668	3 039	3 049	3 044
Slovakia	3 006	3 393	3 200	3 458	3 387	3 440
Finland	5 215	5 741	5 706	5 658	5 536	5 823
Sweden	4 932	5 394	5 180	5 227	5 268	5 423
United Kingdom	3 247	3 369	3 141	3 084	3 075	3 354

Source: Eurostat / JRC IPSC

In a small country such as Malta, a national value for heating degree-days will be sufficient to calculate temperature-corrected energy consumption. In larger countries, regional data are of importance as the climate varies by region. The example of Finland also illustrates the importance of weighting by population. The north of Finland has a very cold climate but the population density is very low. The Finnish population is concentrated in the south of the country where winters are (relatively speaking) less severe. For the space heating shares, the importance of weighting by regional population then becomes evident.

Figure 3.19: Relative heating degree-days 1980 - 2004, EU-25, Finland and Malta



Source: Eurostat / JRC IPSC

The example of Germany

For illustrative purposes (as this publication cannot possibly include actual heating degree-days for all European regions), Table 3.20 shows the regional monthly heating degree-days for Germany in 2004. It depicts the levels at which information is available EU-wide.

Looking at the example for Germany, the regional data show a fairly wide range: the lowest number of heating degree-days in 2004 (2 775) was found for the Düsseldorf region in the federal state of Nordrhein-Westfalen (which enjoys a maritime climate), whereas the highest number was calculated for the Chemnitz region (3 554) in the federal state of Sachsen (with a more continental climate).

A complete set of regional data is available on the CD-ROM accompanying this publication.

Table 3.20: Heating degree-days in German regions, 2004, by month

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	**Annual**
Deutschland	**561**	**453**	**415**	**245**	**184**	**60**	**29**	**11**	**89**	**219**	**401**	**519**	**3 186**
Stuttgart	558	464	417	234	178	44	21	7	86	201	412	552	3 173
Karlsruhe	529	442	396	211	156	35	14	3	70	189	393	532	2 971
Freiburg	527	453	415	240	180	44	19	13	82	186	406	537	3 102
Tübingen	587	487	449	276	211	57	28	20	96	214	432	571	3 428
Oberbayern	585	487	446	256	195	56	26	10	88	208	431	579	3 367
Niederbayern	622	493	464	250	197	58	33	9	104	240	435	594	3 497
Oberpfalz	622	476	452	255	200	56	27	13	113	248	431	587	3 481
Oberfranken	615	481	450	262	216	79	46	16	121	251	431	580	3 548
Mittelfranken	577	455	433	249	192	54	23	4	98	225	422	564	3 294
Unterfranken	568	442	414	226	177	47	25	10	93	224	403	547	3 176
Schwaben	606	484	461	283	218	75	39	19	103	221	444	589	3 541
Berlin	579	457	391	235	141	45	13	7	91	222	395	482	3 057
Brandenburg-Nordost	598	466	402	249	150	56	17	4	96	230	400	481	3 150
Brandenburg-Südwest	591	445	395	240	153	40	7	7	86	220	394	491	3 069
Bremen	525	425	389	233	182	57	29	19	78	212	374	461	2 982
Hamburg	537	458	404	250	180	60	30	19	87	231	386	463	3 105
Darmstadt	520	413	390	202	157	27	14	6	68	206	387	529	2 921
Giessen	552	439	416	238	196	67	36	15	99	233	409	552	3 251
Kassel	569	453	427	258	214	80	49	17	114	244	417	559	3 400
Mecklenburg-Vorpommern	587	461	411	263	169	70	27	8	79	228	390	460	3 152
Braunschweig	552	444	406	247	189	70	41	15	89	225	390	497	3 165
Hannover	528	425	396	230	178	61	25	14	80	210	379	476	3 003
Lüneburg	536	454	400	238	180	55	29	15	83	229	381	467	3 068
Weser-Ems	503	420	386	230	176	54	21	18	70	200	365	463	2 906
Düsseldorf	475	408	369	209	159	53	18	3	63	173	361	485	2 775
Köln	497	417	395	237	184	76	37	11	81	201	385	516	3 037
Münster	484	412	381	214	179	62	18	7	69	185	371	476	2 859
Detmold	515	438	402	233	190	68	30	12	81	200	385	489	3 044
Arnsberg	530	448	416	250	212	88	50	17	95	219	403	524	3 252
Koblenz	535	437	410	241	188	73	37	12	85	218	405	546	3 187
Trier	544	442	412	243	186	73	42	23	90	224	413	551	3 242
Rheinhessen-Pfalz	516	418	386	204	155	34	14	3	60	189	386	527	2 893
Saarland	531	423	396	222	166	58	29	14	74	202	397	540	3 054
Chemnitz	620	483	455	271	222	86	50	15	123	245	430	555	3 554
Dresden	615	459	419	243	178	56	16	7	95	227	402	518	3 236
Leipzig	554	459	403	243	170	52	15	7	84	209	394	499	3 087
Dessau	585	432	392	233	157	37	14	7	79	209	385	492	3 022
Halle	553	438	406	241	185	57	27	7	87	212	392	509	3 114
Magdeburg	558	447	402	245	166	48	28	8	89	223	386	484	3 084
Schleswig-Holstein	546	467	413	264	189	80	42	19	84	236	378	454	3 171
Thüringen	580	461	430	259	216	77	49	15	108	231	415	546	3 389

Source: Eurostat / JRC IPSC

Calculation after lengthy preparation

Once all the necessary information has been gathered, temperature-corrected consumption figures can be calculated. For example, the electricity consumption of households in Belgium amounted to 2 282 thousand TOE in 2004. 27% of the electricity consumed by households in Belgium is used for space heating purposes, so the share of space heating in this category is 0.27 (see Table 3.17). The assessment of the meteorological data for the year 2004 yields a figure of 0.971 for relative degree-days over Belgium as a whole, thus indicating a slightly milder winter than the long-term average.

Applying the formula mentioned earlier

$$FEC_{TempCorrHouseholdElec} = FEC_{HouseholdElec} / (b_{HouseholdElec} \times d_t + 1 - b_{HouseholdElec})$$

the result is as follows:

$$FEC_{TempCorrHouseholdElec} = 2\,282 / (0.27 \times 0.971 + 1 - 0.27)$$
$$FEC_{TempCorrHouseholdElec} = 2\,282 / 0.99217$$
$$FEC_{TempCorrHouseholdElec} = 2\,300$$

If 2004 had been an average year in temperature terms, the electricity consumption of households in Belgium would have amounted to 2 300 TOE and not the 2 282 TOE actually recorded.

This principle has to be applied for all types of fuels used for space heating purposes. The result for households in Belgium is represented in Figure 3.21.

The example illustrates only one component in the entire calculation, as the basic formula for the 'constant heating share approach' (as described earlier) is applied to each individual component of each of the sums

$FEC_{TempCorrIndustryAllProd}$,
$FEC_{TempCorrHouseholdsAllProd}$ and
$FEC_{TempCorrServicesAllProd}$.

Total final energy consumption includes only these three temperature corrections, since, as mentioned earlier, the two other elements remain unchanged: the final energy consumption of the transport sector and that of 'other sectors'.

Hence,

$$FEC_{TempCorrAllProd} = FEC_{TempCorrIndustryAllProd} \text{ plus } FEC_{TransportAllProd} \text{ plus } FEC_{TempCorrHouseholdsAllProd} \text{ plus } FEC_{TempCorrServicesAllProd} \text{ plus } FEC_{OtherSectorsAllProd}$$

Figures 3.22 and 3.23 show the results of the temperature correction for consumption in industry and services in Belgium, respectively. Finally, Graph 3.24 looks at all sectors and gives the overall result of the temperature correction exercise.

Figure 3.21: Belgium: final energy consumption (all products) of households (1000 TOE)

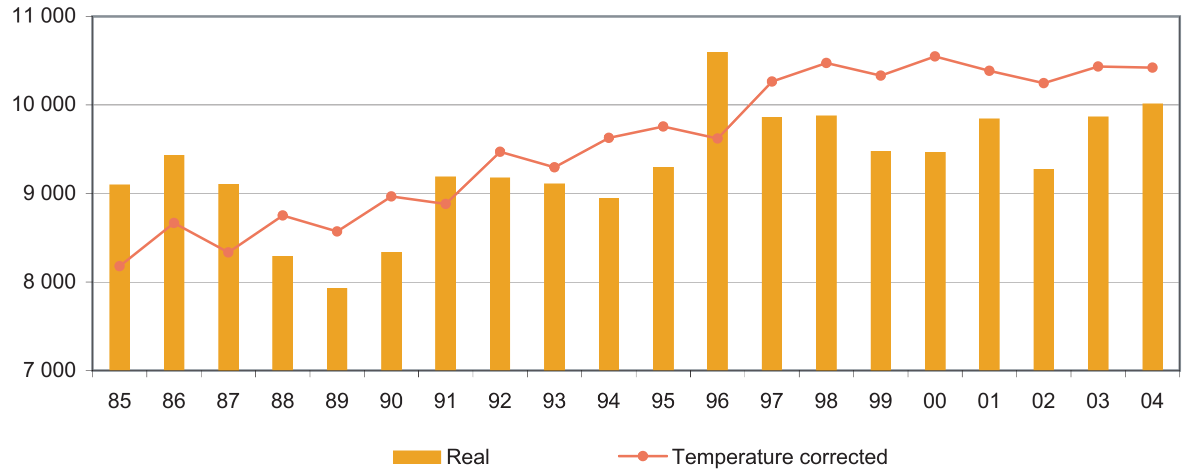


Figure 3.22: Belgium: final energy consumption (all products) of industry (1000 TOE)

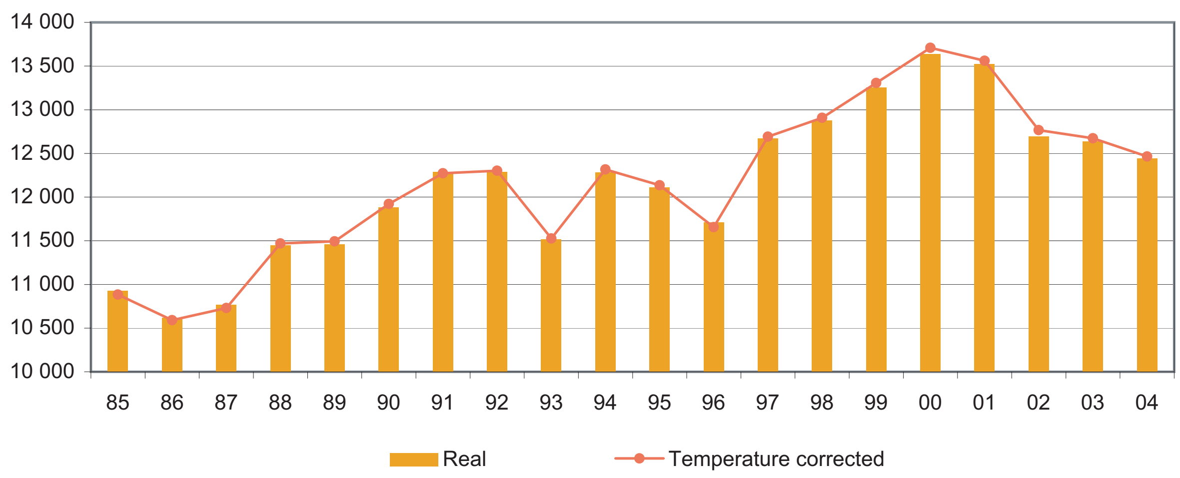


Figure 3.23: Belgium: final energy consumption (all products) of services (1000 TOE)

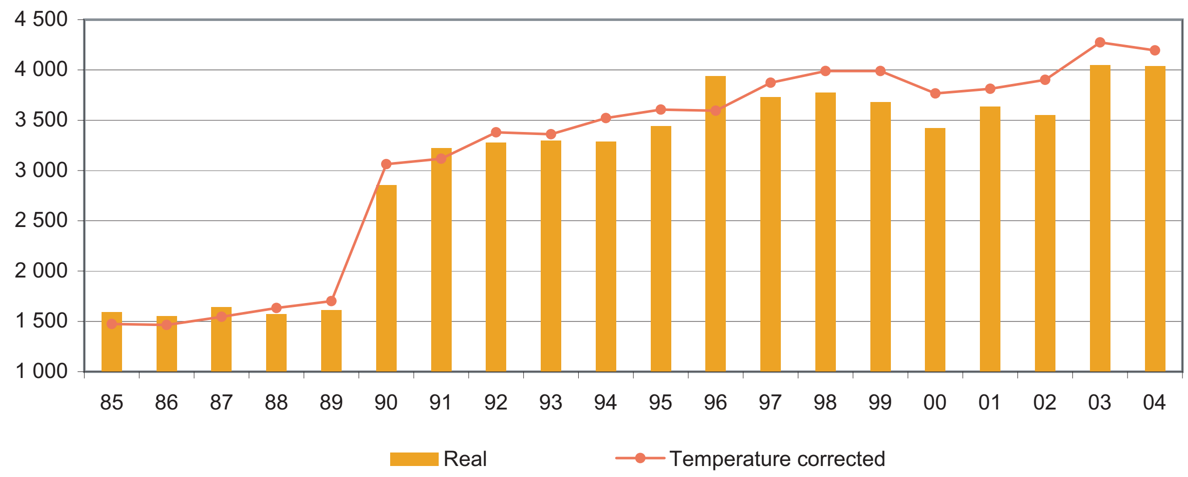
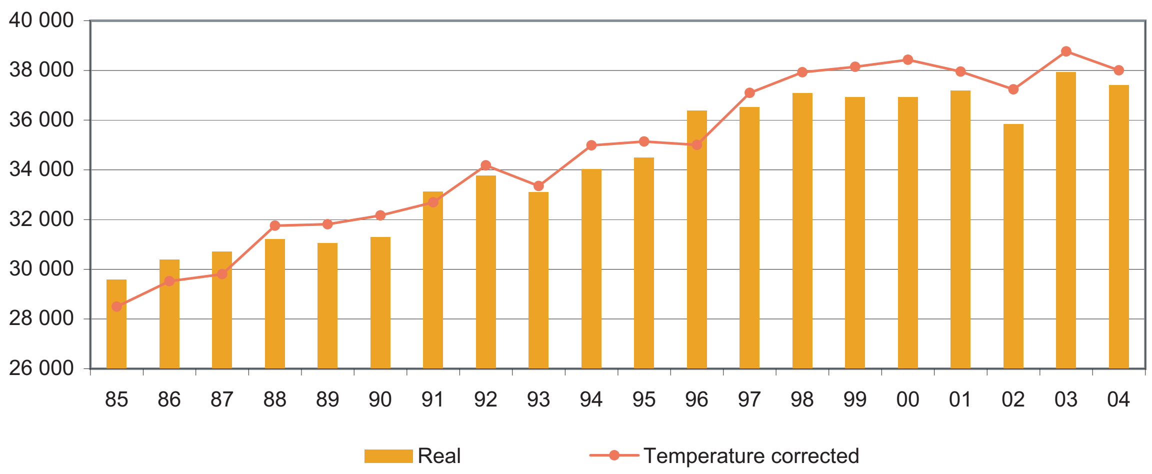


Figure 3.24: Belgium: final energy consumption (all products) of all sectors (1000 TOE)



In more general terms: for a heating share of 20% and a cold year with 10% more degree-days than in a normal (average) year, the correction factor would be 0.98, i.e. corrected energy consumption would be 2% lower than the actual value.

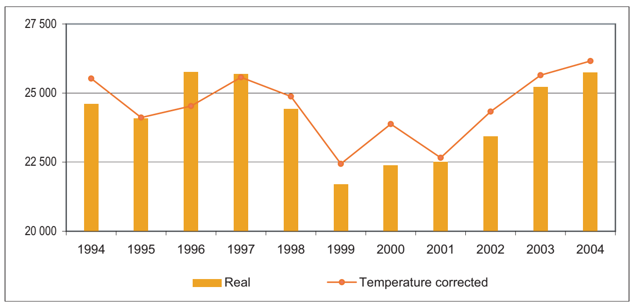
It may be noted that the curves showing the temperature-corrected data 'smooth out' the changes seen in the individual bars. If the effects of temperature fluctuations are excluded, it is easier to recognise patterns and tendencies in energy consumption both for individual sectors and for total energy consumption.

The previous pages have outlined the various stages in calculating temperature-corrected energy consumption data. The components used for this calculation, such as the number of heating degree-days at regional level, are stand-alone products and can be used for other applications. Tables with heating degree-days at regional level are available on the CD-ROM attached to this publication.

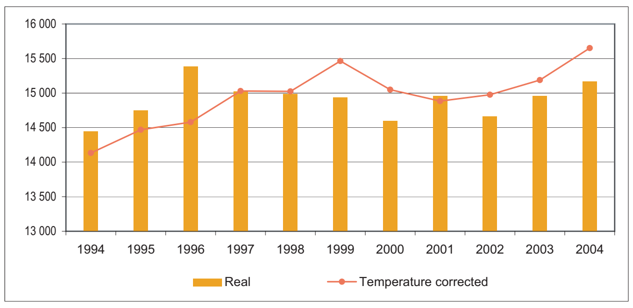
As this publication cannot possibly show the data for actually measured and temperature-corrected final energy consumption for all types of fuel in the various sectors (industry, services, households), Figure 3.24 limits itself to real and temperature-corrected energy consumption for all sectors and products.

Figure 3.25: Final energy consumption (all products) of all sectors, (1000 TOE), by country

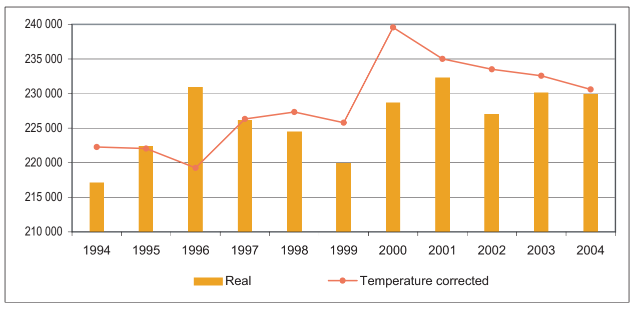
Czech Republic



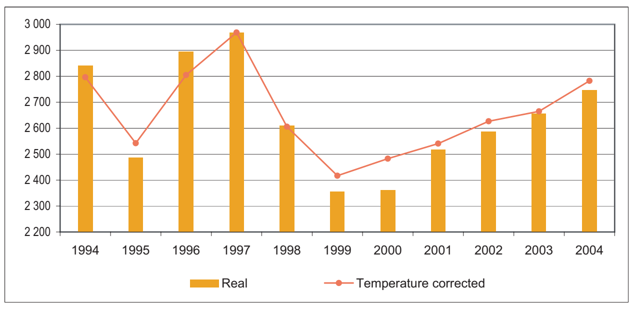
Denmark



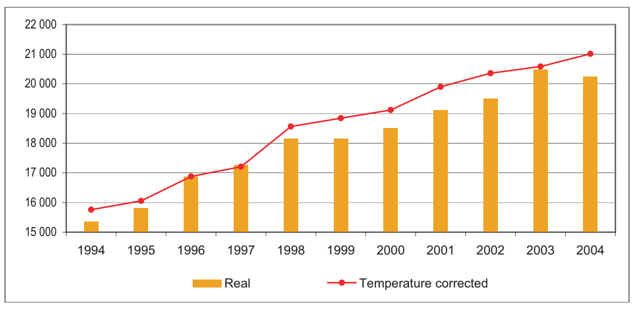
Germany



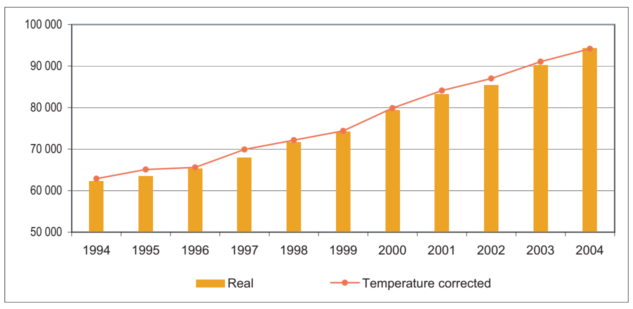
Estonia



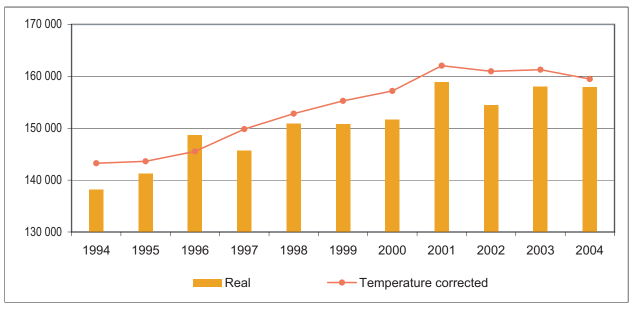
Greece



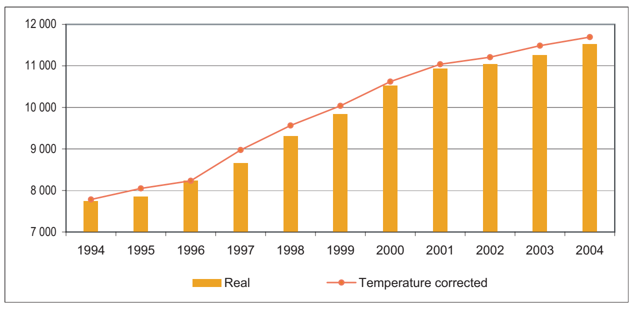
Spain



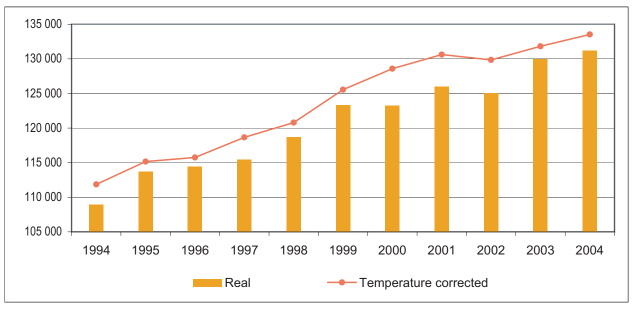
France



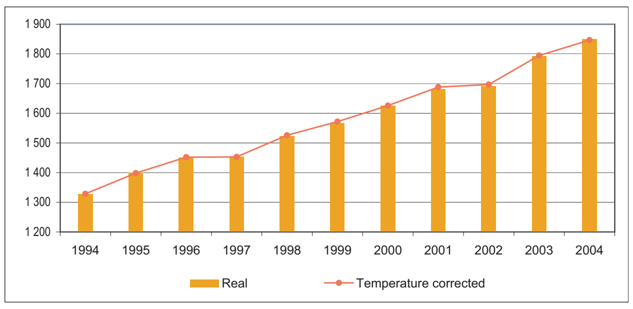
Ireland



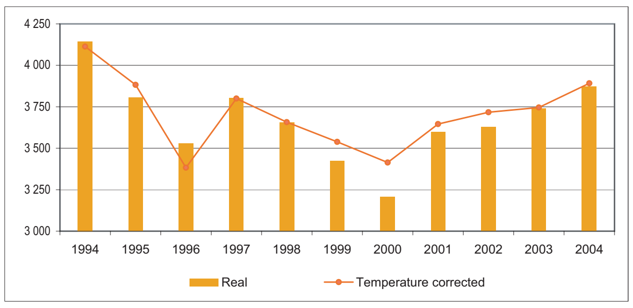
Italy



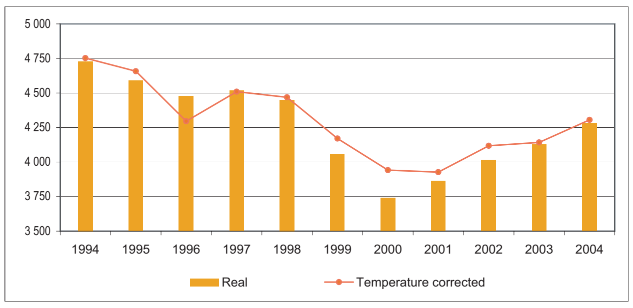
Cyprus



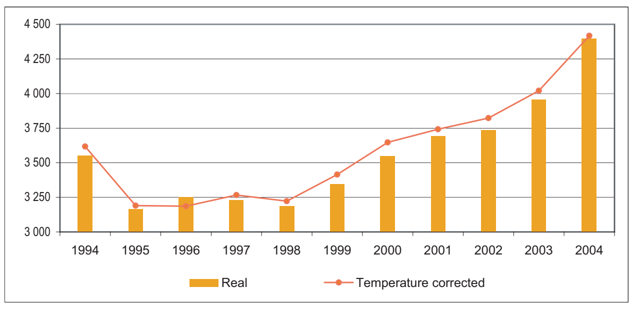
Latvia



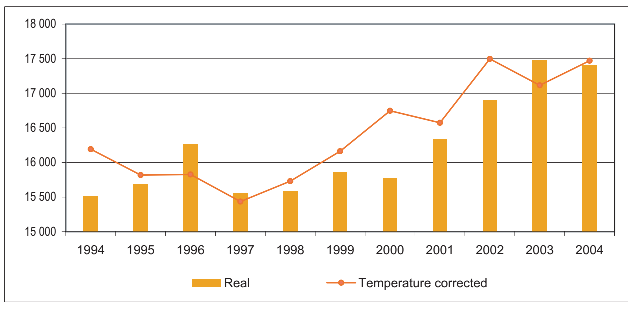
Lithuania



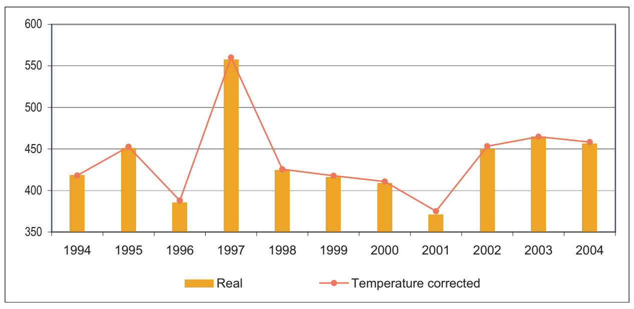
Luxembourg



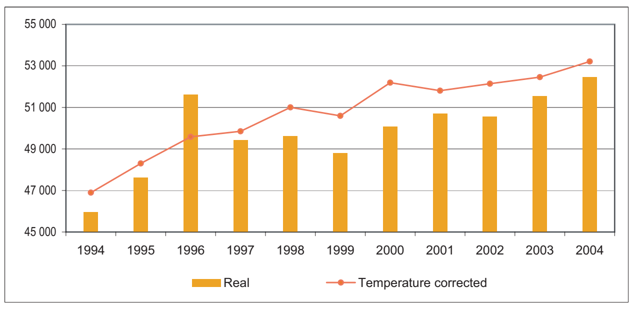
Hungary



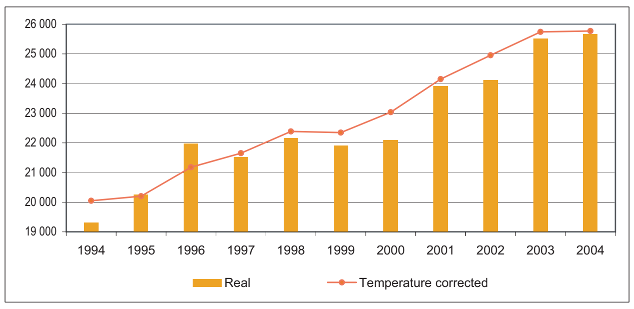
Malta



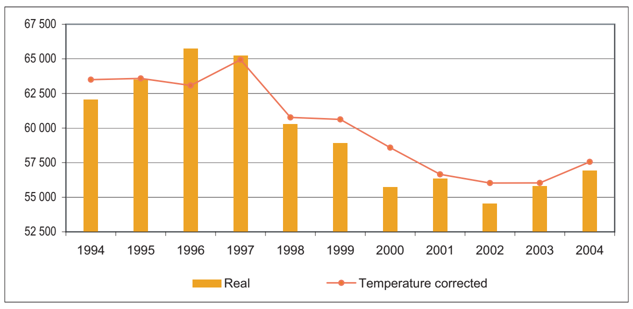
Netherlands



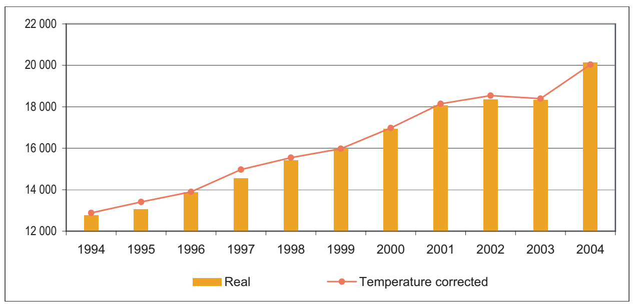
Austria



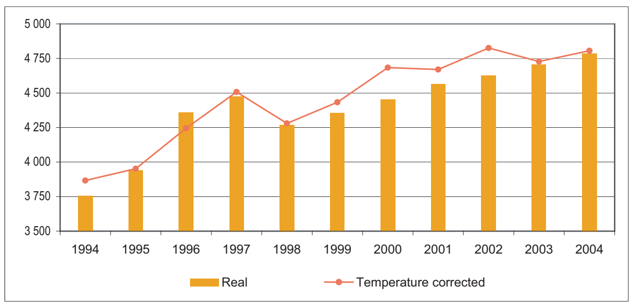
Poland



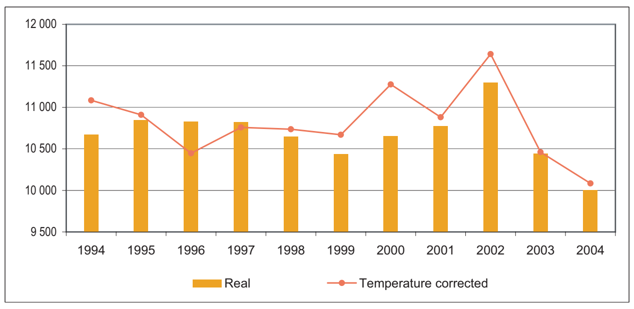
Portugal



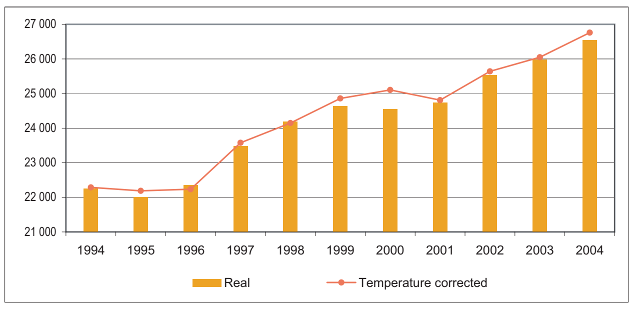
Slovenia



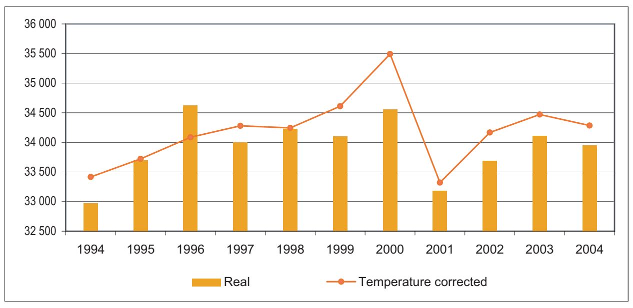
Slovakia



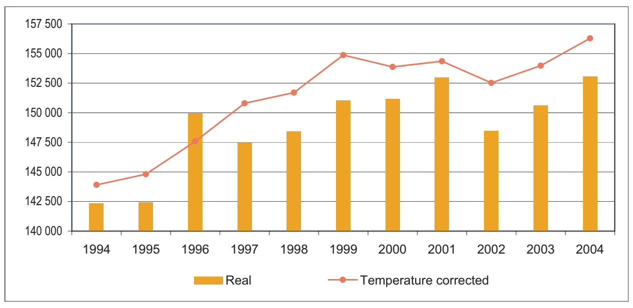
Finland



Sweden



United Kingdom



Note: As it is used as an example earlier in this section, Belgium is not included in this series of graphs (see Figure 3.24).

Combining the information on temperature-corrected energy consumption for the various fuels and sectors in all of the 25 Member States gives us a picture for the European Union as a whole. Figure 3.25 provides an overview of the real and temperature-corrected final energy consumption of households. The period covered is from 1990 to 2004, as data for the new Member States are only available from 1990 onwards.

Figures 3.26 and 3.27 show the final energy consumption of industry and services respectively. Apart from the different consumption patterns that can be noted for the various sectors (albeit influenced by a difference in scaling), the difference between actually measured consumption and consumption corrected for temperature fluctuations appears to be highest in households, where heating shares are generally highest. In 2004 for instance, temperature-corrected energy consumption for households was 309.2 million TOE, 2.7% higher than actually registered consumption (301.1 million TOE). For the same year, the differences for industry and services were 0.4% and 2.1%, respectively. The opposite occurred in 1991 and 1996, which were evidently colder than normal (at least at the level of the EU-25), when actual consumption in all sectors exceeded the levels expected if these years had been average in terms of temperature.

Figure 3.26: EU-25: final energy consumption (all products) of households (1000 TOE)

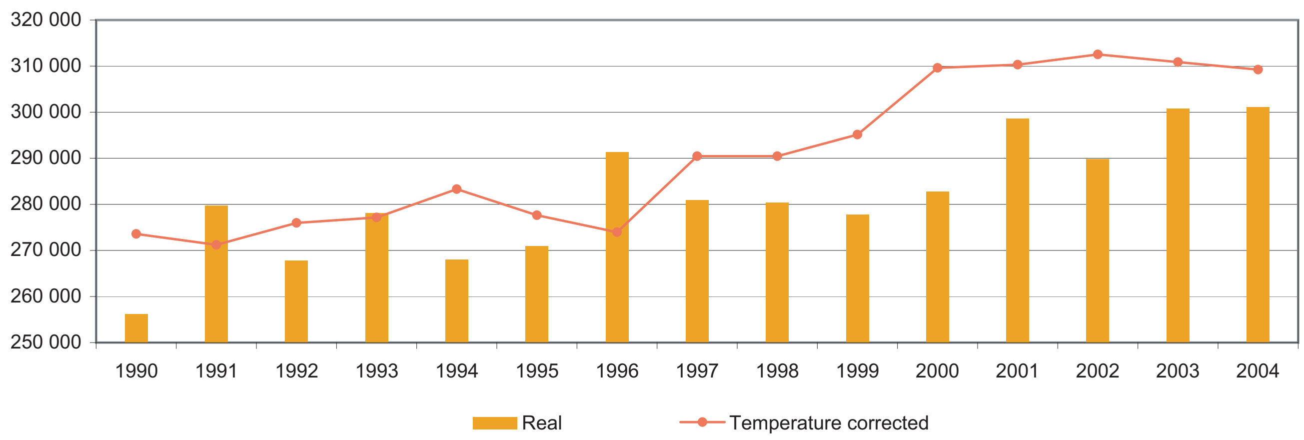


Figure 3.27: EU-25: final energy consumption (all products) of industry (1000 TOE)

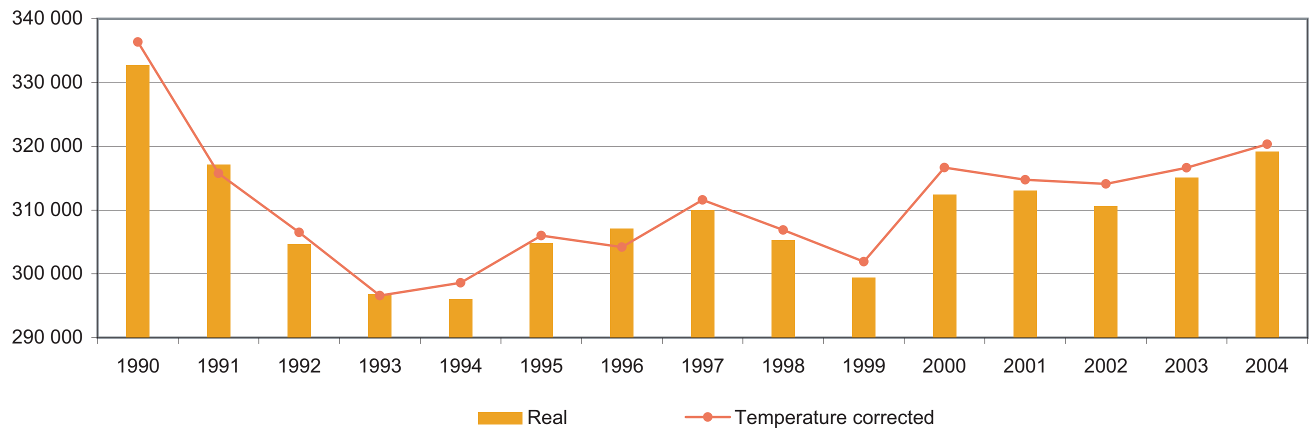
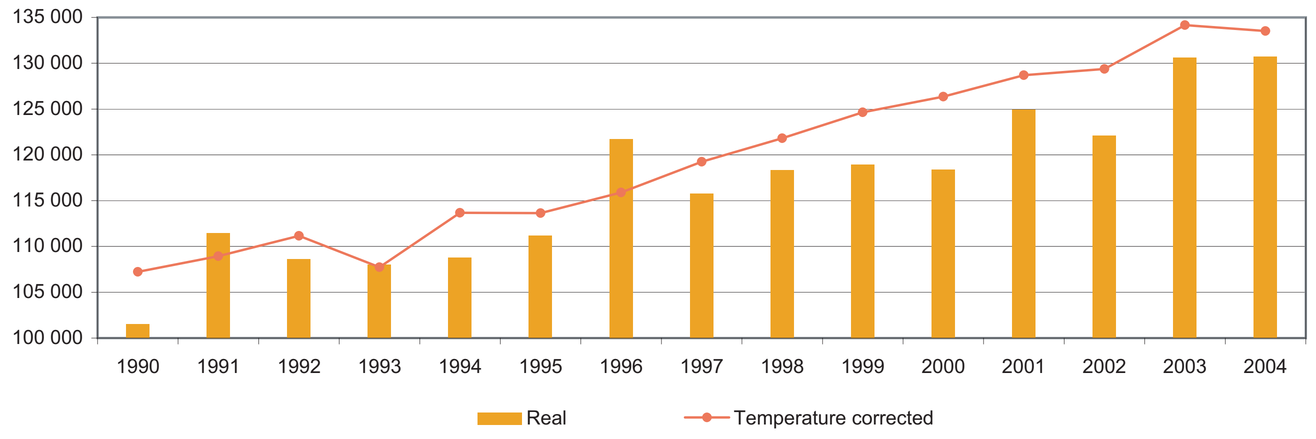


Figure 3.28: EU-25: final energy consumption (all products) of services (1000 TOE)



Fairly warm years since 1997

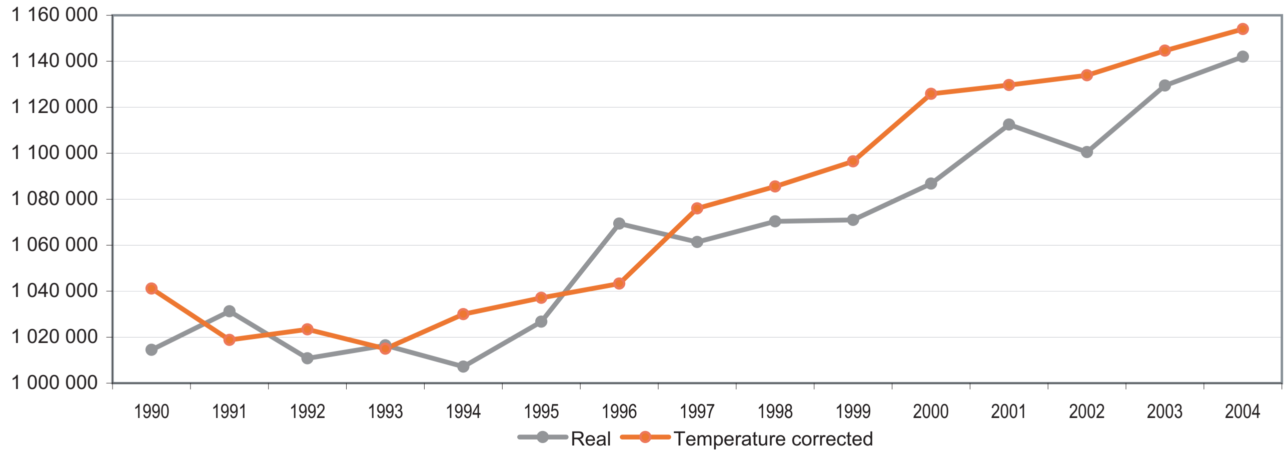
The year 1993 was very close to the long-term (1980-2004) temperature average, as real consumption and temperature-corrected consumption in the three categories practically did not differ at all.

This is confirmed in Graph 3.28, where all consumption categories are taken together. One can also see that actual final energy consumption since 1997 has been persistently below the calculated temperature-corrected consumption.

This suggests warmer-than-average years at EU-level, which is confirmed by the information in Table 3.18 (data for 2000-2004), where the heating degree-days at EU-25 level are all lower than the long-term average.

In these recent years, the largest gap was in the year 2000, with actually consumed energy around 39 million TOE less than what would have been consumed in an average year, corresponding to a difference of 3.6%. In 2003 and 2004, the gap was approximately 15 million TOE, a difference of 1.4%.

Figure 3.29: EU-25: final energy consumption (all products) for all sectors (1000 TOE)



Implementation in all EU countries

Both the success of and the interest in the results of temperature-corrected energy consumption data based on heating degree-days encourages further development in this area. Shorter-term objectives include the further fine-tuning of the heating share data (see Table 3.17) and the collecting of temperature data for the very few regions and years for which this information is still missing. Also, population data at regional level necessary for weighting purposes have to be estimated wherever missing.

Temperature correction will be implemented for all EU Member States, the candidate countries and Norway and the results will be consolidated by Eurostat.

Mid-term objectives consist in examining the feasibility and developing a methodology for the temperature correction of gross inland consumption. This would enable a temperature-corrected energy balance sheet to be produced on space heating, for each individual country and for both end use and the supply side.

Cooling degree-days?

A longer-term objective will be to undertake similar steps to calculate cooling degree-days, of particular interest for the southern and south-eastern countries of Europe. Here, a major challenge will consist in fixing the cooling degree shares.

Finally, there will have to be a methodological extension of the basic temperature correction formula to accommodate a correction for the energy consumed for space cooling.

European Commission

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