KEY INDICATORS

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Introduction

1. In 1998 the European Council in Cardiff started a new initiative to incorporate sustainable development more effectively into practical policy making. The principal idea was to shift responsibilities and control from environmental authorities to the different sectoral policy making bodies that prepare and implement measures.

2. The concept of sustainable development has evolved considerably over the last few years. Today there is a common understanding that sustainable development is a wide concept, encompassing the needs of human beings for products and services, employment, social aspects, and protection of the environment. A sustainable policy should take care of the generations to come, but it must also seek to provide welfare and economic competitiveness today.

3. From an energy point of view it is important to note that sustainable development encompasses the three traditional objectives of energy policy: "security of supply", "competitiveness", and "concern for the environment". Each of these energy policy objectives is important for the sustainable development of society.

4. At the beginning of the 21st century the Community must look for an energy system, that at the same time:

   - provides secure energy supplies and avoids disruptions,
   - is competitive and supports the dynamics of economic growth, employment and welfare, and
   - preserves the environment and maintains the ecological basis for life on earth.

   Understanding this helps to remind us that a **sustainable energy policy** is a policy that maximises the long-term welfare of citizens, by keeping a reasonable balance between security of energy supply, competitive energy services and environmental protection.

5. The difficult task in energy policy is to identify the current and long-term challenges clearly, and to give each goal the appropriate weight. This calls for a **continuous analysis of market developments**, long-term perspectives and options for policy measures, along with their impact, advantages, limitations, and related opportunities and risks. Analysis of energy markets can be improved by using energy indicators. Energy indicators help to identify critical trends well in advance and monitor whether energy markets are on track towards sustainability.

6. In 1999 the Energy Council agreed on a list of relevant energy indicators. These indicators are included in the "Energy Indicators Pocket Book", published in collaboration with EUROSTAT and the European Environment Agency. The "Energy Indicators Pocket Book" tries to give an overview of energy market developments and of the Community's progress towards sustainability. It illustrates the evolution of the Community's energy systems in a condensed form, by combining graphical presentations, data and some explanatory text in a systematic way.

Acknowledgements

Eurostat is pleased to acknowledge the contribution of the European Environment Agency to the preparation of this publication. The provision of data associated with indicators 8.1 to 8.14, 8.16 and 8.17 is acknowledged in particular.

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1 Overview Indicators

indicator 1.1 Energy Dependency

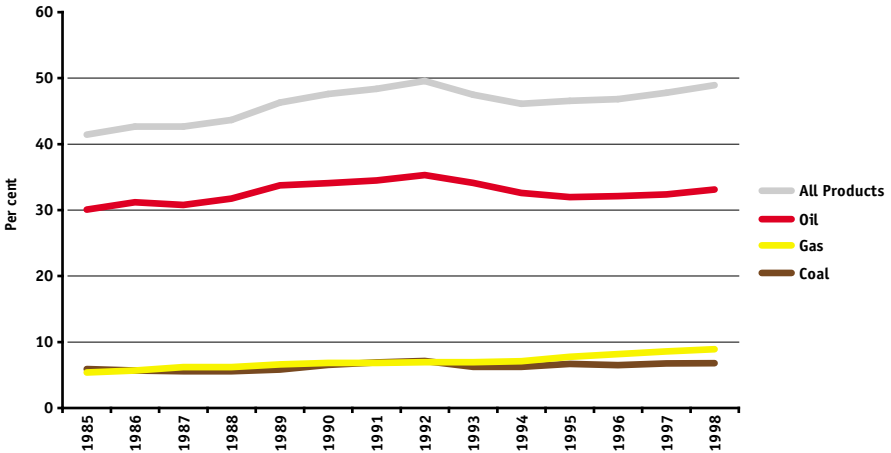


table 1.1 Energy Dependency

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
All Products	42.4	43.7	43.7	44.7	47.4	48.8	49.6	50.8	48.7	47.3	47.8	48.1	49.1	50.4
Oil	30.7	32.0	31.6	32.5	34.6	35.0	35.4	36.2	35.0	33.4	32.8	32.9	33.3	34.1
Gas	5.5	5.8	6.3	6.4	6.8	7.0	7.0	7.1	7.1	7.3	8.0	8.4	8.8	9.2
Coal	6.0	5.8	5.7	5.7	6.0	6.7	7.1	7.3	6.4	6.4	6.9	6.7	6.9	7.0

Units: Per cent

Energy dependency measures the extent to which a country relies on imports to meet its energy needs. The table presents energy dependency in per cent and shows the ratio of net imports of an energy product to the total Gross Inland Consumption.

The chart shows the importance of imported fossil fuels in EU-15 Member States. Within EU-15, approximately one third of the Gross Inland Consumption is satisfied by imported crude oil and its products. Gas dependency has shown the largest percentage increase. The increase in gas use in all sectors is due to a number of factors, including improved availability and pressure to discontinue the use of other fuels due to their high environmental impact.

Dependency on imports has increased over the last 10 years to the point where 50% of primary fuel requirements are now imported. This highlights the increased demand for energy sources, and the extent to which internal EU supply is outstripped by demand for products such as petroleum for transport and gas for electricity generation.

indicator 1.2 Index of Energy Intensity

Reference year = 1990

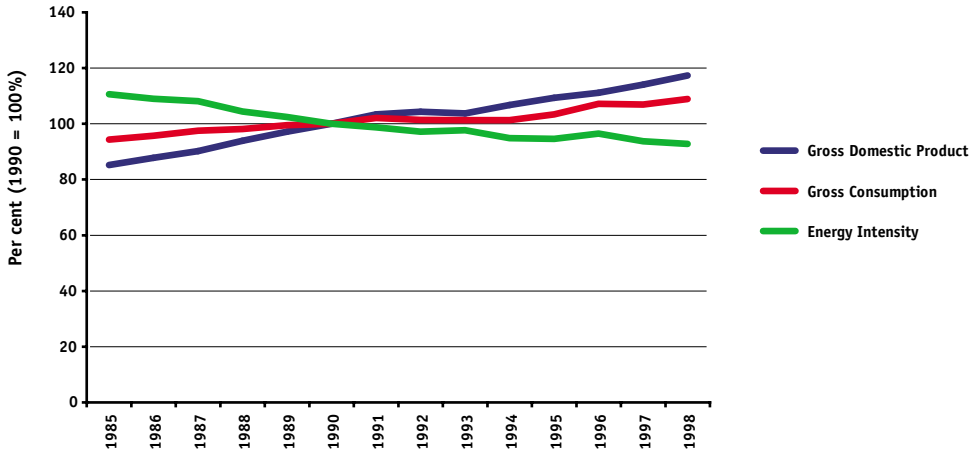


table 1.2 Index of Energy Intensity Reference year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gross Domestic Product	86	89	90	95	99	100	103	104	104	107	109	111	114	117
Gross Inland Consumption	94	96	98	98	100	100	102	101	101	101	103	107	107	109
Energy Intensity	109	108	109	103	101	100	99	97	98	95	95	96	94	93

Units: Per cent (1990 = 100%)

Energy intensity is calculated by dividing the Gross Inland Consumption by the Gross Domestic Product (GDP).

Energy intensity has fallen steadily for several years, with the energy required per unit of output in 1998 being 7% less than that of 1990. Although Gross Inland Consumption has increased by 9% over the period 1990 to 1998, Gross Domestic Product has increased much more rapidly and now stands at 17% above its 1990 level.

Factors which influence this trend include the change in the nature of industry across the EU, with heavy (more energy intensive) industries declining and service (less energy intensive) industries expanding, as well as improvements in the efficiency of energy transformation and the end use of energy.

indicator 1.3 Price of Brent Crude Oil

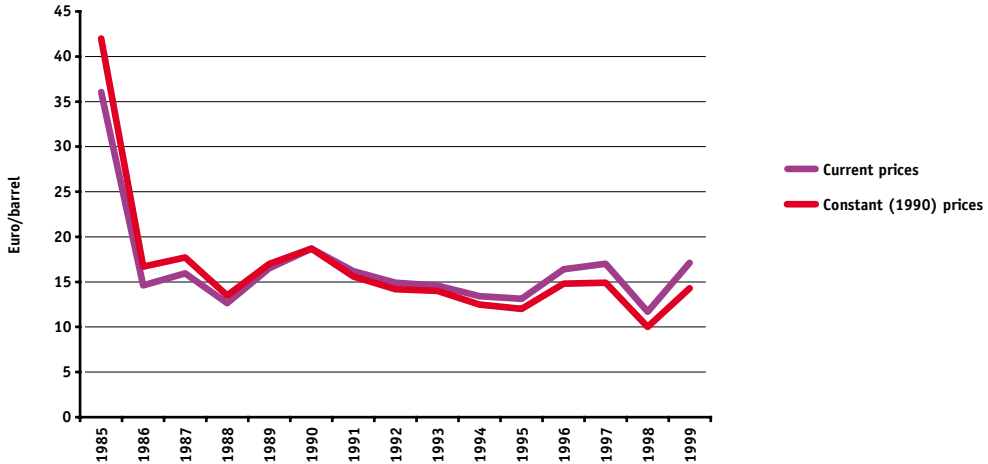


table 1.3 Price of Brent Crude Oil

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Current prices	36.1	14.6	16.0	12.7	16.5	18.7	16.2	14.9	14.6	13.4	13.1	16.4	17.0	11.7	17.1
Constant (1990) prices	42.0	16.7	17.7	13.5	17.0	18.7	15.6	14.2	14.0	12.5	12.0	14.8	14.9	10.0	14.3

Units: Euro / barrel

The price of Brent Crude Oil is used as a yardstick for world crude oil prices.

The price of crude oil has remained low throughout the nineties by comparison to the price in 1985. Much of the fall in price took place between 1985 and 1986 as a result of OPEC countries introducing netback pricing, with the price of the crude oil being negotiated on the basis of the expected value of the products refined from it. This forced the oil producers to compete more actively for market share.

In 1990 the price of crude oil reached a peak due to the Gulf War, although it subsequently fell by 36% over the next five years. Prices rose again in 1996 and 1997, as tensions in the Gulf increased, but fell sharply in 1998 as a result of the Asian economic crisis. The OPEC decision to reduce oil production caused prices to rise in 1999.

indicator 1.4 Contribution of Energy System to Total Emissions of Greenhouse Gases

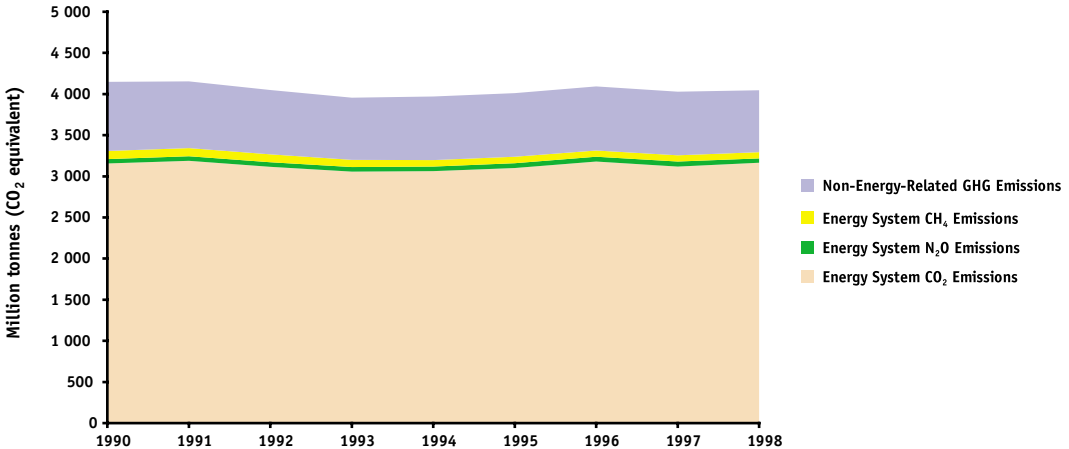


table 1.4 Contribution of Energy System to Total Emissions of Greenhouse Gases

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related GHG Emissions	840	811	782	757	772	773	778	773	752
Energy System N_2O Emissions	52	54	54	53	56	58	60	60	55
Energy System CH_4 Emissions	101	99	96	87	80	79	76	75	74
Energy System CO_2 Emissions	3 156	3 190	3 117	3 058	3 063	3 101	3 179	3 119	3 164

Units: Million tonnes CO_2 equivalent

In this context, the term "Energy System" refers to the combination of the energy industry (i.e. the energy transformation sector) and energy consumption by final consumers. Greenhouse gas emissions are widely acknowledged to give rise to climate change. The three most significant greenhouse gases are considered here: carbon dioxide, methane and nitrous oxide.

Total emissions of these greenhouse gases across the EU fell by 2.5% over the period 1990 to 1998. Non-energy related emissions fell by 10% over this period, but energy system emissions fell by just 0.5%. Carbon dioxide (CO_2) is by far the most significant of these three greenhouse gases, with CO_2 emissions from the energy system now (1998) accounting for 78% of total emissions and 96% of energy system emissions. CO_2 emissions from the energy system increased by just 0.2% over the period from 1990 to 1998, and actually fell by 3.1% during the recession of the early 1990s. Methane (CH_4) remains the second most significant greenhouse gas, accounting for 2.3% of energy system emissions in 1998. However, CH_4 emissions from the energy system fell by 26% over the period from 1990 to 1998. Nitrous oxide (N_2O) only accounts for 1.7% of energy system emissions. N_2O emissions from the energy system increased by 6% between 1990 and 1998, despite a significant decline between 1997 and 1998.

indicator 1.5 Contribution of Energy System to Total Emissions of Acidifying Gases (SO_2 and NO_x)

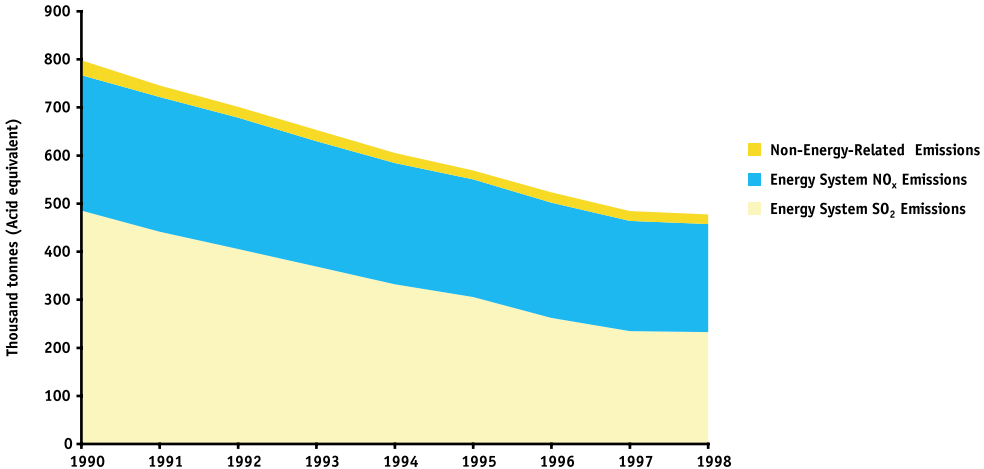


table 1.5 Contribution of Energy System to Total Emissions of Acidifying Gases (SO_2 and NO_x)

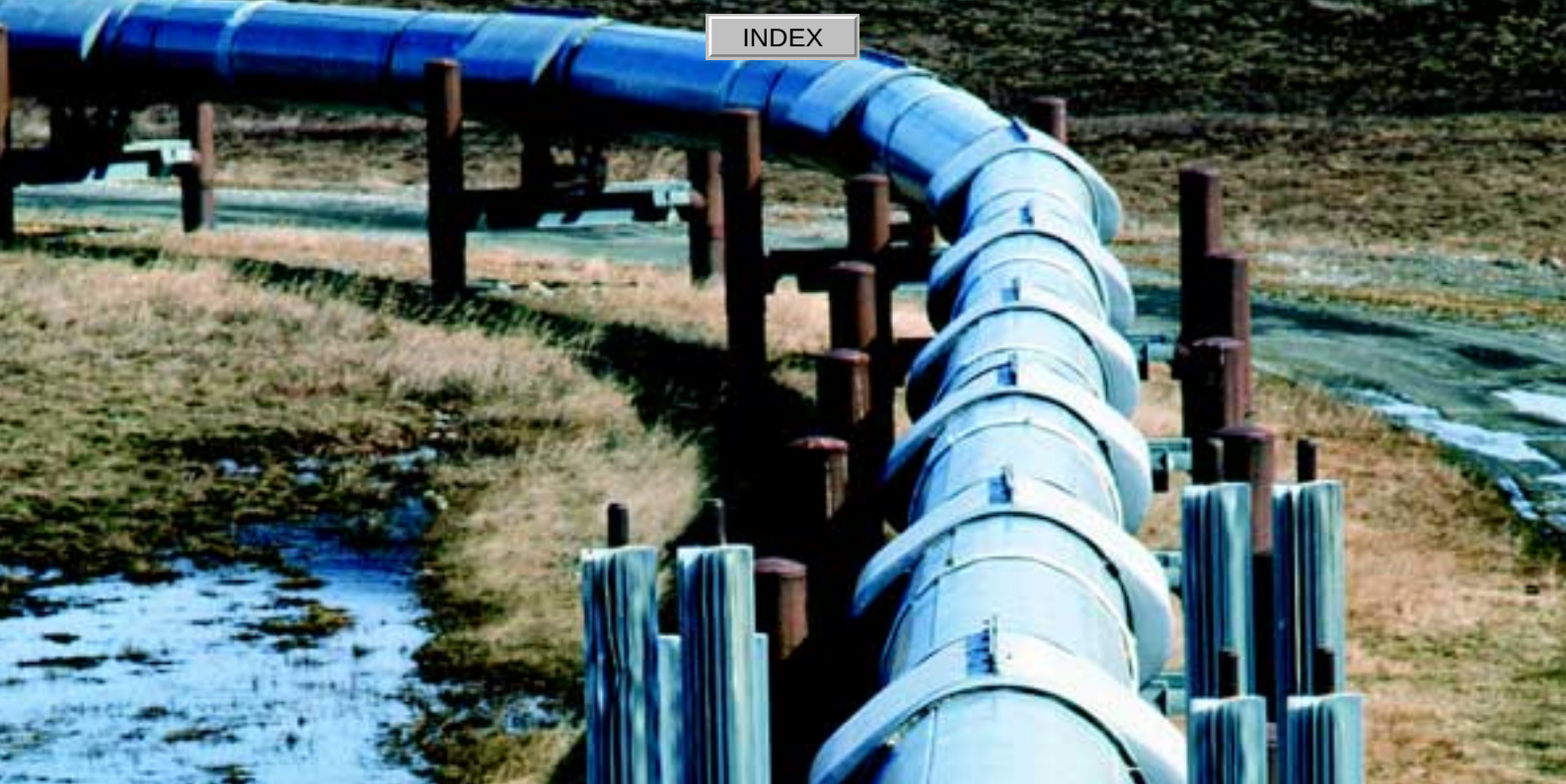
	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related Emissions	31	24	22	23	21	19	21	20	20
Energy System SO_2 Emissions	485	442	405	369	332	305	262	235	233
Energy System NOx Emissions	282	280	273	261	252	245	240	229	225

Units: Thousand tonnes acid equivalent

The units used adjust the tonnes of emissions by their relative potential acid (hydrogen ion) production. Emissions of acidifying gases (sulphur dioxide, nitrogen oxides and ammonia) are partly responsible for acid rain, increased concentration of photo-oxidants in the atmosphere and the occurrence of smog in winter. As the energy system is not a source of ammonia, this acidifying gas is not included in this analysis.

Total emissions of these acidifying gases across the EU fell by 40% over the period from 1990 to 1998, and emissions from the energy system (accounting for 96% of the total) also fell by 40%. Contributory factors were the installation of flue gas desulphurisation (FGD) equipment at power stations and the move away from solid fuels (e.g. lignite and coal) to fuels such as natural gas containing less sulphur.

Sulphur dioxide (SO_2) remains the most significant component of energy system emissions. SO_2 emissions fell by 52% over the period, and now account for 49% of the total compared to 61% in 1990. Emissions of nitrogen oxides (NO_x) from the energy system fell by 20% over the same period and now account for 47% of the total (35% in 1990). Non-energy system emissions of acidifying gases fell by 36% from 1990 to 1998, although most of this reduction took place in the early years.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2 Energy Supply

indicator 2.1 Total Primary Energy Production

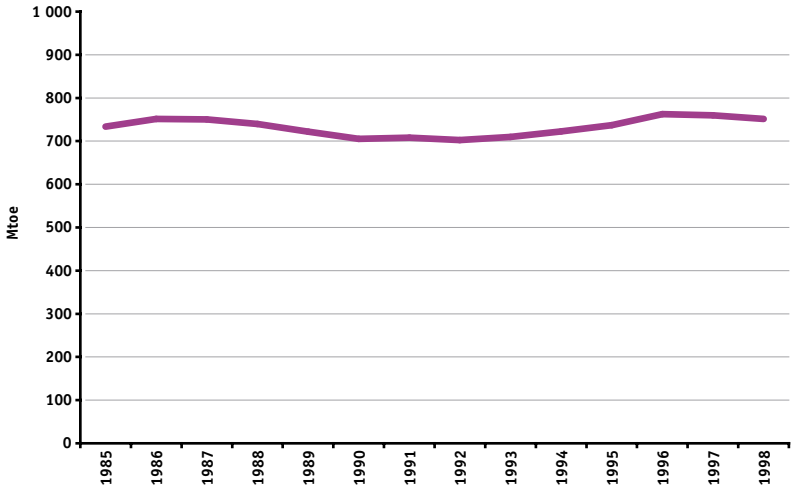


table 2.1 Total Primary Energy Production

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total Primary Energy Production	733 643	751 140	750 097	739 512	722 131	705 130	707 811	702 266	709 622	722 656	737 132	762 582	759 647	750 931

Units: Thousand tonnes of oil equivalent (ktoe)

Primary energy production is the total amount of energy produced within the EU-15 Member States. It includes indigenous fossil fuels, nuclear energy, renewable energy sources and energy derived from other non-imported resources.

In increasingly global energy markets, total primary energy production reflects the extent to which indigenous energy resources are economically and environmentally competitive with imported energy. Energy users, particularly large users, are often free to purchase from the most competitive source, whether or not this is in their own country. It follows that if indigenous EU energy sources are not competitive the demand for them will fall.

Although total primary energy production increased by only 4% from 1989 to 1998, it is clear that there was a dip in production in the early 1990s. This reflected the fact that energy consumption generally follows economic activity, and this was a period of low economic growth in the EU.

indicator 2.2 Primary Energy Production, by Fuel

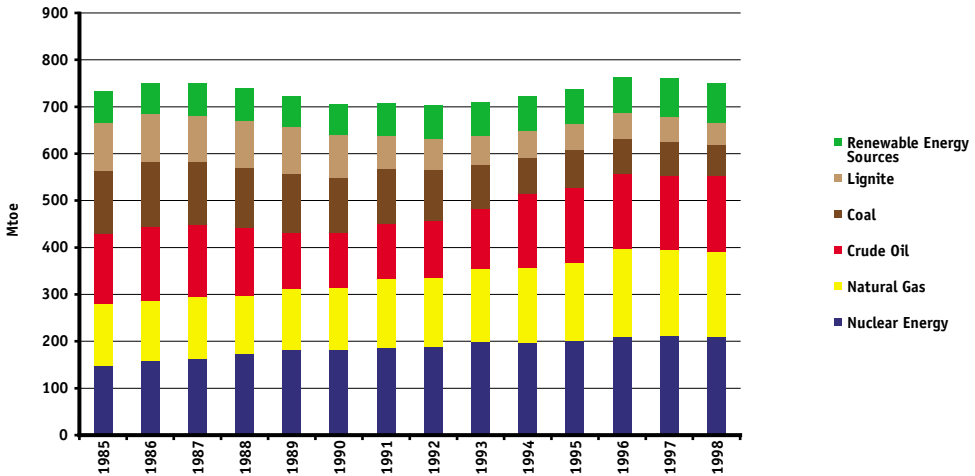


table 2.2 Primary Energy Production, by Fuel

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Renewable Energy Sources	67 026	65 569	68 533	69 145	65 040	65 804	68 916	70 834	72 430	72 636	73 348	76 052	81 771	84 816
Lignite	103 008	102 502	98 986	99 516	99 976	89 832	72 357	65 118	60 238	57 689	55 566	53 890	51 302	47 207
Coal	133 616	139 518	133 918	129 319	125 752	118 387	115 765	109 893	94 508	79 080	81 041	76 275	73 820	66 363
Crude Oil	150 740	155 750	152 833	143 478	119 850	116 798	118 074	121 315	126 994	156 242	159 341	158 870	158 016	161 413
Natural Gas	131 875	129 300	133 791	124 723	129 085	132 871	145 680	146 838	157 894	159 737	166 597	188 632	182 123	181 467
Nuclear Energy	147 378	158 500	162 037	173 332	182 429	181 439	187 021	188 267	197 558	197 271	201 240	208 864	212 615	209 664

Units: Thousand tonnes of oil equivalent (ktoe)

While total primary energy production has remained broadly constant (see 2.1), the balance of fuels contributing to the total has changed appreciably. The production of coal and lignite have both decreased, reflecting reduced industrial demand, fuel-switching (mainly in favour of natural gas) and increased imports of cheaper solid fuels. These changes were in part driven by the need to reduce emissions, since coal and lignite have a high carbon and sulphur content compared to other energy sources. In contrast the use of crude oil and natural gas has increased, reflecting increases both in production capacity and in demand. These now account respectively for 21% and 24% of the total.

Production of nuclear energy has also increased, and this is now the largest single source of primary energy (28% of the total). Little new nuclear capacity has been installed since the early nineties however, so its contribution is now relatively static. The contribution of renewable energy sources has also increased, mostly in the last four years, but it remains low (11% of the total) compared to those of the other energy sources.

indicator 2.3 Indices of Primary Energy Production, by Fuel Reference Year = 1990

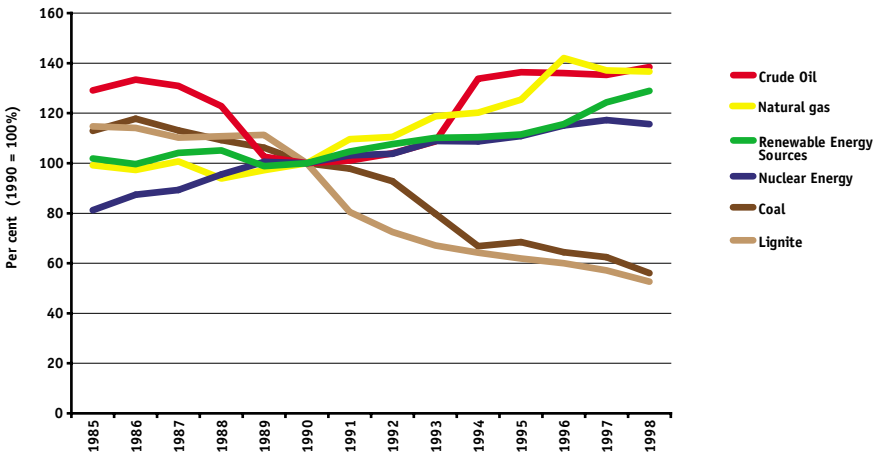


table 2.3 Indices of Primary Energy Production, by Fuel Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Crude Oil	129	133	131	123	103	100	101	104	109	134	136	136	135	138
Natural Gas	99	97	101	94	97	100	110	111	119	120	125	142	137	137
Renewable Energy Sources	102	100	104	105	99	100	105	108	110	110	112	116	124	129
Nuclear Energy	81	87	89	96	101	100	103	104	109	109	111	115	117	116
Coal	113	118	113	109	106	100	98	93	80	67	69	64	62	56
Lignite	115	114	110	111	111	100	81	73	67	64	62	60	57	53

Units: Per cent (1990=100%)

This figure illustrates the changes in the balance of primary energy production between different fuels.

The marked decline in coal and lignite production can be seen in contrast to the net increase in production from all other sources. There were large increases in the production of natural gas and crude oil, reflecting increased demand. The growth in natural gas production has been greatest since 1990, and in 1991 and 1996 in particular, reflecting the increased use of gas for power generation and in industry. Crude oil production decreased in the late eighties following the Piper Alpha incident, but increased throughout the 1990s.

The increase in the production of nuclear energy is clearly seen, although the rate of increase has been much lower in recent years. Production of energy from renewable sources also shows steady growth (29% since 1990), but here the most rapid increase took place in the last three years.

indicator 2.4 Net Imports of Solid Fuels

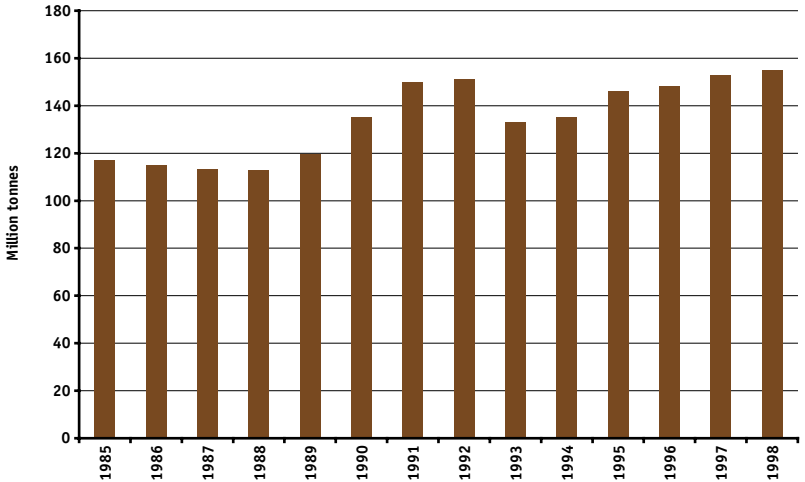


table 2.4 Net Imports of Solid Fuels

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Solid Fuels	116 963	115 019	113 368	112 905	119 446	134 977	150 046	151 281	133 087	135 172	145 926	148 047	152 803	155 008

Units: kilotonnes

Net imports (imports minus exports) of solid fuels (essentially coal) rose by 15% over the period 1990 to 1998. This contrasts with the decline of 45% in the production of coal and lignite in EU-15 over the same period (see 2.2).

Since 1990, imports have exceeded the production of coal within EU-15. These increases in imports (at the expense of local production) reflect the fact that, in an increasingly global energy market, users (particularly large industrial users and power utilities) are turning to cheaper and often cleaner solid fuels from outside EU-15.

indicator 2.5 Net Imports of Oil

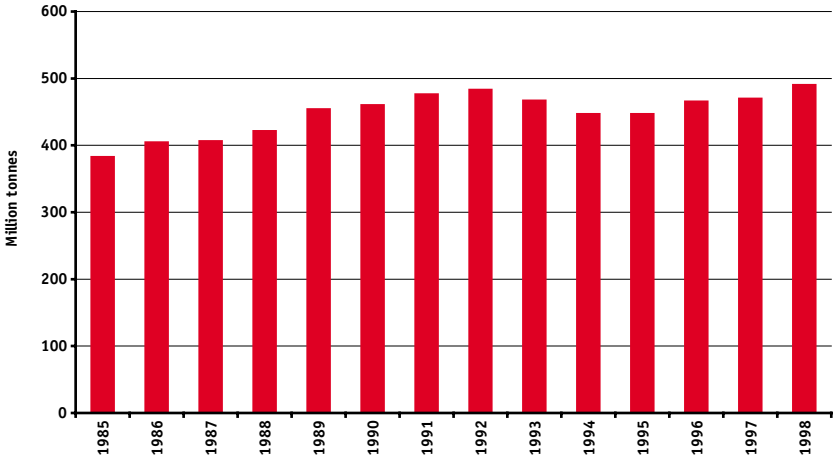


table 2.5 Net Imports of Oil

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Oil	382 217	404 123	405 973	420 991	453 608	459 557	475 757	482 493	466 568	446 419	446 296	464 914	469 411	489 800

Units: kilotonnes

Net imports of oil rose by 7% over the period from 1990 to 1998. Over the same period there was a 38% increase in the production of oil within EU-15 (see 2.2). Although imports declined in the early 1990s as new oil production capacity came on stream, imports have again increased during the last three years when production was relatively stable.

In 1995, imports were around 2.8 times greater than EU production, and by 1998 they were three times greater. The increasing reliance on imports reflects in part the increasing demand for oil, particularly from the transport sector. However, it also reflects the fact that oil on global markets was relatively cheap during this period, leading to increased use of oil where fuel-switching is possible.

indicator 2.6 Net Imports of Natural Gas

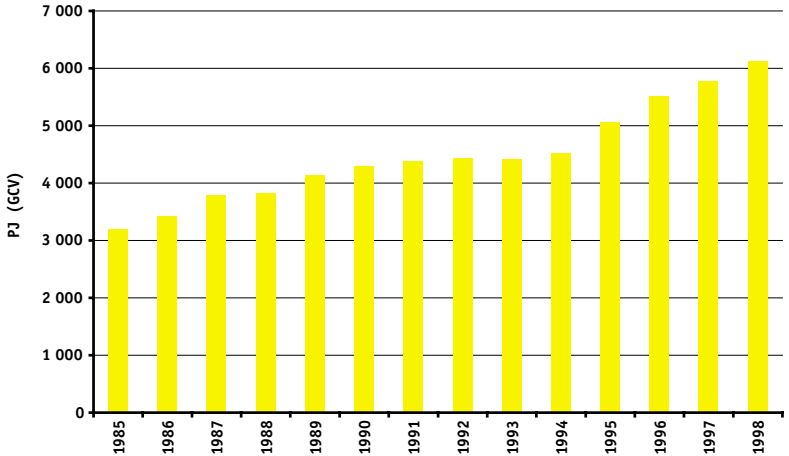


table 2.6 Net Imports of Natural Gas

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Natural Gas	3 191 691	3 426 573	3 788 443	3 831 794	4 134 298	4 293 690	4 388 674	4 429 872	4 417 032	4 528 509	5 053 300	5 510 669	5 776 241	6 116 964

Units: Terajoules (Gross Calorific Value)

Net imports of natural gas into EU-15 rose by 42% between 1990 and 1998, with a particularly rapid growth between 1995 and 1998. In contrast, gas production within EU-15 rose only 37% during the same period (see 2.2). This reflects an increasing reliance on imported gas. In 1995 net imports of gas were around 65% of domestic production, but by 1998 this figure had risen to 72%.

The increase in natural gas imports is due both to increased demand for gas and to increased availability from sources outside EU-15. There has been increased use of gas by industrial, services and domestic consumers (see 3.7 and 3.14) but since 1993 there has been particularly strong growth in its use for electricity generation (see 4.3). This reflects the fact that natural gas is seen as a clean, cheap and efficient fuel, particularly in comparison to solid fuels.

indicator 2.7 Net Imports of Electricity

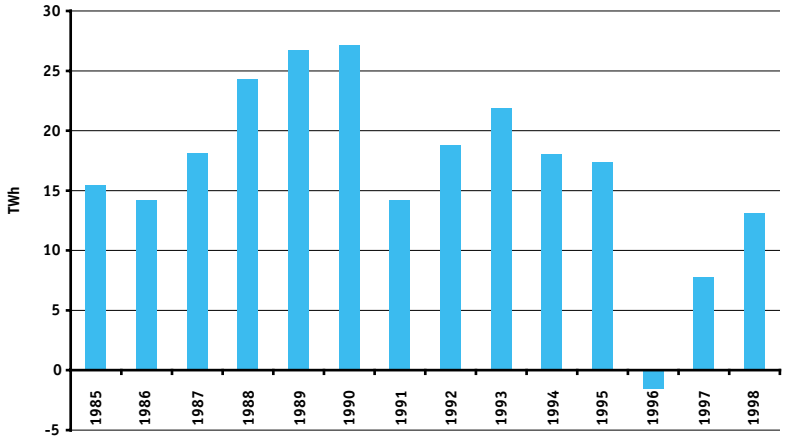


table 2.7 Net Imports of Electricity

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Electricity	15 428	14 219	18 078	24 264	26 712	27 134	14 170	18 792	21 873	18 046	17 402	-1 582	7 782	13 112

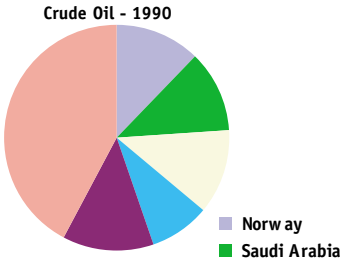
Units: GWh

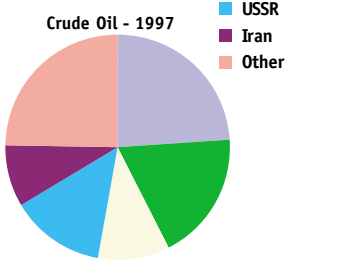
In recent years EU-15 has become less dependent on imports of electricity, and there was even a small net export in 1996. This reduction took place despite an increase in electricity demand in all sectors (see 3.7 and 3.14).

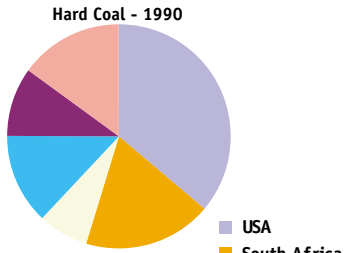
Net imports are very small compared to total generation. In 1998, 13.1 TWh were imported compared to 2 472 TWh generated (see 4.1), and during the period 1990 to 1998 the amount of electricity imported was less than 0.7% of that generated.

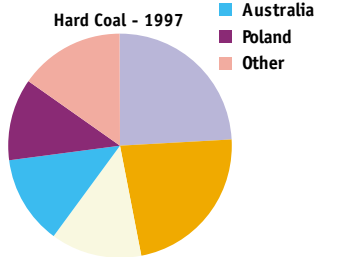
Electricity exchanges between Member States are much greater. In this internal market for electricity the largest exporter in EU-15 is France, although Denmark and Sweden are also significant exporters. The largest importer of electricity is Italy, with the Netherlands and the UK also importing significant amounts.

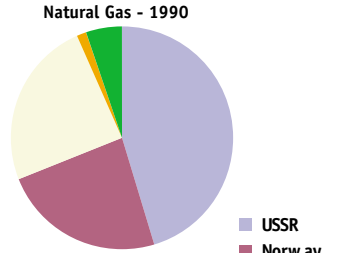
indicator 2.8 Imports of Energy Commodities & Country of Origin











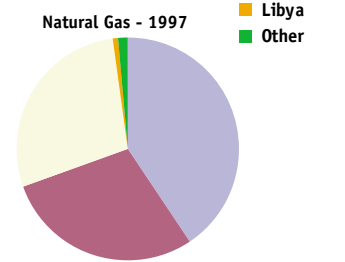


table 2.8 Imports of Energy Commodities & Country of Origin

Crude Oil	1990	1997
Norway	52 374	114 927
Saudi Arabia	49 691	88 557
USSR	37 512	65 274
Libya	50 908	47 844
Iran	55 595	42 724
Other	178 970	115 744

Units: kilotonnes

Hard Coal	1990	1997
USA	46 548	35 357
South Africa	23 970	33 792
Colombia	9 248	19 265
Australia	16 985	18 495
Poland	12 771	17 646
Other	19 265	22 481

Units: kilotonnes

Natural Gas	1990	1997
USSR	1 972 001	2 430 185
Norway	1 030 691	1 741 842
Algeria	1 077 541	1 709 750
Libya	58 029	46 168
Other	229 225	79 378

Units: Terajoules (GCV)

Oil imports from Norway, Saudi Arabia and the USSR all increased substantially between 1990 and 1997, and now account together for 57% of EU imports (33% in 1990). Imports from all other countries fell over the same period.

Coal imports from countries producing low sulphur coal (Indonesia, Colombia, Canada, South Africa, Poland) all increased substantially.

The USSR, Norway and Algeria have increased their share of gas imports from 93% in 1990 to 98% in 1997.

indicator 2.9 Gross Inland Consumption

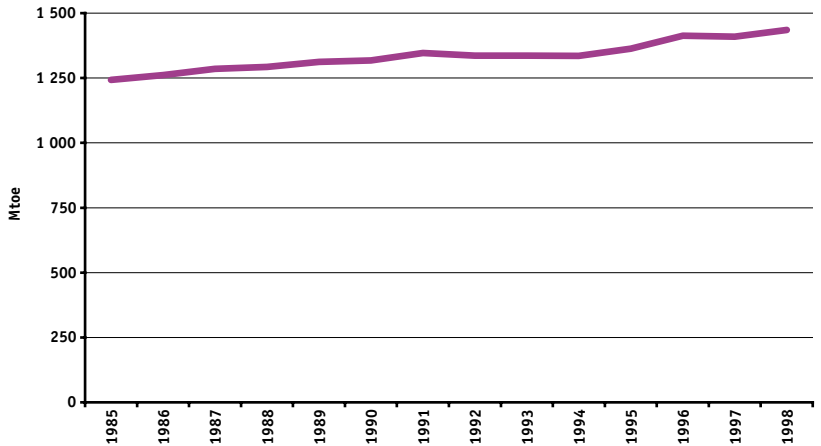


table 2.9 Gross Inland Consumption

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
GIC	1 242 354	1 261 478	1 285 417	1 292 987	1 311 816	1 318 087	1 346 394	1 336 323	1 335 757	1 335 653	1 363 479	1 412 686	1 409 540	1 435 331

Units: Thousand tonnes of oil equivalent (ktoe)

Gross inland consumption is the total consumption of primary energy within EU-15. This includes energy produced within EU-15 plus net imports, after allowing for stock changes and bunkers.

Gross inland consumption in EU-15 increased by 9% over the period 1990 to 1998. Most of this increase took place since 1994, following a period of relative stability during the preceding four years.

This pattern of consumption broadly reflected economic growth, there being a period of relative recession from 1990 to 1994 but more rapid growth in recent years. Consumption also reflects climatic factors, with the peak in 1996 coinciding with a relatively severe winter and increased heating demand.

indicator 2.10 Gross Inland Consumption, by Fuel

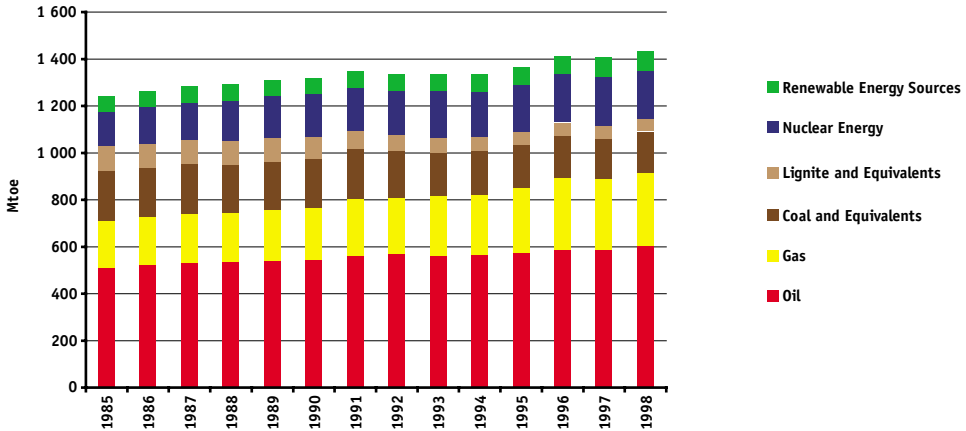


table 2.10 Gross Inland Consumption, by Fuel

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Renewable Energy Sources	67 026	65 569	68 533	69 145	65 040	65 804	68 916	70 834	72 430	72 636	73 348	76 052	81 771	84 816
Nuclear Energy	147 378	158 500	162 037	173 332	182 429	181 439	187 021	188 267	197 558	197 271	201 240	208 864	212 615	209 664
Lignite and Equivalents	102 838	101 040	98 371	97 672	98 565	91 079	74 222	66 681	61 677	58 047	55 445	54 968	51 852	49 617
Coal and Equivalents	213 345	208 875	213 225	207 692	207 487	210 073	212 048	199 931	185 382	184 613	182 329	179 919	171 635	173 102
Gas	197 965	200 698	212 710	206 522	215 651	222 052	239 693	237 113	252 230	253 635	273 351	305 137	302 540	315 499
Oil	512 268	525 359	528 790	536 345	540 020	545 051	563 079	571 665	564 369	567 700	576 043	587 662	587 753	601 167

Units: Thousand tonnes of oil equivalent (ktoe)

The total consumption of energy in EU-15 has increased (see 2.9), but there are significant differences between different fuels. The biggest change is in the use of gas, which increased its share of consumption from 17% to 22% between 1990 and 1998. This is due to its increased use in the industrial, domestic and electricity generating sectors, both because of its increased availability and also because of the need to reduce emissions. The contribution of nuclear energy to total energy consumption has risen by 1% during the period from 1990 to 1998. Despite this limited growth, nuclear now accounts for 15% of total energy consumption.

The largest source of energy throughout the period 1990 to 1998 has been oil, which has consistently accounted for more than 40% of total consumption. Consumption of oil accounted for 42% of total energy consumption in 1998, and much of this related to use in the transport sector (see 3.11). Use of coal and lignite has decreased sharply, by 18% and 46% respectively during the period 1990 to 1998, and reflects the shift away from these more polluting fuels. Consumption of energy derived from renewable sources has increased by 29%, but its share of the total increased by only 1% between 1990 and 1998.

indicator 2.11 Indices of Gross Inland Consumption, by Fuel

Reference Year = 1990

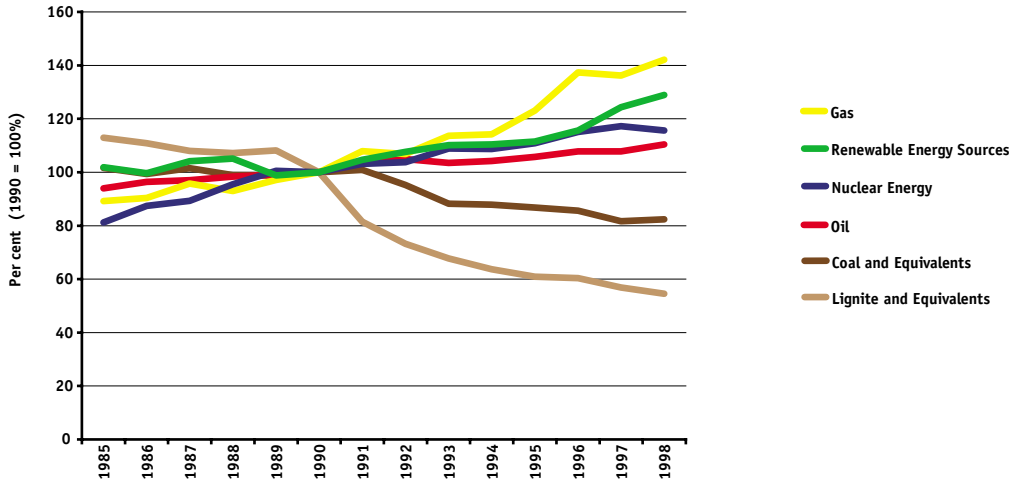


table 2.11 Indices of Gross Inland Consumption, by Fuel Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gas	89	90	96	93	97	100	108	107	114	114	123	137	136	142
Renewable Energy Sources	102	100	104	105	99	100	105	108	110	110	112	116	124	129
Nuclear Energy	81	87	89	96	101	100	103	104	109	109	111	115	117	116
Oil	94	96	97	98	99	100	103	105	104	104	106	108	108	110
Coal and Equivalents	102	99	102	99	99	100	101	95	88	88	87	86	82	82
Lignite and Equivalents	113	111	108	107	108	100	82	73	68	64	61	60	57	54

Units: Per cent (1990 = 100 %)

These data illustrate the change in the contribution of different fuels to the gross inland consumption in EU-15 Member States.

The drop in the consumption of lignite and coal can be clearly seen, in contrast with the sharp rise in the use of natural gas. The decline in solid fuel consumption and increase in gas consumption reflects mainly fuel switching between the two as a result of the increased availability and lower emissions of natural gas. The slower growth in oil is similar to the growth in total consumption, with oil maintaining a constant proportion of the gross inland consumption.

Consumption of nuclear energy and energy derived from renewable sources are also increasing, both in absolute terms and in terms of their contribution to total consumption. However, nuclear output has stabilised over the last three years, reflecting the lack of new capacity coming on line. In contrast, the contribution of renewable energy sources has grown most rapidly over the same period.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3 Final Energy Consumption

indicator 3.1 Final Energy Consumption

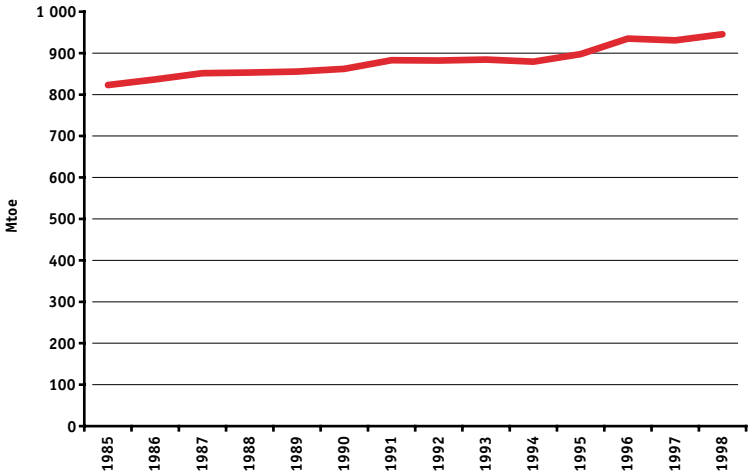

table 3.1 Final Energy Consumption

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	823 167	836 674	851 433	853 287	855 598	862 220	882 811	882 294	884 601	879 402	897 503	935 197	931 018	944 715

Units: Thousand tonnes of oil equivalent (ktoe)

Final Energy Consumption is the energy actually consumed by end users. It is lower than the Gross Inland Consumption (see 2.9), which is the total supply of energy available for transformation into other products or for direct consumption. The difference is mainly accounted for by losses in conversion to secondary energy commodities such as electricity, by distribution losses and by the use of fuels for non-energy purposes.

Final Energy Consumption has increased by 10% over the period 1990 to 1998.

The data indicate a period of relative stability in the early 1990s, with a marginal decline of 0.4% from 1991 to 1994. This reflects the fact that energy consumption is linked to economic activity, and this was a period of low economic growth across the EU. In contrast, the peak in 1996 relates to the severity of the winter across Europe that year, since this increases the consumption of energy for heating purposes.

indicator 3.2 Ratio of Final Energy Consumption to Gross Inland Consumption

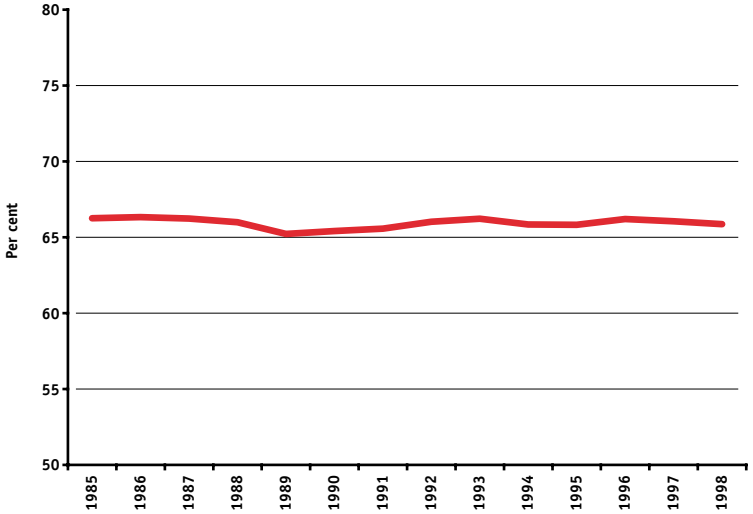

table 3.2 Ratio of Final Energy Consumption to Gross Inland Consumption

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Ratio	66.3	66.3	66.2	66.0	65.2	65.4	65.6	66.0	66.2	65.8	65.8	66.2	66.1	65.8

Units : Per cent

As already noted (see 3.1), the difference between Gross Inland Consumption (GIC) and Final Energy Consumption (FEC) is accounted for mainly by losses incurred during energy conversion processes (for example, electricity generation from fossil fuels), by distribution losses (e.g. in electricity transmission), and by the consumption of energy by the energy industry itself. In addition to these losses, a small quantity of energy products is used for non-energy purposes, such as feedstocks within the chemical industry.

The ratio of FEC to GIC remained relatively stable throughout the period from 1990 to 1998. The minimum was 65.4% (1990) and the maximum 66.2% (1993 and 1996).

However, the ratio does differ between Member States. For example, countries which import nearly all of their energy have a higher ratio due to their smaller transformation sector. The ratio is also higher in countries where renewable energy accounts for a significant fraction of energy supply. In contrast, the ratio is lower in countries where nuclear energy makes a significant contribution. This is because the conversion process from nuclear heat to electrical power is less efficient than in power generation using other primary energy sources.

indicator 3.3 Final Energy Consumption, by Sector

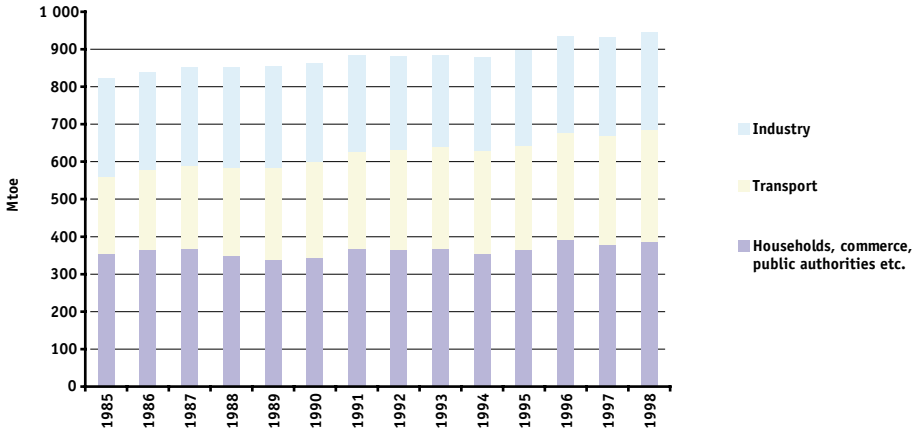

table 3.3 Final Energy Consumption, by Sector

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Industry	264 439	259 108	264 149	268 816	271 565	265 226	256 408	252 539	246 505	250 830	257 462	259 581	262 645	261 575
Transport	202 805	213 580	220 790	234 737	245 018	253 847	257 124	265 329	271 209	272 154	275 689	283 382	288 766	298 858
Households, commerce, public authorities etc.	355 923	363 986	366 495	349 734	339 015	343 147	369 280	364 426	366 888	356 418	364 353	392 234	379 607	384 282

Units: Thousand tonnes of oil equivalent (ktoe)

In terms of final energy consumption, there are significant differences between different sectors of the economy.

Industry was the only sector where energy consumption decreased over the period from 1990 to 1998, with a fall of just 1%. However, industry accounted for 31% of total consumption in 1990, and by 1998 this had fallen to 28%. This relative decline reflects the contraction in manufacturing industry across the EU over this period, together with improvements in energy efficiency that have been achieved. Consumption in the sector was lowest during the recession of the early 1990s.

Energy consumption in the transport sector has increased consistently throughout the period. Transport is the only sector where consumption increased every year from 1990 to 1998, and this sector now accounts for 32% of total consumption. This increase is due to a significant rise in travel, particularly by road and air.

The households, commerce and public authorities sector has remained the largest in relation to total energy consumption (41% in 1998 compared to 40% in 1990). Consumption increased by 12% over the period, with households accounting for approximately two-thirds of the total consumption in the sector.

indicator 3.4 Indices of Final Energy Consumption, by Sector

Reference Year = 1990

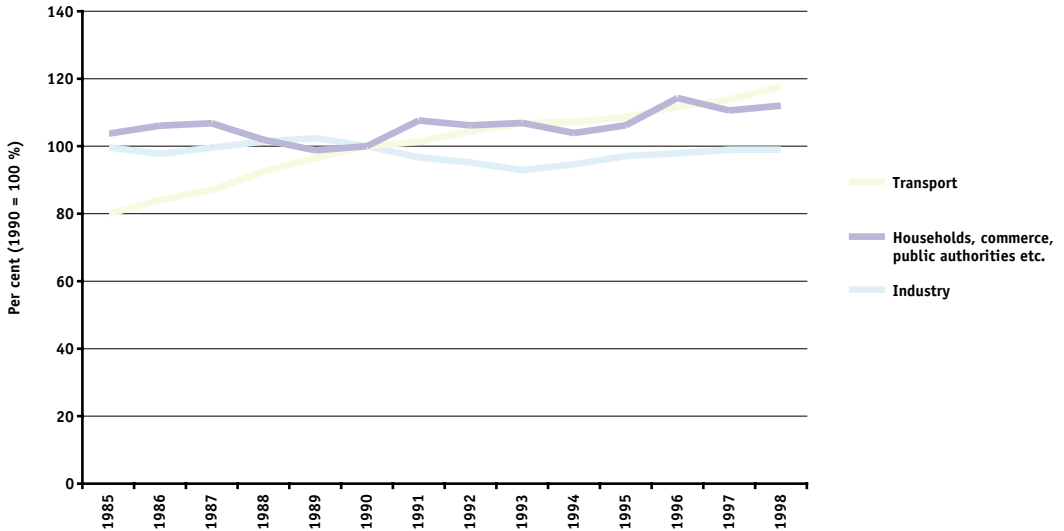

table 3.4 Indices of Final Energy Consumption, by Sector

Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Transport	80	84	87	92	97	100	101	105	107	107	109	112	114	118
Households, commerce, public authorities etc.	104	106	107	102	99	100	108	106	107	104	106	114	111	112
Industry	100	98	100	101	102	100	97	95	93	95	97	98	99	99

Units: Per cent (1990 = 100%)

The trends in consumption in the three sectors are clearly demonstrated by indices expressed relative to 1990.

Consumption in the industrial sector reflects the level of economic activity, with a decline during the recession of the early 1990s but growth since 1993.

The significant and continuing growth in energy consumption in the transport sector is clearly identified.

Consumption in the households, commerce and public authorities (tertiary) sector has also increased. This sector shows peaks relating to the severity of the winters, since the use of energy for space heating accounts for a significant part of total consumption in this sector.

indicator 3.5 Energy Consumption, by Type of Industry

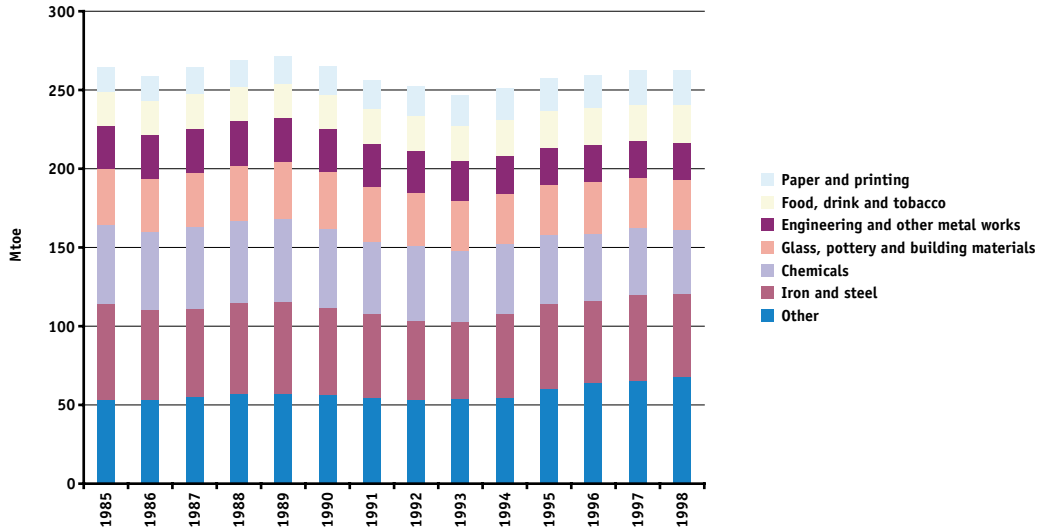

table 3.5 Energy Consumption, by Type of Industry

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Paper and printing	15 454	15 776	16 613	16 847	17 312	17 987	18 035	18 770	19 233	19 869	20 793	20 930	21 908	21 985
Food, drink and tobacco	21 569	21 582	21 938	21 720	22 005	21 945	22 333	22 448	22 320	22 475	22 978	23 571	23 242	23 650
Engineering and other metal works	27 793	27 956	28 411	27 985	27 797	27 404	27 673	26 458	24 934	24 258	23 562	23 534	23 000	24 042
Glass, pottery and building materials	35 039	33 711	34 064	35 494	36 314	35 780	34 854	34 198	32 248	32 226	32 271	32 508	32 118	31 378
Chemicals	50 366	50 051	51 999	51 801	52 422	50 307	45 608	46 967	44 620	44 320	43 638	42 830	42 400	40 424
Iron and steel	61 064	56 569	56 037	58 069	58 943	55 715	53 451	50 519	48 958	52 930	54 095	52 056	54 749	52 752
Other	53 152	53 463	55 088	56 900	56 770	56 087	54 453	53 179	54 192	54 753	60 126	64 152	65 229	67 344

Units: Thousand tonnes of oil equivalent (ktoe)

All of the more energy intensive sectors showed significant reductions in energy consumption over the period 1990 to 1998. Consumption in the iron and steel sector fell by 5%, but this sector remains the largest energy user (20% of total industrial consumption in 1998). Consumption in the chemicals sector declined by 20% over the period, and now accounts for 15% of the total. The glass, pottery and building materials sector also showed a more modest decline (12%), along with the less energy intensive engineering sector (12%).

In contrast, consumption in the less energy-intensive sectors increased over the same period. Consumption in the paper and printing sector increased by 22% between 1990 and 1998, while consumption in the food, drink and tobacco sector increased by 8% and other sectors not separately classified increased by 20%. However, the food and paper sectors together still accounted for only 17% of total industrial consumption in 1998, while other sectors accounted for 26%.

indicator 3.6 Indices of Energy Consumption, by Type of Industry

Reference Year = 1990

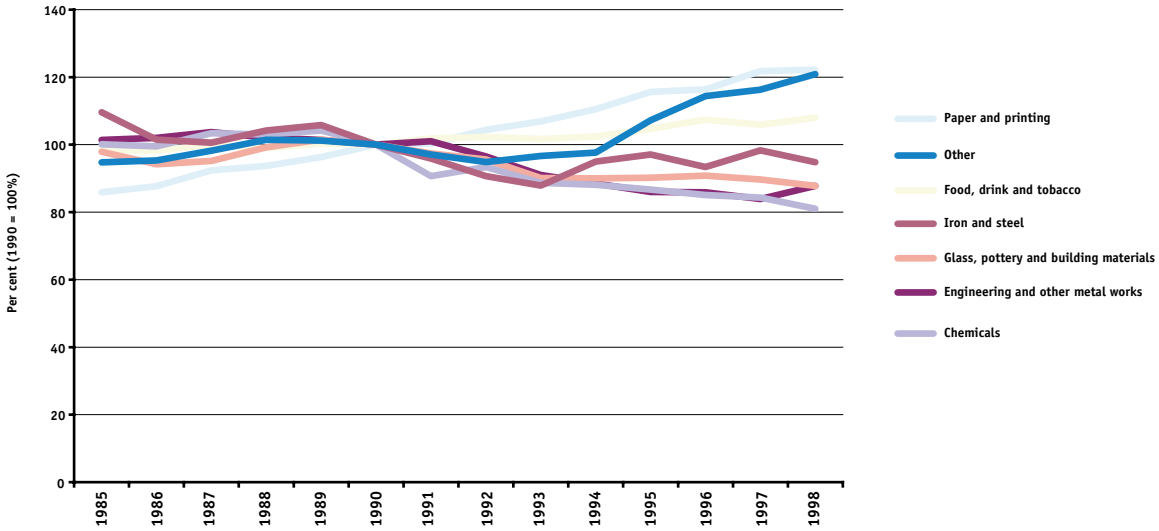

table 3.6 Indices of Energy Consumption, by Type of Industry

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Paper and printing	86	88	92	94	96	100	100	104	107	111	116	116	122	122
Other	95	95	98	101	101	100	97	95	97	98	107	114	116	120
Food, drink and tobacco	98	98	100	99	100	100	102	102	102	102	105	107	106	108
Iron and steel	110	102	101	104	106	100	96	91	88	95	97	93	98	95
Glass, pottery and building materials	98	94	95	99	101	100	97	96	90	90	90	91	90	88
Engineering and other metal works	101	102	104	102	101	100	101	97	91	89	86	86	84	88
Chemicals	100	99	103	103	104	100	91	93	89	88	87	85	84	80

Units: Per cent (1990 = 100 %)

A downward trend in energy consumption in the three energy intensive industries (iron and steel, chemicals, glass, pottery and building materials) and engineering is evident from the early 1990s.

Energy consumption in the food, drink and tobacco sector has shown modest but sustained growth across the period 1990 to 1998, whereas the paper and printing sector has shown much more rapid growth. Other industrial sectors were affected by the recession during the early 1990s, but have seen rapid recovery and growth in recent years.

indicator 3.7 Energy Consumption in Industry, by Fuel

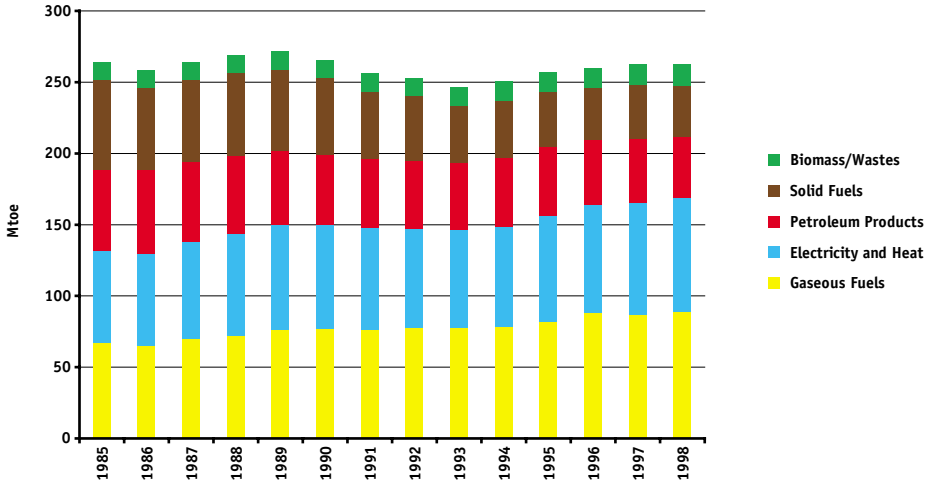

table 3.7 Energy Consumption in Industry, by Fuel

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Biomass/Wastes	12 342	12 319	12 413	12 377	12 885	12 585	12 692	12 188	13 017	13 783	14 052	13 889	14 754	15 205
Solid Fuels	63 519	57 886	57 159	57 642	56 872	53 486	47 672	45 185	40 126	40 133	39 138	36 332	37 684	35 546
Petroleum Products	56 595	58 318	56 545	55 475	51 938	48 857	48 261	47 712	46 588	48 227	47 802	45 296	44 714	42 171
Electricity and Heat	65 189	65 753	67 779	71 036	73 275	73 111	71 321	70 186	69 456	70 566	74 447	75 812	78 427	79 857
Gaseous Fuels	66 172	64 744	70 190	72 234	76 580	77 160	76 435	77 248	77 302	78 106	82 008	88 238	87 053	88 784

Units: Thousand tonnes of oil equivalent (ktoe)

Solid fuels accounted for 20% of industrial energy consumption in 1990, but by 1998 this had fallen to 14%. The use of petroleum products in industry also declined from 18% in 1990 to 16% in 1998.

In contrast the use of all other sources of energy increased over the period. The most significant increase was in the use of gas, which is now the largest single energy source and accounted for 34% of the total in 1998 compared to 29% in 1990. The increase in gas use partly reflects an increased use of this fuel in industrial boilers due to the operational and efficiency benefits it gives. There has also been a significant (9%) increase in electricity consumption by industry between 1990 and 1998, and this now accounts for 31% of the total consumption in the sector. The contribution of biomass and wastes remains modest (6% of the total in 1998), but consumption of this form of energy has increased by 21% over the period 1990 to 1998.

indicator 3.8 Indices of Energy Consumption in Industry, by Fuel Reference Year = 1990

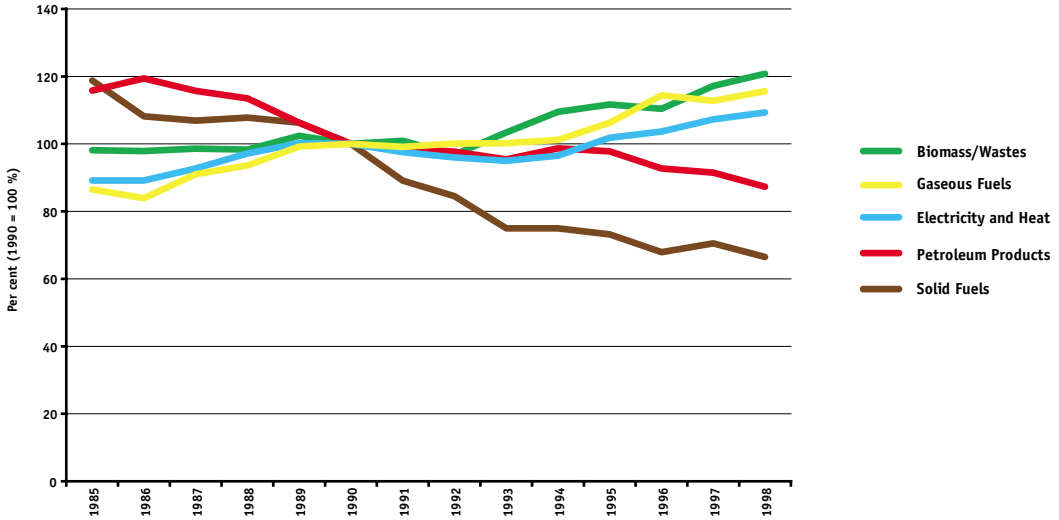

table 3.8 Indices of Energy Consumption in Industry, by Fuel Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Biomass/Wastes	98	98	99	98	102	100	101	97	103	110	112	110	117	121
Gaseous Fuels	86	84	91	94	99	100	99	100	100	101	106	114	113	115
Electricity and Heat	89	90	93	97	100	100	98	96	95	97	102	104	107	109
Petroleum Products	116	119	116	114	106	100	99	98	95	99	98	93	92	86
Solid Fuels	119	108	107	108	106	100	89	84	75	75	73	68	70	66

Units: Per cent (1990 = 100%)

The rapid and continuing decline in the contribution of solid fuels to industrial energy consumption from 1990 to 1998 reflects both the decline in the more energy intensive industries that traditionally used solid fuels, and the move towards cleaner and cheaper fuels. The increase in the use of both electricity and gas by industry was slowed by the recession in the early 1990s, but has now accelerated again.

indicator 3.9 Energy Consumption, by Mode of Transport

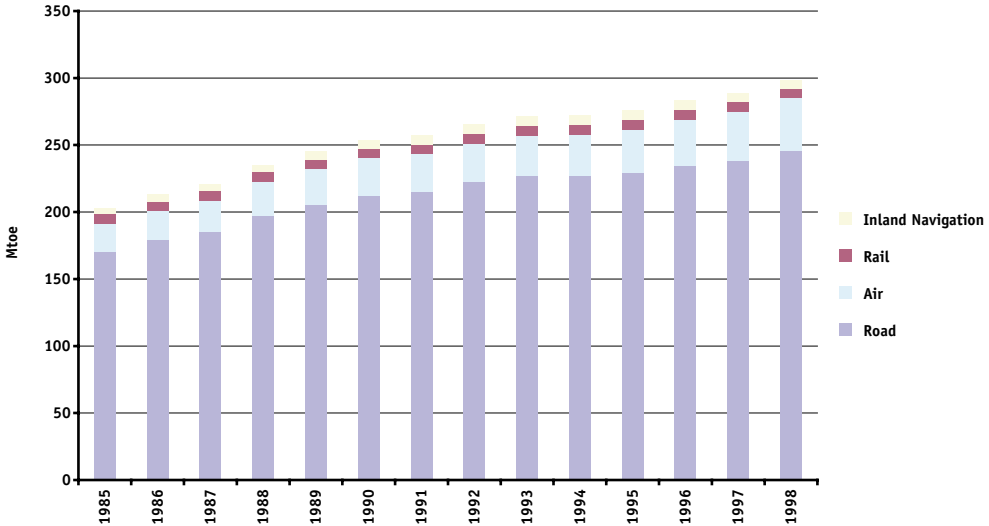

table 3.9 Energy Consumption, by Mode of Transport

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Inland Navigation	4 328	5 503	5 030	5 005	6 076	6 684	6 843	7 140	6 901	6 969	6 686	6 862	6 515	6 356
Rail	6 966	6 954	6 984	6 813	6 740	6 888	7 083	7 133	7 330	7 295	7 438	7 572	7 617	7 605
Air	21 093	22 076	23 246	25 435	26 815	27 808	27 877	28 796	30 049	31 303	32 545	34 367	36 060	38 939
Road	170 419	179 047	185 530	197 484	205 388	212 468	215 321	222 260	226 929	226 587	229 020	234 580	238 574	245 958

Units: Thousand tonnes of oil equivalent (ktoe)

All modes of transport except inland navigation have shown substantial increases in energy consumption over the period 1990 to 1998, with total consumption increasing by 18%. The proportion of energy consumed by each mode has, however, remained approximately constant.

Road transport consumes by far the largest share, with 82% of the total in 1998 (84% in 1990). Air travel has seen both the largest percentage increase and the fastest rate of rise in energy consumption, with a 40% rise over the period 1990 to 1998, which has increased its share from 11% to 13% of the total.

Energy consumption for rail transport increased by 10% between 1990 and 1998. During the same period energy consumption by inland navigation fell by 5%. Rail and inland navigation account for only a relatively small proportion of the total energy consumption in transport, with shares of 2.5% and 2.1% respectively in 1998.

indicator 3.10 Indices of Energy Consumption, by Mode of Transport

Reference Year = 1990

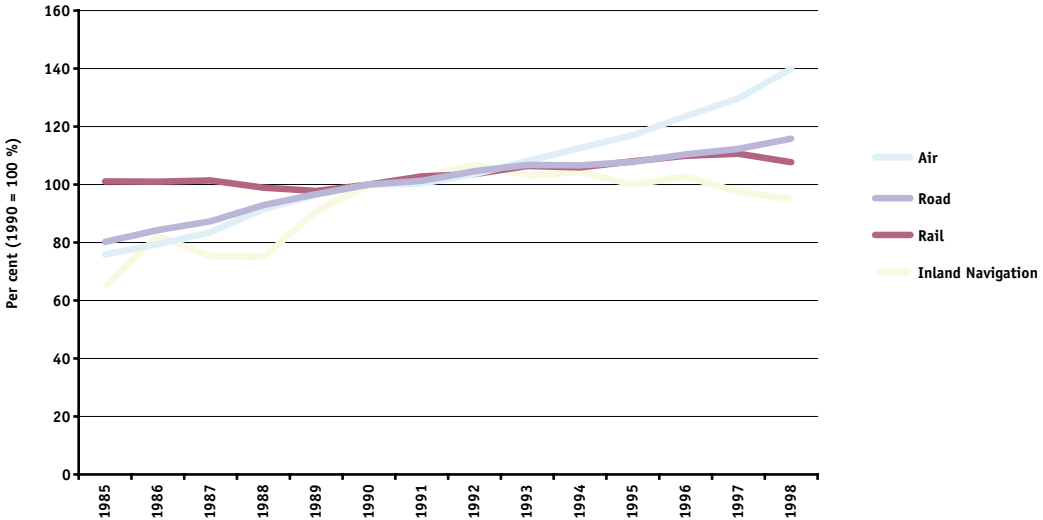

table 3.10 Indices of Energy Consumption, by Mode of Transport

Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Air	76	79	84	91	96	100	100	104	108	113	117	124	130	140
Road	80	84	87	93	97	100	101	105	107	107	108	110	112	116
Rail	101	101	101	99	98	100	103	104	106	106	108	110	111	110
Inland Navigation	65	82	75	75	91	100	102	107	103	104	100	103	97	95

Units: Per cent (1990 = 100%)

The above indices clearly demonstrate the different rates of change in energy consumption for different modes of transport. Energy consumption for air transport increased most rapidly, with an average annual increase of 4.3% over the period 1990 to 1998 compared to 2.1% for transport as a whole. This reflects the increased demand for air travel across the EU-15 and globally.

Energy use in road transport has increased by 16% over the period 1990 to 1998, reflecting the increased use being made of road vehicles for both passenger and freight transport. Passenger transport by car (expressed in passenger-km) increased by 14% over the period, while domestic freight transport (tonne-km) increased by 35%.

The growth in energy consumption for rail transport has been slower, with only a 10% increase over the period. This reflects a small (2.7%) increase in the number of passenger-km travelled, and a decrease of 5% in the amount of freight carried by rail (tonne-km).

indicator 3.11 Energy Consumption in the Transport Sector, by Fuel

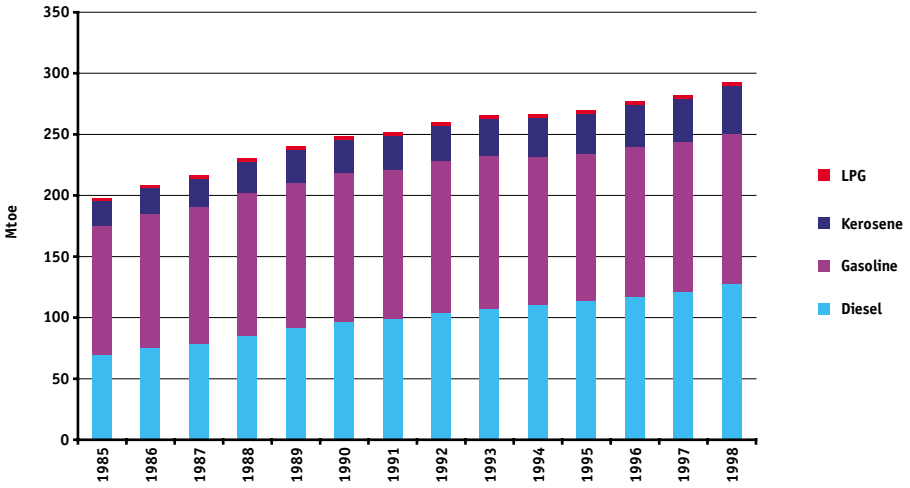

table 3.11 Energy Consumption in the Transport Sector, by Fuel

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
LPG	2 314	2 346	2 489	2 538	2 707	2 689	2 617	2 487	2 563	2 625	2 772	2 811	2 886	2 906
Kerosene	21 002	21 977	23 072	25 313	26 667	27 706	27 783	28 717	29 971	31 235	32 421	34 267	35 977	38 832
Gasoline	105 880	110 095	112 992	117 294	119 217	122 318	122 417	124 871	125 979	122 177	121 077	123 130	122 588	123 003
Diesel	68 956	74 437	77 546	84 818	91 481	96 006	98 826	103 508	106 798	109 995	113 294	116 870	120 980	127 700

Units: Thousand tonnes of oil equivalent (ktoe)

There have been significant changes in the balance of the fuels used in the transport sector. The most significant change was a 33% increase in the use of diesel fuel over the period from 1990 to 1998, increasing its share of the total from 39% to 44%. This illustrates the increase in popularity of diesel-fuelled vehicles. Diesel and gasoline are used mainly for road transport, although diesel is also used in inland navigation and rail transport.

LPG consumption increased by 8% between 1990 and 1998 but its share of the total remains around 1%. Kerosene is used exclusively as an aircraft fuel, and the increase in consumption of kerosene to 13% of the total directly reflects the increase in the use of this mode of transport.

indicator 3.12 Indices of Energy Consumption in the Transport Sector

Reference Year = 1990

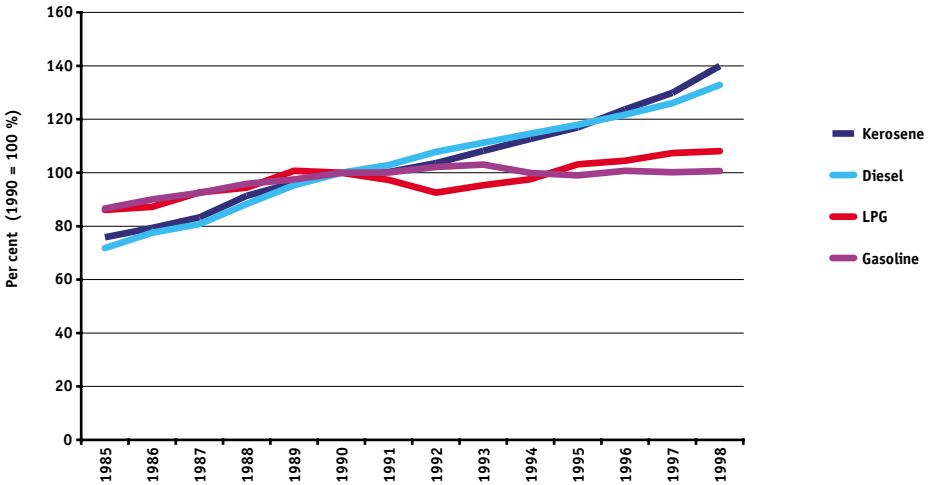

table 3.12 Indices of Energy Consumption in the Transport Sector

Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Kerosene	76	79	83	91	96	100	100	104	108	113	117	124	130	140
Diesel	72	78	81	88	95	100	103	108	111	115	118	122	126	133
LPG	86	87	93	94	101	100	97	93	95	98	103	105	107	108
Gasoline	87	90	92	96	97	100	100	102	103	100	99	101	100	101

Units: Per cent (1990 = 100%)

The indices clearly show the changes in the balance of transport fuels already described (see 3.11). The most rapid growth has been in the use of kerosene for air transport, which increased by an average of 4.3% per annum over the period from 1990 to 1998. The consumption of diesel increased by 33% over the same period (3.6% per annum), reflecting fuel switching from gasoline in the road sector and its use in rail and inland navigation.

There was an 8% increase in LPG consumption for transport over the period 1990 to 1998. Consumption of LPG fell significantly in the early nineties, but has increased progressively since 1992.

The consumption of gasoline remained relatively stable over the period from 1990 to 1998, although in absolute terms it remains the most widely used transport fuel. It follows that the observed increase in road transport over the period has taken place with diesel-fuelled rather than gasoline-fuelled vehicles.

indicator 3.13 Consumption of Unleaded Gasoline as Percentage

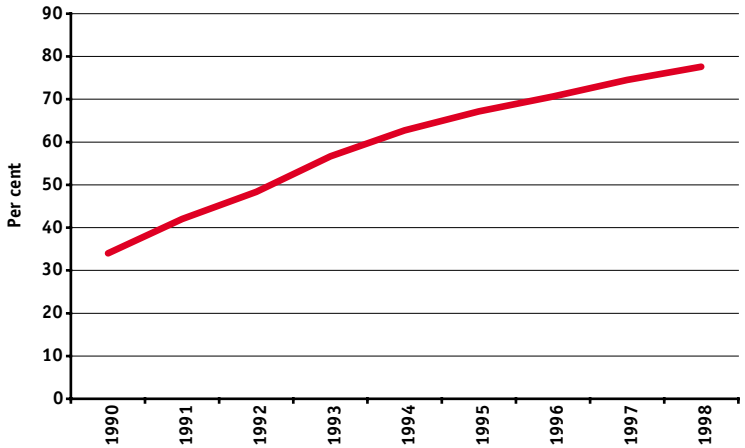

table 3.13 Consumption of Unleaded Gasoline as Percentage

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Per cent unleaded	34	42	48	57	63	67	71	75	78

Units: Per cent

In many EU Member States unleaded gasoline is taxed at a lower rate than leaded fuel, however this tax differential has reduced during the nineties (see 7.7 and 7.8).

Since its introduction, unleaded gasoline has been steadily increasing its share of the market. By 1998 unleaded gasoline accounted for 78% of all gasoline sales within EU-15, but there are significant differences between Member States. In 1998 for example, unleaded gasoline accounted for 100% of sales in Denmark, Germany, The Netherlands, Austria, Finland and Sweden, but for a much lower proportion in countries such as Greece and Spain (48%), Portugal (54%) and Italy (56%).

indicator 3.14 Energy Consumption in Agriculture, Services and Households, by Fuel

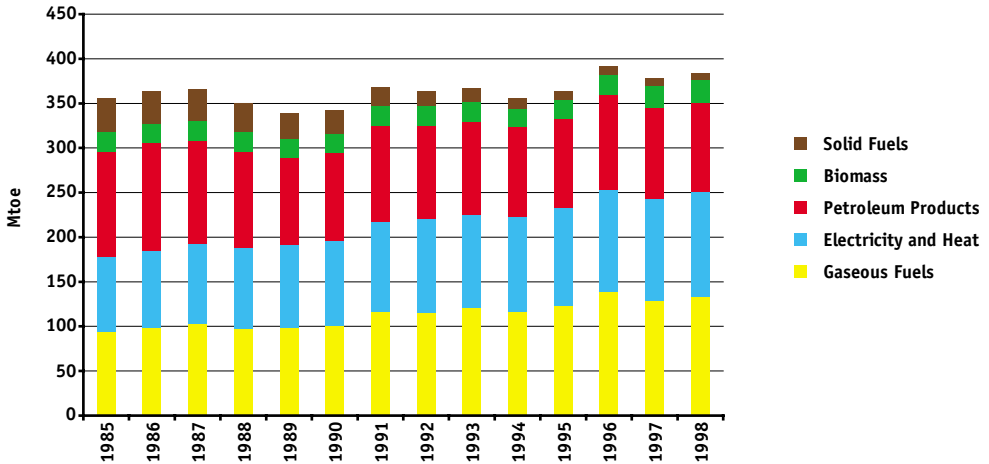

table 3.14 Energy Consumption in Agriculture, Services and Households, by Fuel

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Solid Fuels	37 780	36 609	35 748	31 528	28 357	26 606	21 193	16 076	14 826	11 749	9 828	9 959	8 744	6 787
Biomass	22 188	21 848	22 268	21 548	21 262	21 608	23 357	22 800	22 250	20 630	21 212	21 939	25 373	26 263
Petroleum Products	117 900	120 430	115 274	108 375	97 469	98 318	107 385	104 303	103 736	99 904	99 891	106 562	101 240	99 859
Electricity and Heat	83 437	86 300	90 256	90 841	92 666	95 250	99 909	105 068	104 652	106 462	109 319	113 899	114 244	117 444
Gaseous Fuels	94 436	98 590	102 715	97 187	98 767	100 865	116 911	115 624	120 853	117 067	123 470	139 187	129 316	133 221

Units: Thousand tonnes of oil equivalent (ktoe)

The total energy consumption in this sector increased by 12% over the period from 1990 to 1998. The sector is dominated by household energy use, mainly fuels and electricity for space heating.

There has been a dramatic reduction in the use of solid fuels in this sector, with consumption falling by 74% between 1990 and 1998. Solid fuels now account for only 1.8% of total consumption in the sector (compared to 7.8% in 1990), reflecting the general trend away from these fuels in favour of less polluting energy sources. In contrast, the consumption of both electricity and gaseous fuels has increased significantly over the period. Gas consumption increased by 32% between 1990 and 1998. Gas remains the largest single fuel source, accounting for 35% of the total consumption in the sector. Electricity and heat consumption increased by 23% over the period, and now accounts for 31% of the total.

The use of petroleum products remained relatively stable from 1990 to 1998. This contrasts with the period from 1985 to 1990, when the consumption of petroleum products fell as many householders switched from oil to gas, electricity or heat for heating purposes.

Biomass contributed only 6.8% of the total energy consumed in this sector during 1998.

indicator 3.15 Indices of Energy Consumption in Agriculture, Services and Households, by Fuel

Reference Year = 1990

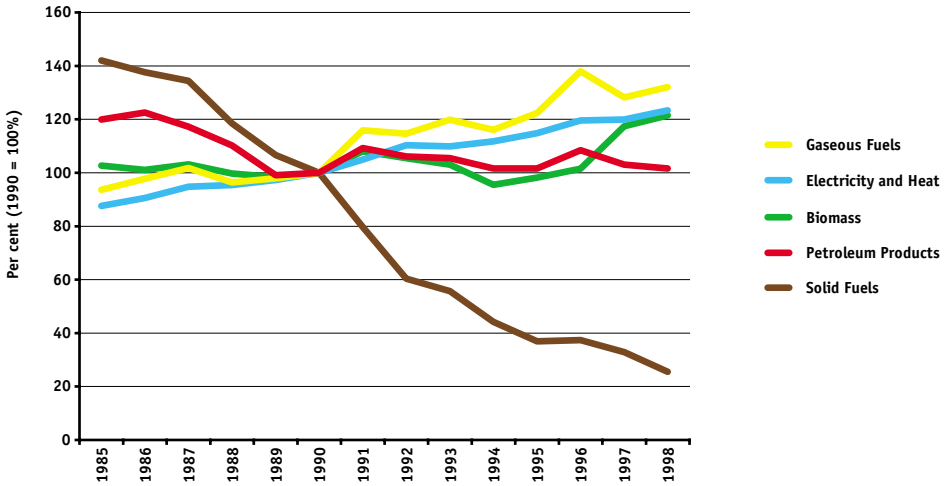

table 3.15 Indices of Energy Consumption in Agriculture, Services and Households, by Fuel

Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gaseous Fuels	94	98	102	96	98	100	116	115	120	116	122	138	128	132
Electricity and Heat	88	91	95	95	97	100	105	110	110	112	115	120	120	123
Biomass	103	101	103	100	98	100	108	106	103	95	98	102	117	122
Petroleum Products	120	122	117	110	99	100	109	106	106	102	102	108	103	102
Solid Fuels	142	138	134	119	107	100	80	60	56	44	37	37	33	26

Units: Per cent (1990 = 100%)

The indices reflect the trends already observed (see 3.14).

The significant reduction in the use of solid fuels since 1990 (and indeed before that date) is clear, with a continuous decrease in all years and an average annual fall of 15.7% over the period 1990 to 1998.

Consumption of gas increased most rapidly, and the general trend reflects fuel switching from solid fuels and (to a lesser extent) from petroleum products. The trend in electricity consumption was similar to that for gas, although the overall increase (23%) over the period 1990 to 1998 was less pronounced.

The use of petroleum products remained relatively stable throughout the period 1990 to 1998.

Consumption of energy derived from biomass has also increased over the period, but starting from a lower base. As in the industrial sector (see 3.8), most of this growth occurred from 1995 to 1998.

indicator 3.16 Energy Consumption in Households, by Fuel

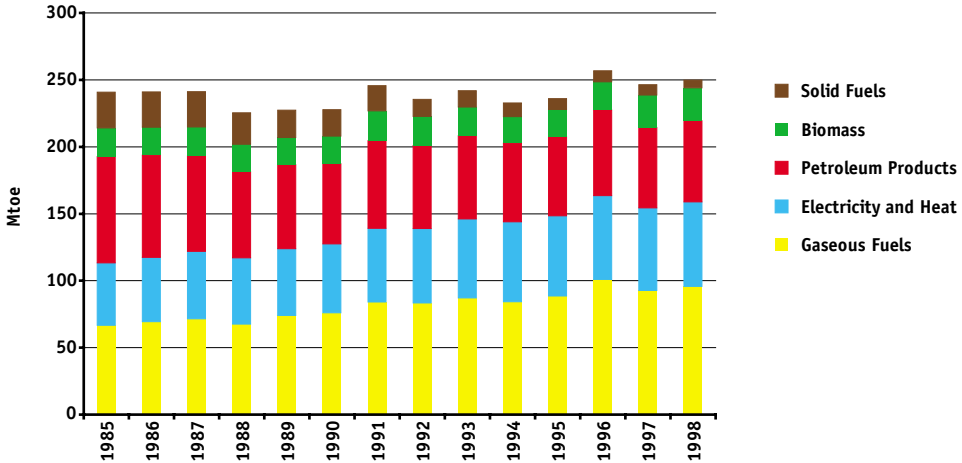

table 3.16 Energy Consumption in Households, by Fuel

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Solid Fuels	26 711	26 253	26 363	23 499	20 427	19 751	18 789	12 667	12 089	10 149	8 086	8 294	7 646	5 801
Biomass	21 185	20 845	21 265	20 545	20 246	20 576	22 279	21 701	21 329	19 780	20 258	20 906	24 282	24 549
Petroleum Products	79 461	76 355	71 645	64 348	62 846	59 841	65 411	61 999	62 309	58 790	59 216	64 034	60 073	60 690
Electricity and Heat	46 756	48 010	50 338	49 343	49 744	51 544	55 107	55 697	58 853	59 649	59 833	62 690	61 665	63 013
Gaseous Fuels	66 627	69 465	71 558	67 690	74 148	76 039	84 126	83 305	87 232	84 319	88 664	100 897	92 723	95 570

Units: Thousand tonnes of oil equivalent (ktoe)

Household energy consumption accounts for over 60% of total consumption in the agriculture, services, public administration and households sector. It follows that the trends in the households sub-sector are similar to those in the sector as a whole (see 3.14).

Overall, the energy consumption in households increased by 9.6% between 1990 and 1998.

By 1998, the consumption of solid fuels in households had fallen to less than a third of its 1990 level. In contrast, the consumption of gas increased by 26% over the same period, and gas now accounts for 38% of total consumption. The consumption of electricity also increased by 22% over the same period.

The consumption of petroleum products increased by 1% from 1990 to 1998, but a more accurate picture of the trend in consumption is obtained by considering the overall decrease of 7% which occurred between 1991 and 1998 (see 3.17). It should however be noted that the energy consumption data have not been corrected for temperature variations.

The use of biomass increased slightly, and now accounts for 9.8% of household energy consumption across EU-15.

indicator 3.17 Indices of Energy Consumption in Households, by Fuel

Reference Year = 1990

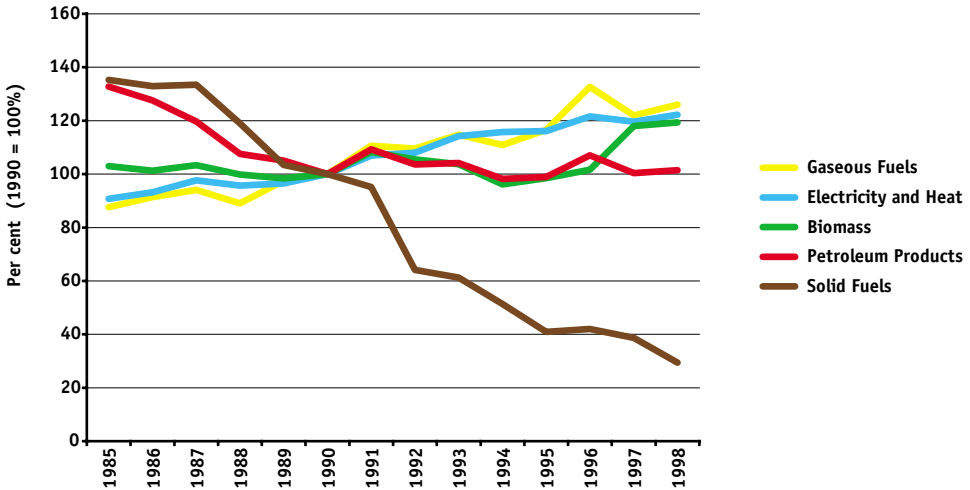

table 3.17 Indices of Energy Consumption in Households, by Fuel

Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gaseous Fuels	88	91	94	89	98	100	111	110	115	111	117	133	122	126
Electricity and Heat	91	93	98	96	97	100	107	108	114	116	116	122	120	122
Biomass	103	101	103	100	98	100	108	105	104	96	98	102	118	119
Petroleum Products	133	128	120	108	105	100	109	104	104	98	99	107	100	101
Solid Fuels	135	133	133	119	103	100	95	64	61	51	41	42	39	29

Units: Per cent (1990 = 100%)

The above indices demonstrate the trends already observed (see 3.16).

The use of solid fuels has decreased at an average annual rate of 14.2% over the period 1990 to 1998, reflecting the move away from these less convenient and more polluting sources of energy.

The corresponding increase in gas consumption is clear, reflecting its increased availability as a substitute for solid fuels and (to a lesser extent) petroleum products.

Electricity use in this sub-sector increased by 22% over the same period.

Although the consumption of petroleum products in the households sub-sector remained relatively stable, there has been a slight (1%) increase from 1990 to 1998.

Consumption of energy derived from biomass has increased. Biomass now accounts for 9.8% of total consumption in this sub-sector, while the households sub-sector accounts for no less than 93% of total biomass consumption in the sector as a whole.

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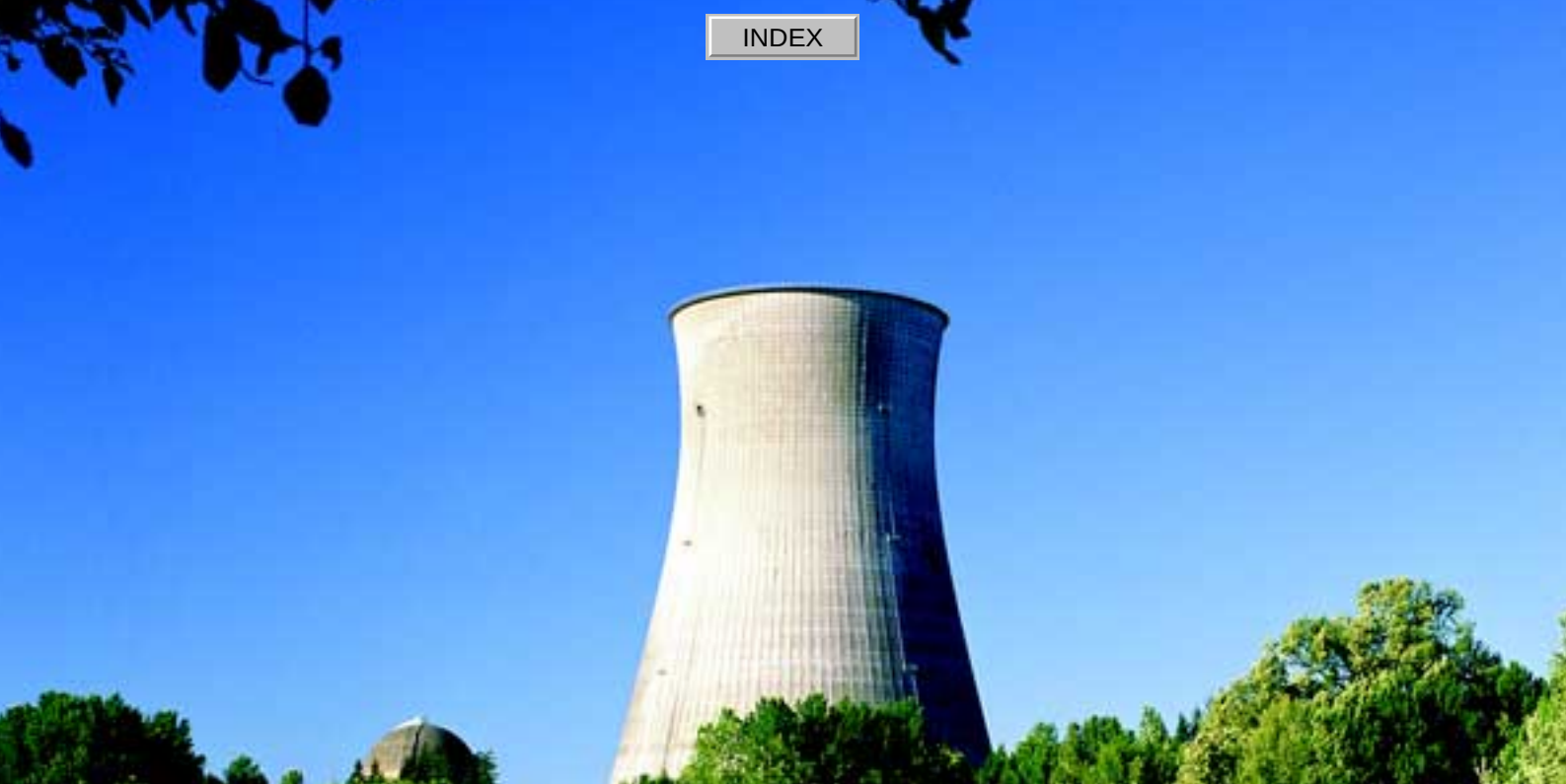

4 Energy Industry

indicator 4.1 Power Station Generation, by Type

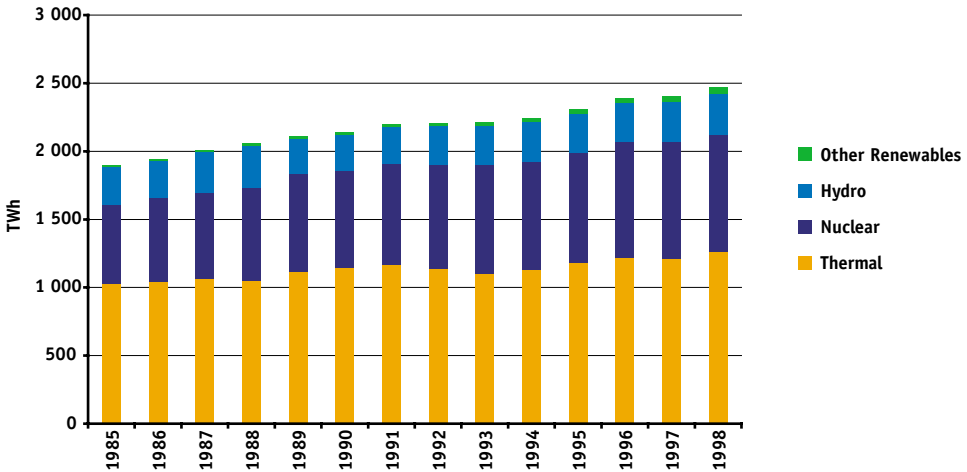

table 4.1 Power Station Generation, by Type

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Other Renewables	13 446	14 254	14 495	15 740	19 040	19 431	20 231	22 369	24 972	27 855	30 189	32 845	38 626	47 362
Hydro	283 781	269 376	295 997	311 319	251 422	259 048	268 456	285 944	289 379	296 969	290 128	288 591	296 016	305 445
Nuclear	575 023	622 559	636 472	682 018	723 391	720 189	747 352	759 925	794 284	791 953	810 266	851 200	859 893	854 182
Thermal	1 029 700	1 038 790	1 062 594	1 050 983	1 114 023	1 140 761	1 163 668	1 139 479	1 103 375	1 129 184	1 178 101	1 216 682	1 211 879	1 265 183

Units: GWh

Between 1990 and 1998 the total amount of electricity generated at power stations in EU-15 increased by 16%. Over this period, the balance between different types of power station remained broadly constant.

The largest contribution came from thermal power stations, which accounted for 51% of the total in 1998. Electricity generation from thermal power stations increased by 11% between 1990 and 1998.

There was a 19% growth in the output from nuclear power stations between 1990 and 1998, although the output remained almost constant from 1996 to 1998. This reflects the fact that fewer new nuclear power stations have been completed in recent years.

The amount of electricity produced by hydro-electric power plants increased by 18% over the period, and now accounts for just 12% of total production, which is the same percentage as in 1990.

Electricity obtained from other (i.e. non-hydropower) renewable energy sources has seen the most rapid growth, increasing by 144% between 1990 and 1998. However, this renewable energy contributed only 1.9% of total electricity production across the EU in 1998.

indicator 4.2 Fuel Input to Thermal Power Stations

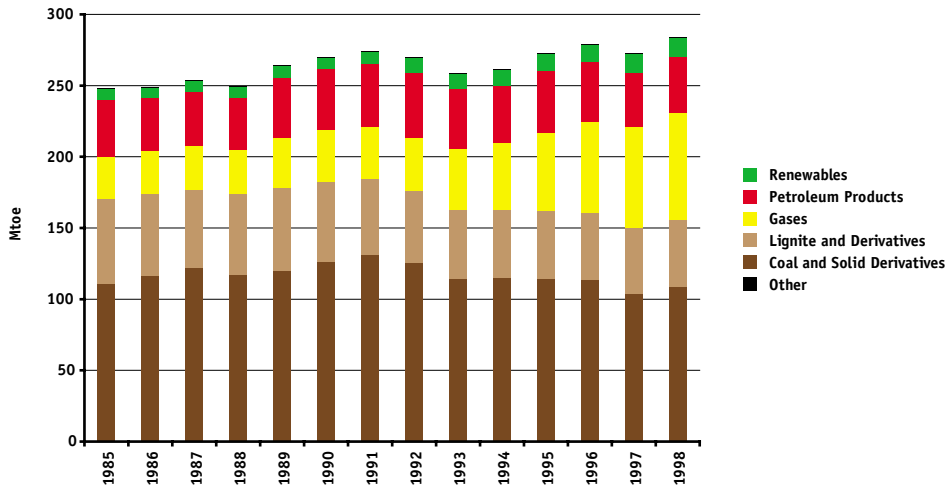

table 4.2 Fuel Input to Thermal Power Stations

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Renewables	7 525	7 636	7 770	7 785	8 341	8 387	8 747	10 030	10 798	10 924	11 635	12 019	12 961	13 256
Petroleum products	39 945	36 988	37 607	36 686	42 201	42 559	44 275	46 114	42 247	40 390	43 650	41 630	38 430	39 078
Gases	29 904	29 694	31 305	31 344	34 908	36 530	36 708	36 839	42 462	46 843	55 170	64 156	70 825	75 554
Lignite and derivatives	59 123	57 775	54 658	56 676	58 353	55 518	52 678	50 945	48 744	48 081	47 541	47 430	45 953	46 639
Coal and Solid derivatives	111 251	116 564	122 076	117 074	119 910	126 800	131 671	125 383	114 440	114 742	114 279	113 432	104 020	108 895
Other	207	215	196	194	448	257	213	216	231	199	228	220	705	338

Units: Thousand tonnes of oil equivalent (ktoe)

Fuel inputs to thermal power stations reflect both the electricity generated and the efficiency of the generation process. Overall, fuel input increased by 5% between 1990 and 1998, although there was actually a decline in 1993 and 1994.

The consumption of gas increased by 107% between 1990 and 1998, reflecting fuel switching from solid fuels.

The consumption of coal and solid derivatives fell by 14% between 1990 and 1998, broadly in line with the drop in output from coal-fired power stations. This reflects mainly fuel switching to cleaner fuels such as gas.

The use of oil products in power stations rose in the early 1990s, and peaked in 1992. Since then it has declined steadily. Overall, oil consumption fell by 8% between 1990 and 1998, and now represents just 14% of total fuel input to power production.

Again, the use of renewable fuels increased rapidly (58% between 1990 and 1998), but accounted for only 4.7% of total fuel input in 1998.

indicator 4.3 Indices of Fuel Input to Thermal Power Stations Reference Year = 1990

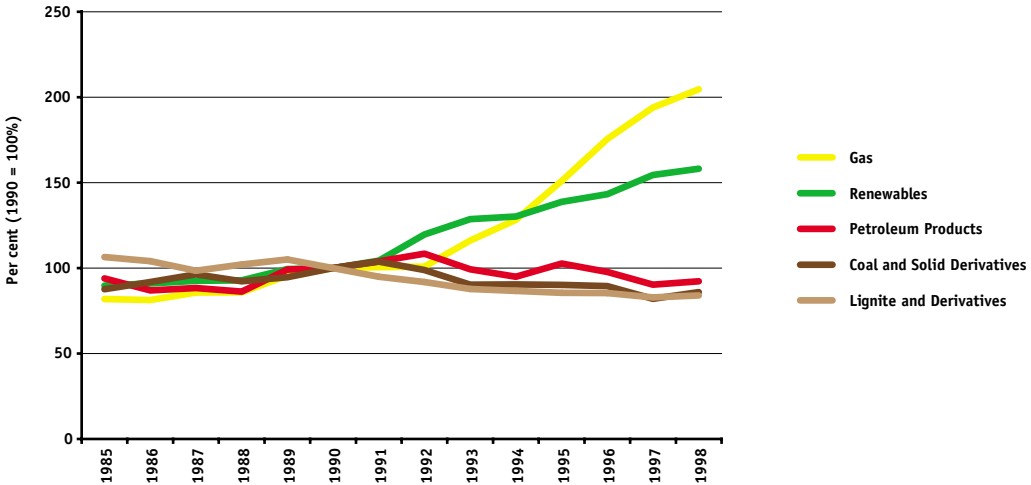

table 4.3 Indices of Fuel Input to Thermal Power Stations Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Gas	82	81	86	86	96	100	100	101	116	128	151	176	194	207
Renewables	90	91	93	93	99	100	104	120	129	130	139	143	155	158
Petroleum Products	94	87	88	86	99	100	104	108	99	95	103	98	90	92
Coal and Solid Derivatives	88	92	96	92	95	100	104	99	90	90	90	89	82	86
Lignite and Derivatives	106	104	98	102	105	100	95	92	88	87	86	85	83	84

Units: Per cent (1990 = 100%)

The indices demonstrate the relative growth or decline in the use of different fuels for power generation (see 4.2).

There has been a rapid increase in the use of gas, particularly since 1992, as new gas-fired installations came on stream to take advantage of the low emissions and increased availability of this fuel. The use of renewable energy has also increased rapidly, as it becomes more competitive with conventional fuels.

Since 1990 the use of oil in power generation has decreased by 8%, although consumption actually increased by 8% between 1990 and 1992 and declined thereafter.

Between 1990 and 1998 the use of lignite and derivatives declined by 16%, while the use of coal and solid derivatives fell by 14%. This was due mostly to fuel switching (mainly to gas) following concerns over the emissions from solid fuels.

indicator 4.4 Installed Capacity of Electricity Generation Plant, by Type

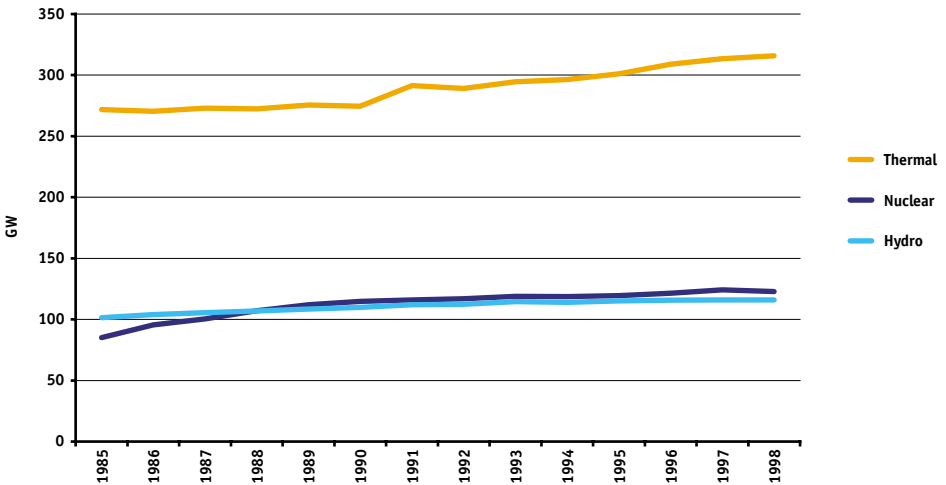

table 4.4 Installed Capacity of Electricity Generation Plant, by Type

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Thermal	271 850	270 378	272 970	272 310	275 530	274 500	291 356	289 131	294 577	296 333	301 114	308 888	313 509	316 009
Nuclear	85 062	95 435	100 470	107 140	112 000	114 670	116 004	117 003	118 850	118 718	119 560	121 449	124 180	123 130
Hydro	101 480	103 931	105 620	106 810	108 410	109 764	112 070	112 356	114 499	113 956	115 223	115 708	115 985	115 962

Units: MW

As a result of the re-unification of Germany there is a break in the above data series between 1990 and 1991. This analysis is therefore based on the period 1991 to 1998. The total installed capacity of electricity generating plants rose by 7% from 1991 to 1998. This was less than the 12% increase in the amount of electricity generated during the period (see 4.1), and reflects higher load factors and the improved availability of most of the new capacity coming on line.

The installed thermal power station capacity increased by 8% between 1991 and 1998, and now represents 57% of total capacity, compared to 56% in 1991.

Installed nuclear capacity increased by 6% from 1991 to 1998, and accounts for 22% of total capacity, as it also did in 1991. The more limited increase in nuclear capacity in recent years reflects increasing public concern over this technology. Installed hydro-electric capacity increased by only 3% over the period, with very little change since 1995. This reflects the limited opportunities for establishing new large-scale hydro-electric plants within EU-15.

indicator 4.5 Installed Capacity of Thermal Power Stations, by Type

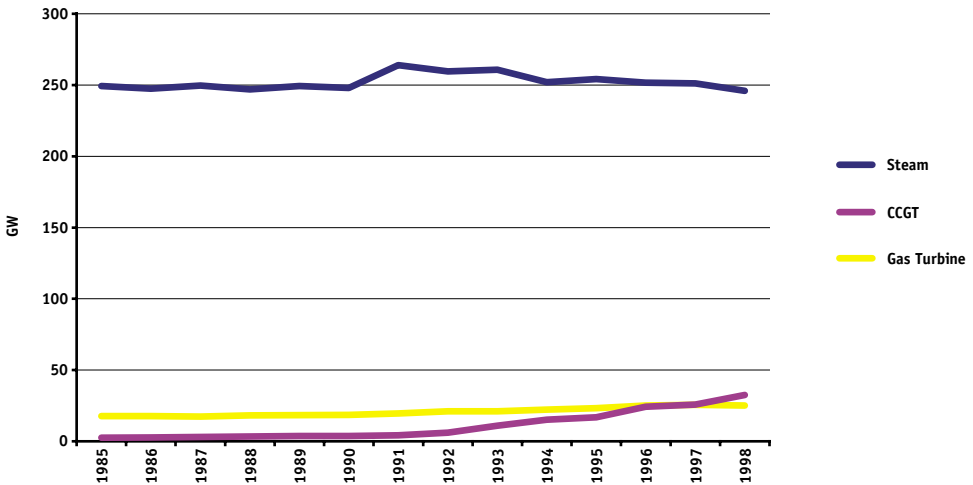

table 4.5 Installed Capacity of Thermal Power Stations, by Type

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Steam	249 290	247 402	249 634	246 897	249 344	247 954	263 924	259 617	260 676	252 043	254 137	251 630	251 223	246 352
CCGT	2 453	2 637	3 091	3 299	3 647	3 744	4 279	6 017	10 928	15 122	16 842	24 196	25 774	32 747
Gas Turbine	17 611	17 678	17 434	18 173	18 334	18 566	19 535	21 051	20 986	22 309	23 184	25 043	25 544	24 397

Units: MW

As a result of the re-unification of Germany there is a break in the above data series between 1990 and 1991. This analysis is therefore based on the period 1991 to 1998.

The installed capacity of steam generating plants fell slightly over the period 1991 to 1998, but still accounts for by far the largest proportion of total capacity (81%).

The installed gas turbine capacity increased steadily from 1991 to 1996, but has been relatively static since then. This reflects the increased use of the more efficient CCGT technology, with installed capacity increasing by a factor of almost seven (but from a very low base) between 1991 and 1998. In 1997 CCGT systems overtook gas turbine systems in terms of installed capacity, and now account for 11% of the total compared to 8% for gas turbines.

indicator 4.6 Installed Capacity of Wind Turbines

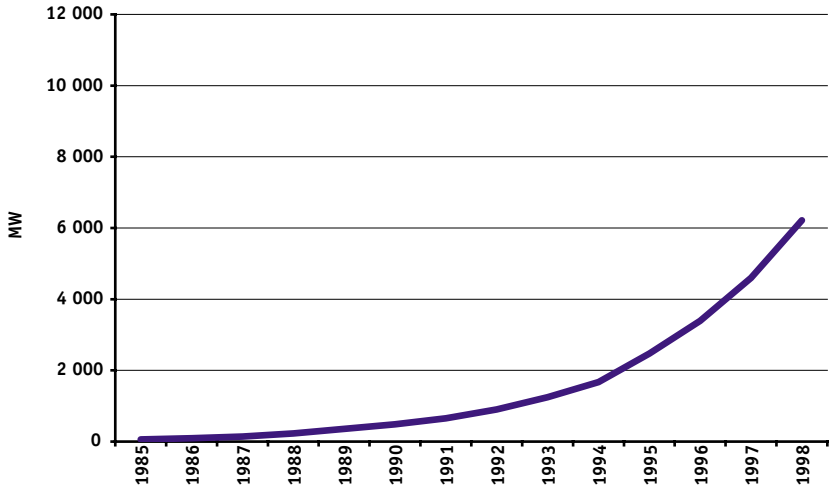

table 4.6 Installed Capacity of Wind Turbines

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wind	60	92	140	230	355	483	657	905	1 245	1 674	2 472	3 391	4 600	6 026

Units: MW

Between 1990 and 1998 the capacity of installed wind turbines across EU-15 increased by a factor of almost 13, and this rapid growth is continuing with a 31% increase in capacity in 1998 alone. In 1998 approximately two thirds of the installed capacity was located in Germany and Denmark.

The increase in the installed wind generation capacity reflects in part the financial support available for these systems in many EU Member States, together with the relatively wide availability of wind as a resource and the increasing competitiveness of electricity generated from wind power. It is important to recognise that wind generation is still a relatively minor contributor to electricity generation from renewable sources (itself a small part of total generation), and that hydro-electric power remains far more significant in terms of installed capacity as well as output (see 5.4).

indicator 4.7 Efficiencies of Power Stations, by Type

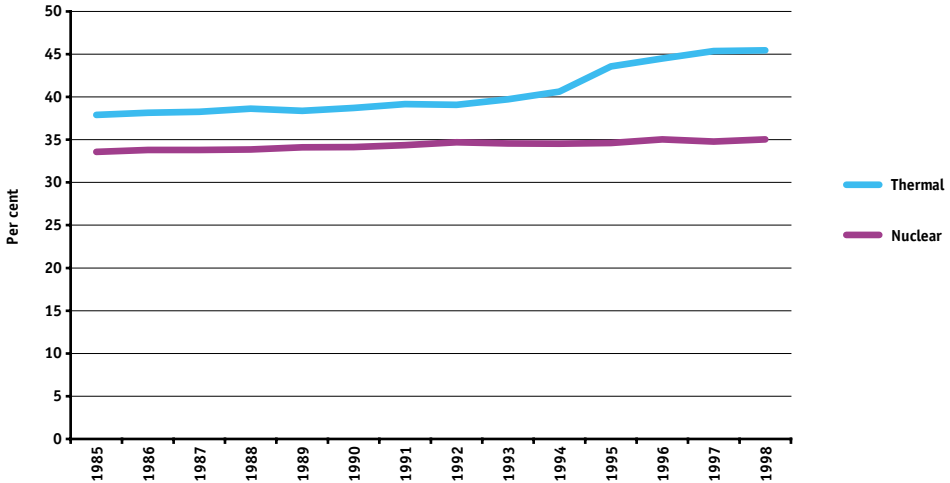

table 4.7 Efficiencies of Power Stations, by Type

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Thermal	37.9	38.2	38.3	38.6	38.4	38.7	39.2	39.1	39.7	40.6	43.6	44.5	45.4	45.5
Nuclear	33.6	33.8	33.8	33.9	34.1	34.1	34.4	34.7	34.6	34.5	34.6	35.0	34.8	35.0

Units: Per cent

The efficiency of a power station is defined as the gross production of electricity relative to the energy input as fuel (NCV). In the case of nuclear power, this input is defined as the energy in the steam at entry into the turbines driving the generators. In the case of Combined Heat and Power (CHP) plants, the output is defined as the sum of the heat and electricity outputs.

Between 1990 and 1998 nuclear power stations increased their average efficiency from 34.1% to 35.0%, a relative improvement of 2.6%. Over the same period, the efficiency of thermal power stations increased from 38.7% to 45.5%, a relative improvement of 17.4%.

The reasons for the significant improvement in the average efficiency of thermal power stations include fuel switching, the commissioning of new, high-efficiency generating plants and the decommissioning of older inefficient plant. In particular, there was a move away from coal and towards gas as a more efficient fuel, often using high efficiency combined cycle gas turbine systems.

indicator 4.8 Output From Refineries

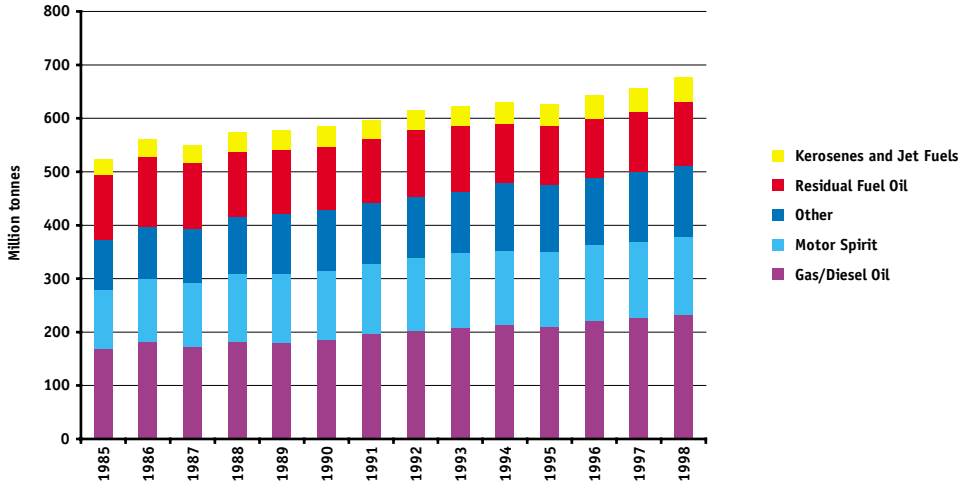

table 4.8 Output From Refineries

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Kerosenes and Jet Fuels	29 535	32 327	32 727	35 550	37 355	38 471	35 022	36 246	36 746	39 473	40 994	43 854	44 067	44 963
Residual Fuel Oil	122 526	131 325	124 612	121 332	119 538	118 503	121 725	125 268	121 584	111 992	109 057	110 672	112 902	118 657
Other	92 274	97 164	99 761	108 098	112 403	113 538	112 551	113 724	115 708	125 865	126 261	126 275	130 871	133 478
Motor Spirit	110 564	116 720	119 962	125 829	128 357	130 600	132 311	136 928	139 241	139 893	140 068	141 720	143 355	145 700
Gas/Diesel Oil	169 254	182 903	173 233	182 170	180 763	184 890	196 014	202 717	208 669	213 153	209 978	221 619	225 897	232 625

Units: Thousand tonnes

Between 1990 and 1998 the total refinery output across EU-15 increased by 15%.

The largest increase in refinery output was gas/diesel oil, with output increasing by 26% between 1990 and 1998. This reflects the growth in road freight (as most freight vehicles are diesel fuelled) and the increased use of diesel in cars. The increase in air traffic resulted in increased demand for kerosene and jet fuel, with output increasing by 17% over the same period. The output of motor spirit increased by 12% during this period, again reflecting a growth in road traffic.

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5 Renewable Energy Sources

indicator 5.1 Renewables Contribution to Gross Inland Consumption

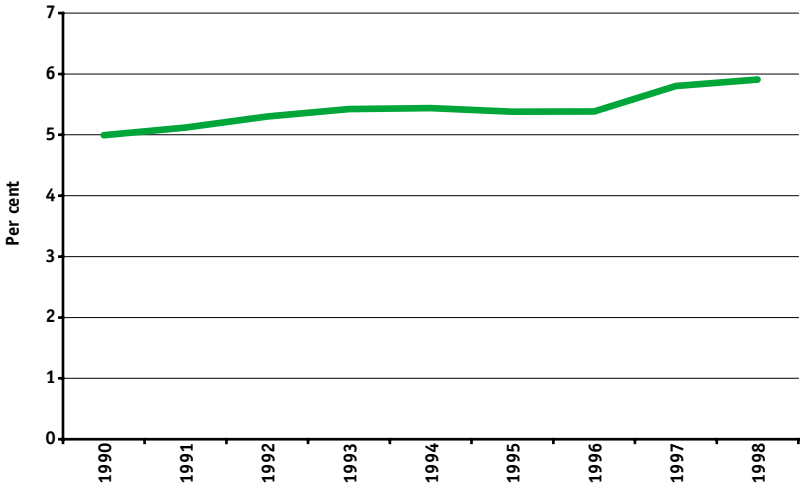

table 5.1 Renewables Contribution to Gross Inland Consumption

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RES	4.99	5.12	5.30	5.42	5.44	5.38	5.38	5.80	5.91

Units: Per cent

The contribution from renewable energy sources (RES) to gross inland consumption increased from 5.0% in 1990 to 5.9% in 1998. After modest increases from 1990 to 1993 contributions remained relatively static, with the most significant increase taking place during the last two years. The contribution from renewable energy sources to gross inland consumption has risen by 29% in absolute terms (see 2.10).

indicator 5.2 Renewables Contribution to Gross Inland Consumption, by Source

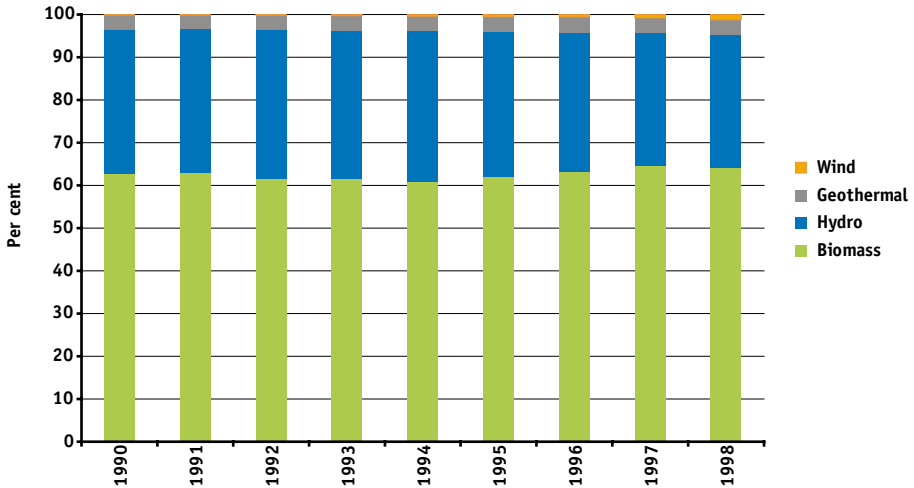

table 5.2 Renewables Contribution to Gross Inland Consumption, by Source

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wind	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.8	1.2
Geothermal	3.4	3.2	3.4	3.6	3.5	3.4	3.6	3.5	3.5
Hydro	33.9	33.6	34.8	34.5	35.3	34.1	32.8	31.2	31.1
Biomass	62.6	63.1	61.6	61.6	60.9	61.9	63.1	64.5	64.1

Units: Per cent

Biomass is the most widely used renewable energy source, accounting for 64% of the contribution to gross inland consumption (GIC) in 1998. Much of this takes the form of wood and wood by-products.

Hydropower is also a significant contributor, and accounted for 31% of the total in 1998. However, in energy terms the contribution of hydropower increased much less than those of the other technologies between 1990 and 1998. This is reflected in the reduced percentage contribution of hydropower (from 34% in 1990 to 31% in 1998), and results from the fact that the potential for large scale hydropower has already been largely exploited.

The use of geothermal energy increased between 1990 and 1998, but still accounts for only 3.5% of the renewables contribution to GIC. Its use is limited by the lack of a financially viable resource in most EU Member States.

Wind energy has seen a significant growth over the period (see 4.6), but its contribution to GIC remains small by comparison with those of the other technologies.

indicator 5.3 Renewables Contribution to Total Electricity Generation

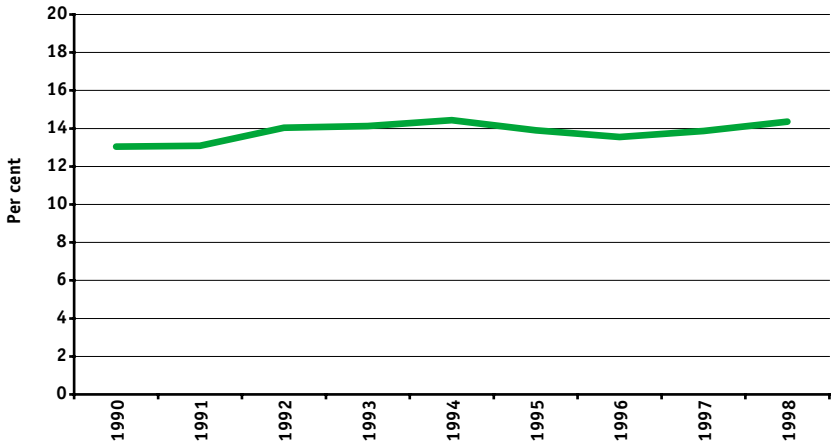

table 5.3 Renewables Contribution to Total Electricity Generation

	1990	1991	1992	1993	1994	1995	1996	1997	1998
RES	13.0	13.1	14.0	14.2	14.5	13.9	13.5	13.9	14.3

Units: Per cent

The contribution of renewable energy sources (RES) to total electricity generation showed a relative increase of 9.6% between 1990 and 1998. There was a 27% increase in the contribution of renewables in energy terms over the period, but this was offset by a 16% increase in total electricity generation (see 4.1). However, for the last two years electricity generation from renewables has increased more rapidly, and has outpaced the growth in overall electricity generation.

indicator 5.4 Renewables Contribution to Total Electricity Generation, by Source

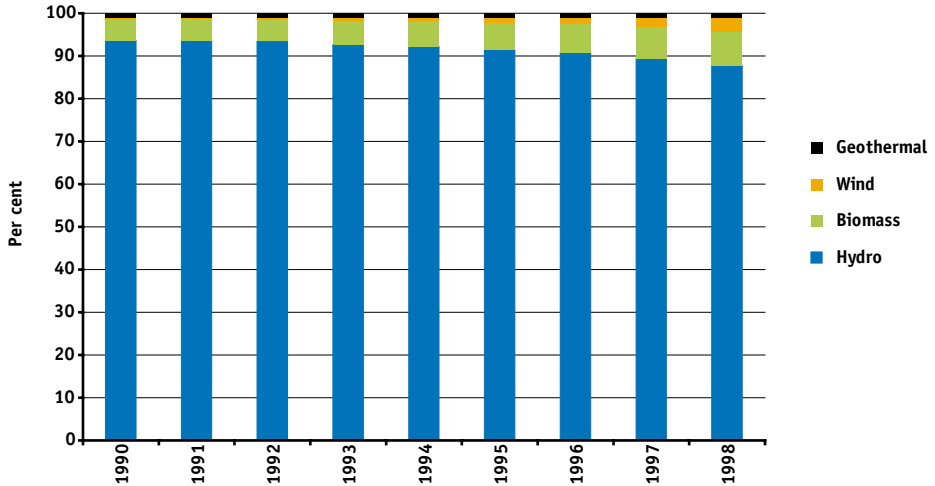

table 5.4 Renewables Contribution to Total Electricity Generation, by Source

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Geothermal	1.2	1.1	1.1	1.2	1.1	1.1	1.2	1.2	1.2
Wind	0.3	0.4	0.5	0.8	1.1	1.3	1.5	2.2	3.4
Biomass	5.5	5.5	5.6	6.0	6.4	7.1	7.5	8.2	8.8
Hydro	93.0	93.0	92.7	92.1	91.4	90.6	89.8	88.5	86.6

Units: Per cent

In terms of total electricity generation, hydropower is by far the most significant renewable energy source (RES) and accounted for 87% of the total in 1998. The contribution from hydropower to total electricity generation has however experienced a relative decrease of 2% between 1990 and 1998. This demonstrates the extent to which the potential for large scale hydropower has already been exploited, while other RES have realised only a small proportion of their potential. The contribution from small scale hydropower plants is increasing, but this amounts to only a small percentage of total hydropower generation.

Generation from biomass has grown steadily over the period, and this remains the second most important contributor of electricity from RES. Wind powered generation has seen the most rapid growth, and its share of total electricity generation increased by a factor of almost thirteen between 1990 and 1998.

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6 Energy Efficiency

indicator 6.1 Indices of Final Energy Consumption, GDP and Ratio

Reference Year = 1990

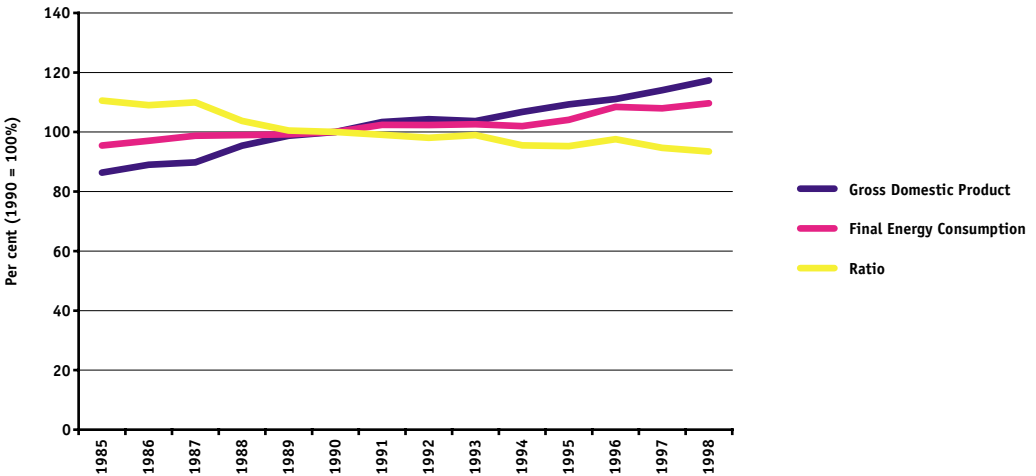

table 6.1 Indices of Final Energy Consumption, GDP and Ratio

Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	95	97	99	99	99	100	102	102	103	102	104	108	108	110
Gross Domestic Product	86	89	90	95	99	100	103	104	104	107	109	111	114	117
Ratio	111	109	110	104	100	100	99	98	99	96	95	98	95	93

Units: Per cent (1990 = 100%)

The ratio of final energy consumption to gross domestic product (GDP) in constant terms gives an indication of the effectiveness with which energy is used to produce added value. The table and graph display this ratio as an index, with 1990 shown as the reference year.

GDP rose by 17% from 1990 to 1998, despite a period of low economic growth during the recession of the early nineties. Over the same period final energy consumption rose by 10%, and it too increased only slowly during the recession. The ratio of final energy consumption to gross domestic product has therefore shown an overall decrease of 7% over the period. This decrease reflects a combination of improved energy efficiency and a move away from the more energy-intensive heavy industries towards the less energy-intensive lighter industries and the services sector.

indicator 6.2 Gross Inland Consumption per Capita

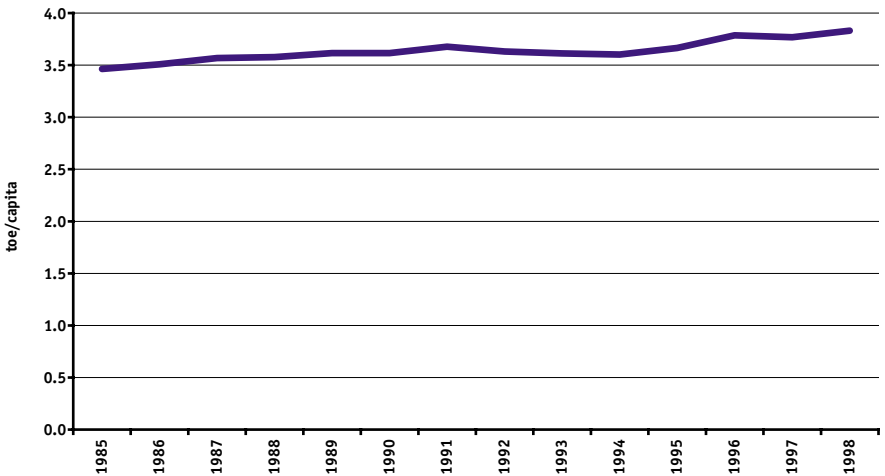

table 6.2 Gross Inland Consumption per Capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
GIC per capita	3.46	3.51	3.57	3.58	3.62	3.62	3.68	3.63	3.61	3.60	3.67	3.79	3.77	3.83

Units: tonnes of oil equivalent per capita (toe/capita)

Gross inland consumption per capita increased by 6% between 1990 and 1998, and continued the trend established in the preceding years.

Gross inland consumption per capita increased at a fairly uniform rate of about 1% per year between 1985 and 1991. A period of low growth in energy consumption followed, as the EU went through a period of recession. This caused energy consumption per person to decrease. Energy consumption increased from 1994 onwards as the economy recovered, and a similar increase was observed in the rate of energy consumption per person.

indicator 6.3 Final Consumption of Electricity per Capita

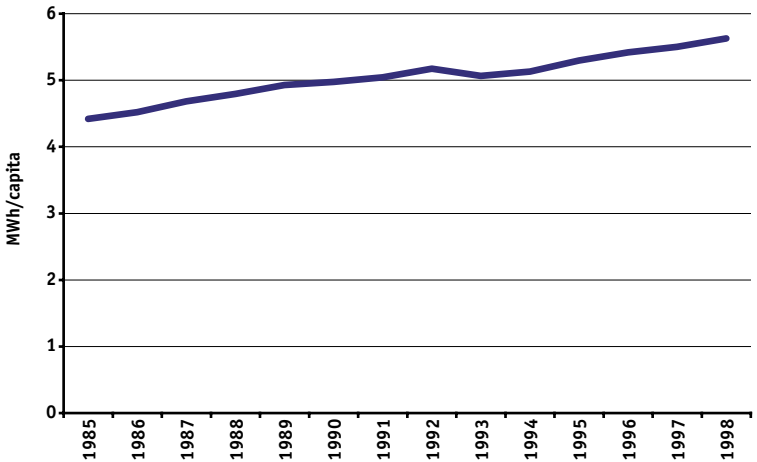

table 6.3 Final Consumption of Electricity per Capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Electricity per Capita	4.42	4.52	4.68	4.79	4.93	4.98	5.04	5.17	5.07	5.13	5.30	5.42	5.50	5.63

Units: MWh per capita

Overall electricity consumption per capita rose by 13% between 1990 and 1998, again reflecting the trend observed in preceding years. However, this increase is significantly greater than the 6% increase in gross inland consumption per capita over the same period (see 6.2), resulting from the increased penetration of electricity into final energy consumption.

indicator 6.4 Consumption of Electricity in Households per Capita

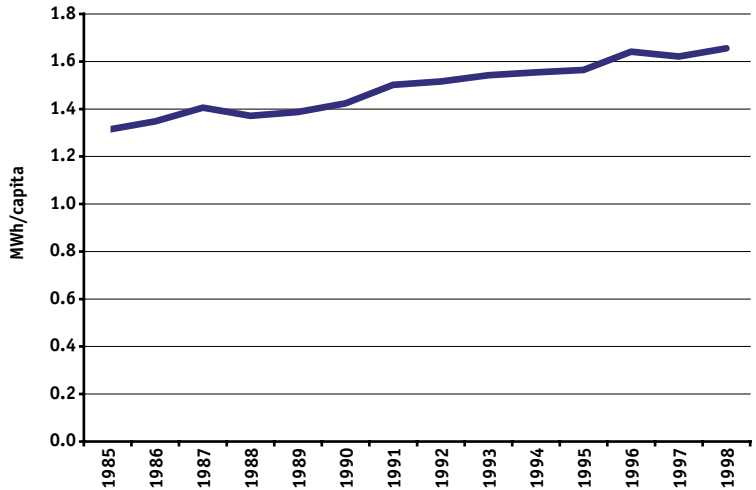

table 6.4 Consumption of Electricity in Households per Capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Household Electricity per Capita	1.31	1.35	1.41	1.37	1.39	1.42	1.50	1.52	1.54	1.55	1.56	1.64	1.62	1.65

Units: MWh per capita

Electricity consumption in households is strongly linked to the size of the population served. Between 1990 and 1998 the per capita consumption of electricity in households rose by 16%, compared to the 13% increase in overall electricity consumption per person (see 6.3). Thus electricity consumption in households is increasing more rapidly than electricity consumption in general. Household electricity consumption was not greatly affected by the relative economic slowdown in the early 1990s.

indicator 6.5 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Iron and Steel Industry (Reference Year = 1990)

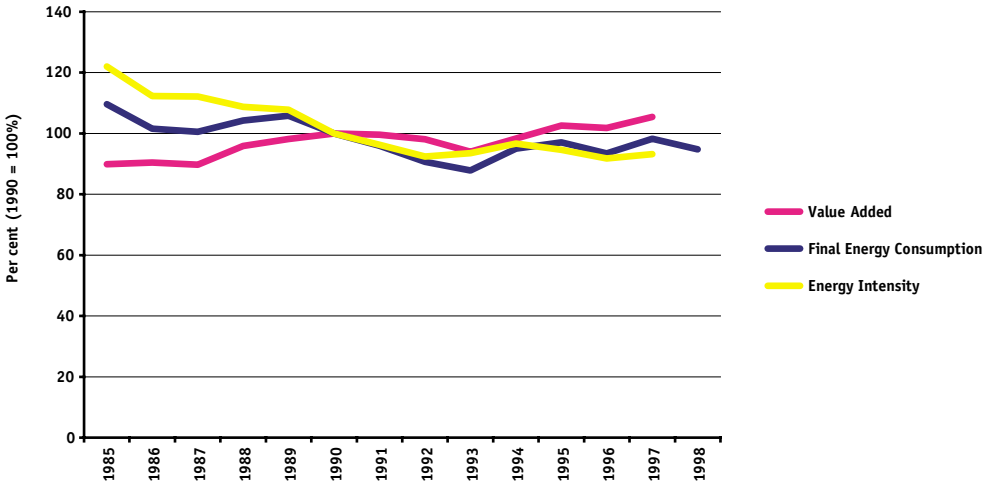

table 6.5 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Iron and Steel Industry (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	110	102	101	104	106	100	96	91	88	95	97	93	98	95
Value Added	90	90	90	96	98	100	100	98	94	98	103	102	105	*
Energy Intensity	122	112	112	109	108	100	96	92	94	97	95	92	93	*

*Units: Per cent (1990 = 100%) * Data not available*

The energy intensity of a sector is the ratio of energy consumption in the sector to the value added by that sector, and is an indication of the effectiveness with which the energy has been used.

Within the iron and steel industry, energy consumption fell by 5% between 1990 and 1998. Consumption fell to a minimum in 1993, but has generally increased since then (despite dips in 1996 and 1998) as output recovered after the recession.

Improvements in energy intensity are the result of improvements in energy efficiency and restructuring of the industry, typically by measures such as closing older inefficient plants and producing products with greater value added. The iron and steel industry underwent major restructuring throughout Europe during the last decade.

indicator 6.6 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Chemicals Industry (Reference Year = 1990)

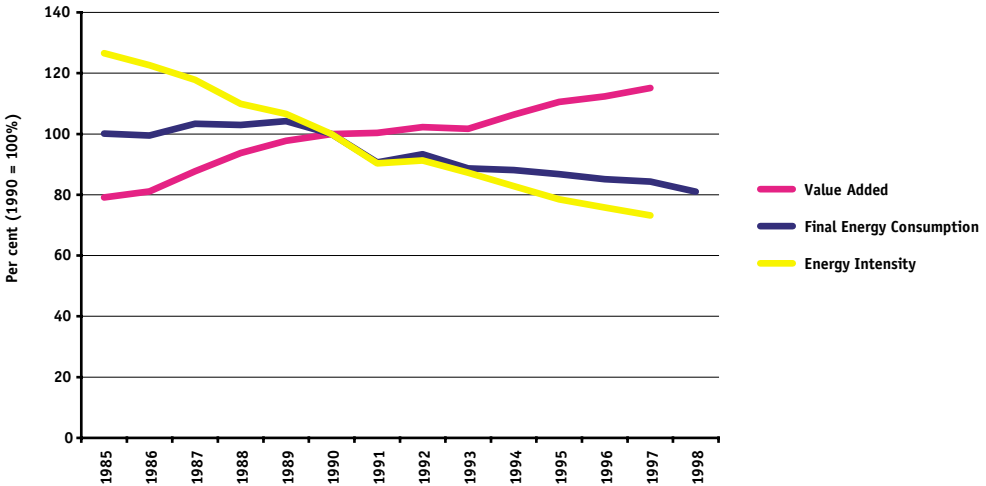

table 6.6 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Chemicals Industry (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	100	99	103	103	104	100	91	93	89	88	87	85	84	81
Value Added	79	81	88	94	98	100	100	102	102	106	111	112	115	*
Energy Intensity	127	123	118	110	107	100	90	91	87	83	78	76	73	*

Units: Per cent (1990 = 100%) ** Data not available*

The energy intensity of a sector is the ratio of energy consumption in the sector to the value added by that sector, and is an indication of the effectiveness with which the energy has been used.

Energy consumption in the chemicals industry reduced by 19% between 1990 and 1998, following a period of relative stability in the late 1980s. At the same time, value added increased by 15% to 1997 thereby reducing energy intensity within the industry by 27% over the period from 1990 to 1997.

Improvements in energy intensity are the result of improvements in energy efficiency and restructuring of the industry, typically by measures such as closing older inefficient plants and producing products with greater value added.

The chemical industry has seen a high degree of consolidation and merger activity throughout the 1990s. Another trend within the industry has been a higher degree of specialisation within individual companies.

indicator 6.7 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Glass, Pottery and Building Materials Industry (Reference Year = 1990)

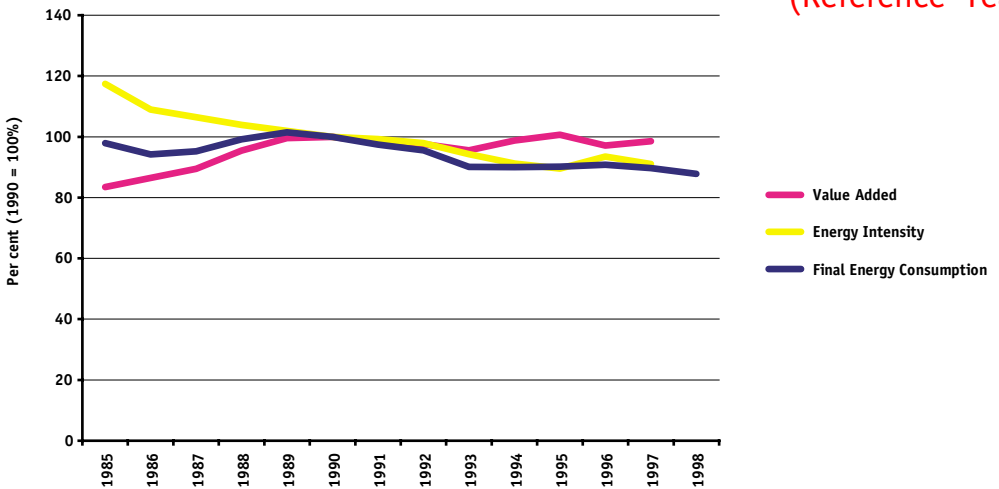

table 6.7 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Glass, Pottery and Building Materials Industry (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	98	94	95	99	101	100	97	96	90	90	90	91	90	88
Value Added	83	86	89	95	100	100	98	98	96	99	101	97	99	*
Energy Intensity	117	109	106	104	102	100	99	98	94	91	90	93	91	*

Units: Per cent (1990 = 100 %) ** Data not available*

The energy intensity of a sector is the ratio of energy consumption in the sector to the value added by that sector, and is an indication of the effectiveness with which the energy has been used.

Energy consumption in the glass, pottery and building materials industry peaked in 1989 and 1990, and declined by 12% over the period from 1990 to 1998. There was a rapid drop in the early 1990s, but from 1993 energy consumption was relatively stable. Value added by the industry declined during the early 1990s, but recovered almost to its 1990 level by 1997.

Improvements in energy intensity are the result of improvements in energy efficiency and restructuring of the industry, typically by measures such as closing older inefficient plants and producing products with greater value added. A series of international mergers has taken place within the glass, pottery and building materials industry in recent years, and one feature of this increasing internationalisation has been a shifting of production to countries where costs are lower than in the EU.

In general this sector produces commodity products, so specialisation is not as viable a strategy for increasing added value, as it is in the case of the chemicals sector.

indicator 6.8 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Paper and Printing Industry (Reference Year = 1990)

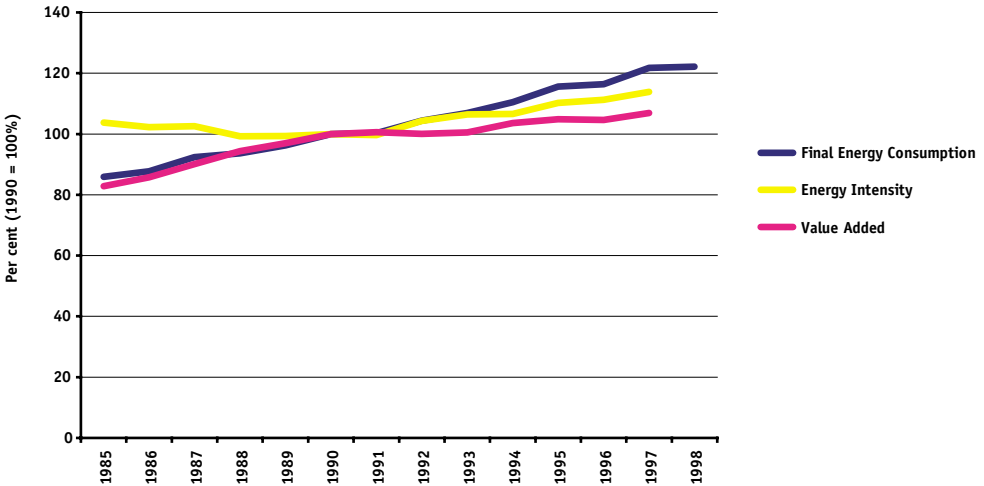

table 6.8 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Paper and Printing Industry (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	86	88	92	94	96	100	100	104	107	110	116	116	122	122
Value Added	83	86	90	94	97	100	101	100	100	104	105	105	107	*
Energy Intensity	104	102	103	99	99	100	100	104	106	107	110	111	114	*

Units: Per cent (1990 = 100%) ** Data not available*

The energy intensity of a sector is the ratio of energy consumption in the sector to the value added by that sector, and is an indication of the effectiveness with which the energy has been used.

Energy consumption in the paper and printing industry increased by 22% between 1990 and 1998, and was affected only marginally by the recession in the early 1990s. The value added in the sector declined slightly in the early 1990s, but increased from 1993 onwards.

A significant factor in the increased energy consumption by the industry was the 25% rise in paper consumption across the EU.

Energy intensity in the paper and printing industry has risen consistently from 1990 to 1997, and reflects the more rapid growth in energy consumption (22%) than in value added (7%).

indicator 6.9 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Food, Drink and Tobacco Industries (Reference Year = 1990)

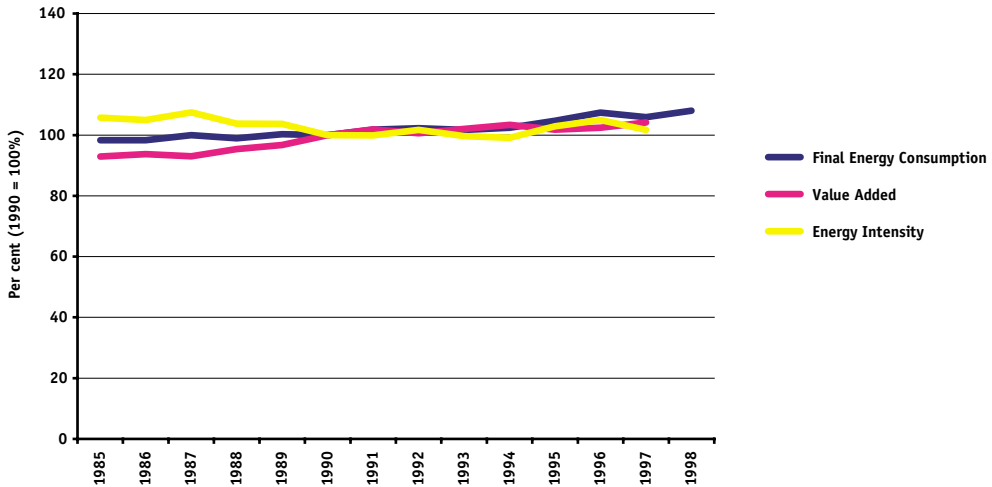

table 6.9 Indices of Final Energy Consumption, Value Added and Energy Intensity, for the Food, Drink and Tobacco Industries (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Final Energy Consumption	98	98	100	99	100	100	102	102	102	102	105	107	106	108
Value Added	93	94	93	95	97	100	102	101	102	103	102	102	104	*
Energy Intensity	106	105	107	104	104	100	100	102	100	99	103	105	102	*

Units: Per cent (1990 = 100%) ** Data not available*

The energy intensity of a sector is the ratio of energy consumption in the sector to the value added by that sector, and is an indication of the effectiveness with which the energy has been used.

Energy consumption in the food, drink and tobacco industries increased by 8% between 1990 and 1998. Consumption was stable during the recession (1991 to 1994), but has increased over the last four years. Value added by the industry has grown slowly during the 1990s.

The ratio of final energy consumption to value added in the food, drink and tobacco industry rose by just 2% over the period from 1990 to 1997 and reflects the marginally greater increase in energy consumption (5.9%) than in value added (4.2%) over the same period.

indicator 6.10 Contribution of CHP Plant to Total Electricity Generation (1998)

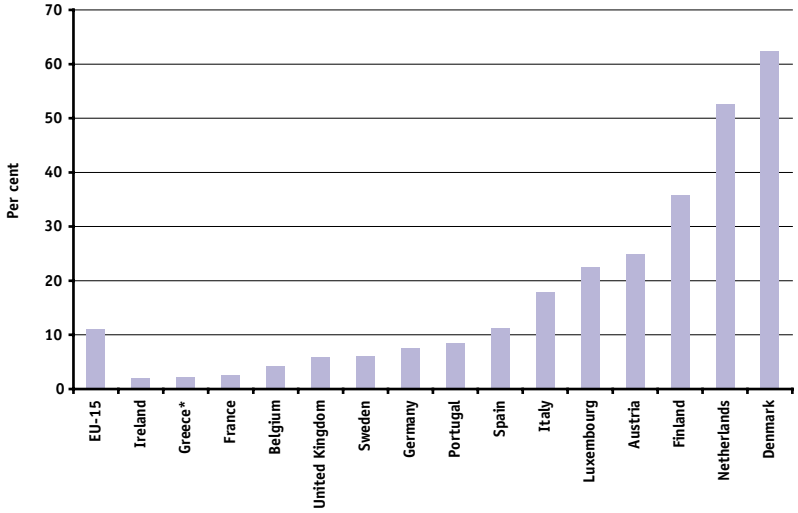

table 6.10 Contribution of CHP Plant to Total Electricity Generation (1998)

Member State	Electricity generated by CHP Plant	Member State	Electricity generated by CHP Plant
EU-15	11.0	Portugal	8.4
Ireland	1.9	Spain	11.2
Greece*	2.1	Italy	17.8
France	2.5	Luxembourg	22.5
Belgium	4.1	Austria	24.8
United Kingdom	5.8	Finland	35.8
Sweden	6.0	Netherlands	52.6
Germany	7.5	Denmark	62.3

Units: Per cent ** Eurostat estimated data*

Combined Heat and Power (CHP) or cogeneration plants generate both electricity and useful heat. Conventional (thermal) power plants typically convert only 38% to 40% of the energy available in the primary fuel into electricity (see 4.8), with the remainder of this energy being discharged as waste heat rather than being used. In a CHP plant much of this heat is used, typically for space heating and/or in industrial processes. As a result, the overall efficiency of the plant is much higher and typically reaches 65% to 80%.

The higher efficiency of CHP plants brings cost benefits to the plant users, as less primary energy in fossil fuel (generally gas or oil) is needed to produce the same useful outputs. There are also environmental benefits in terms of reduced emissions of greenhouse gases (particularly CO_2) and other polluting gases such as SO_2 and NO_x.

The use of CHP varies widely between EU Member States. The contribution of CHP plants to total electricity generation ranges from 62% (Denmark) to 2% (Ireland, Greece). The countries with the largest contribution from CHP tend to have extensive district heating networks, since these are heated from a central plant that simultaneously generates electricity.


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7 Energy Prices

indicator 7.1 Current and Constant Import Prices of Steam Coal

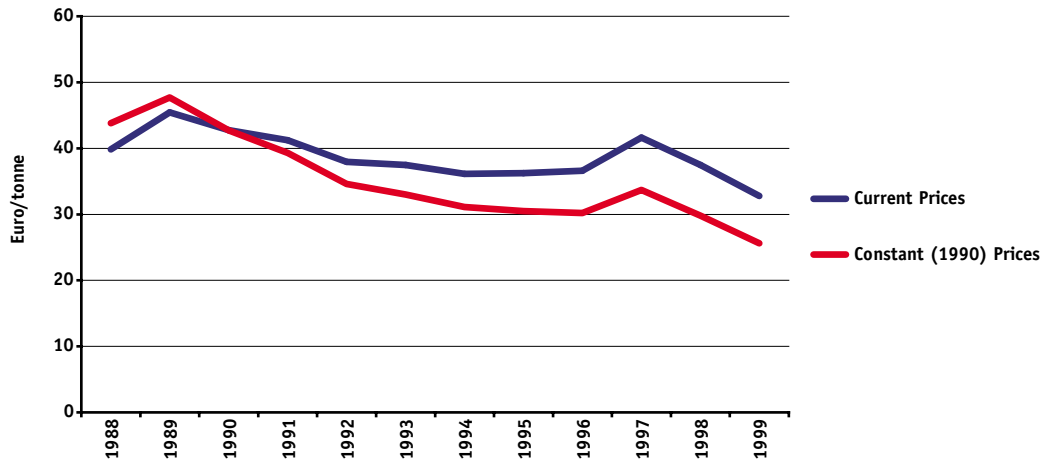

table 7.1 Current and Constant Import Prices of Steam Coal

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Current	39.8	45.4	42.7	41.2	38.0	37.5	36.1	36.3	36.6	41.6	37.5	32.8
Constant (1990)	43.8	47.7	42.7	39.3	34.6	33.0	31.1	30.5	30.2	33.7	29.8	25.6

Units: Euro/tonne

Imported steam coal is used mainly for power generation but also in large, coal-fired boilers in industry.

Between 1990 and 1999 the price of imported steam coal fell by 23% in nominal terms (current prices) and by 40% at constant (1990) prices. Imports of all solid fuels increased by 15% between 1990 and 1998 (see 2.4). However, the total consumption of coal and equivalent fuels in power stations fell by 14% over the same period (see 4.3).

The market picture is therefore one of reducing reliance on coal for power production, but sourcing of a rapidly increasing percentage of that diminishing total from outside EU-15. The main reason for this is the cheaper prices that are clearly demonstrated here, although there are often environmental benefits as well. It follows that the falling price is not necessarily the price for coal from the same source, as cheaper coal from a wider range of sources becomes available on world markets.

The peak in the price of steam coal in 1997 coincides with the increase in world oil prices (see 1.3) and is reflected in a dip in the use of coal for power generation (see 4.2) as the market responded to these higher prices.

indicator 7.2 Current and Constant Import Prices of Coking Coal

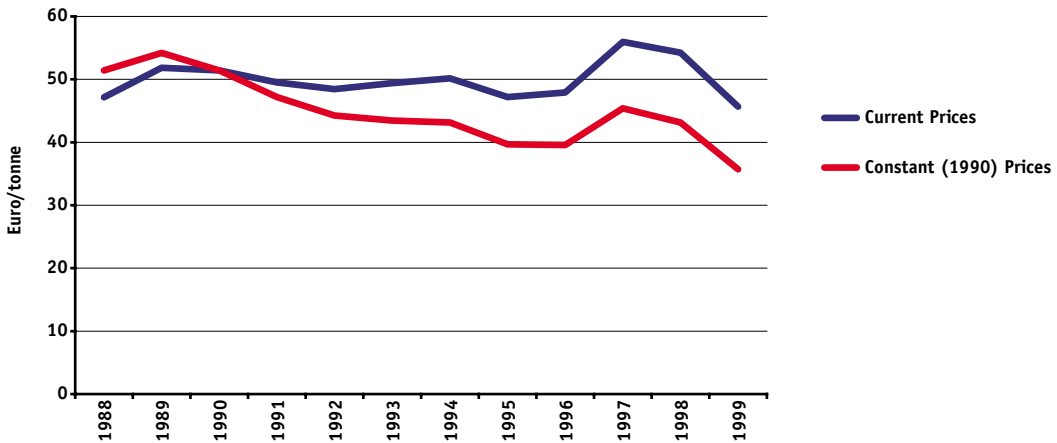

table 7.2 Current and Constant Import Prices of Coking Coal

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Current	47.2	51.8	51.4	49.5	48.5	49.4	50.2	47.2	47.9	55.9	54.2	45.7
Constant (1990)	51.4	54.2	51.4	47.2	44.2	43.5	43.2	39.7	39.6	45.4	43.2	35.7

Units: Euro/tonne

Coking coal is used almost exclusively in the steel industry.

Between 1990 and 1999 the price of imported coking coal fell by 11% in nominal terms (current prices) and by 31% at constant (1990) prices. This is less of a decline than that observed in the price of steam coal (see 7.1).

indicator 7.3 Indices of VAT-Free Industrial Fuel Prices (Reference Year = 1990)

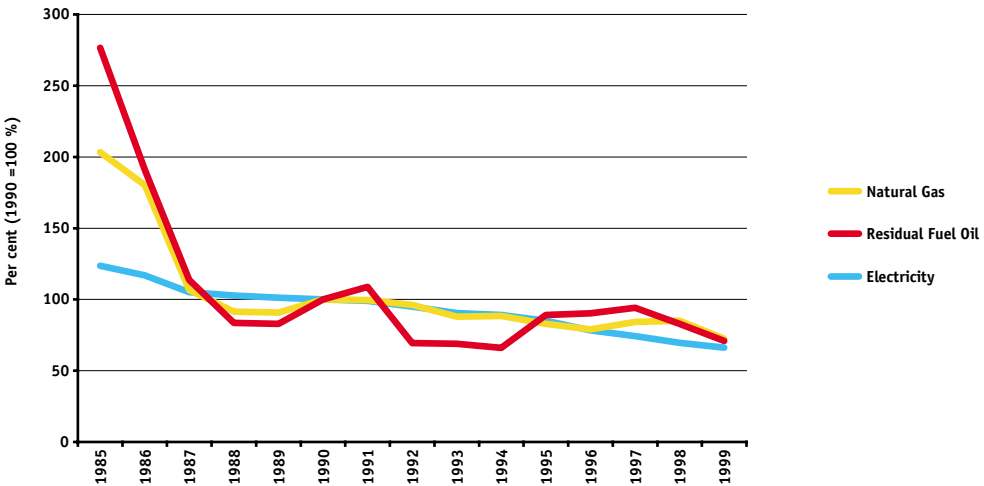

table 7.3 Indices of VAT-Free Industrial Fuel Prices (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Natural Gas	203	180	107	91	91	100	100	96	88	88	83	79	84	85	72
Residual Fuel Oil	277	191	114	84	83	100	109	69	69	66	89	90	94	83	71
Electricity	124	117	105	103	101	100	99	95	90	89	85	78	74	69	66

Units: Per cent (1990 =100 %)

In real terms industrial fuel prices net of VAT (Value Added Tax) have fallen across the EU between 1990 and 1999.

Residual fuel oil prices follow world oil prices, and therefore declined during the early nineties (except for the peak in prices related to the Gulf War in 1991), mainly as a result of reduced demand during this period of recession. Oil prices rose from 1995 to 1997, but declined somewhat in 1998 and 1999.

The price of gas decreased throughout the nineties in a manner somewhat similar to that of fuel oil. This reflects both the increased availability of gas and the need to remain competitive with fuel oil. Thus the price of gas rose in 1997 and 1998, but declined again in 1999.

The price of electricity has fallen in every year from 1990 to 1999. This reflects the effects of a move towards cheaper fuels such as gas for electricity generation, falling prices for fossil fuels generally and, in particular, greater competition in electricity markets as a result of increased liberalisation in several EU-15 Member States.

indicator 7.4 Tax Component of Industrial Fuel Prices

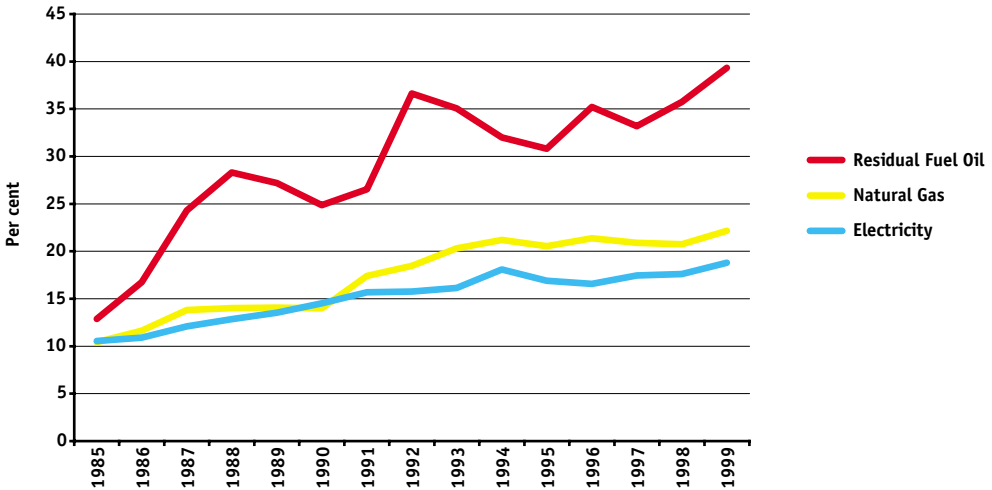

table 7.4 Tax Component of Industrial Fuel Prices

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Residual Fuel Oil	12.9	16.8	24.3	28.3	27.2	24.9	26.5	36.6	35.1	32.0	30.8	35.2	33.2	35.7	39.3
Natural Gas	10.4	11.6	13.8	14.0	14.1	14.0	17.4	18.5	20.3	21.2	20.5	21.4	20.9	20.7	22.2
Electricity	10.6	10.9	12.1	12.8	13.5	14.5	15.7	15.8	16.1	18.1	16.9	16.6	17.5	17.6	18.8

Units: Per cent

The levels of tax on energy prices are set by individual Member States, and in fact vary significantly between countries.

From 1990 to 1999 the rate of tax on all industrial fuels increased across the EU. The greatest increase was in the tax on residual fuel oil, which increased by 14.4 percentage points to reach 39.3% and was the most heavily taxed fuel throughout the decade. Over the same period, the tax rate on natural gas (the second most heavily taxed fuel, except in 1990) increased by 8.2 percentage points to reach 22.2% in 1999. The tax rate on electricity increased by only 4.3 percentage points, and this remains the least taxed fuel at 18.8%.

The increase in taxes on energy for industry across the EU contrasts with the fall in tax-free energy prices over the same period.

indicator 7.5 Indices of Tax-Inclusive Domestic Fuel Prices (Reference Year = 1990)

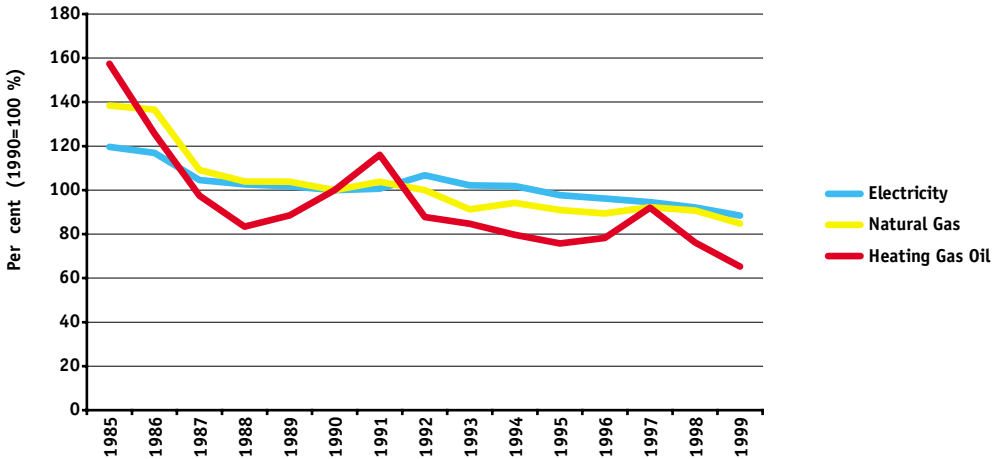

table 7.5 Indices of Tax-Inclusive Domestic Fuel Prices (Reference Year = 1990)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Electricity	120	117	105	103	102	100	101	107	102	102	98	96	94	92	88
Natural Gas	138	137	109	104	104	100	104	100	91	94	91	89	92	91	85
Heating Gas Oil	157	126	97	83	89	100	116	88	85	80	76	78	92	76	65

Units: Per cent (1990 =100 %)

Tax-inclusive prices of all domestic (housing) fuels have fallen in real terms (constant 1990 prices) between 1990 and 1999 across the EU. Unlike the industrial market, domestic fuel prices are affected by weather conditions, with colder years pushing up demand and prices, as well as by wider market factors.

Heating oil prices fell by 35% in real terms over the period. There was a peak increase (16%) in 1991, as world oil prices rose as a result of the Gulf War. The smaller peak in 1997 was related to increased demand as a result of the cold winter across Europe.

Tax-inclusive gas prices have been more stable throughout the nineties, falling by 15% between 1990 and 1999. As in the case of oil, the peak in 1991 is linked to the Gulf War, while minor peaks in 1994 and 1997 are more related to weather conditions.

On the basis of constant prices, electricity prices for the domestic sector have fallen by 12% over the period 1990 to 1999.

indicator 7.6 Tax Component of Domestic Fuel Prices

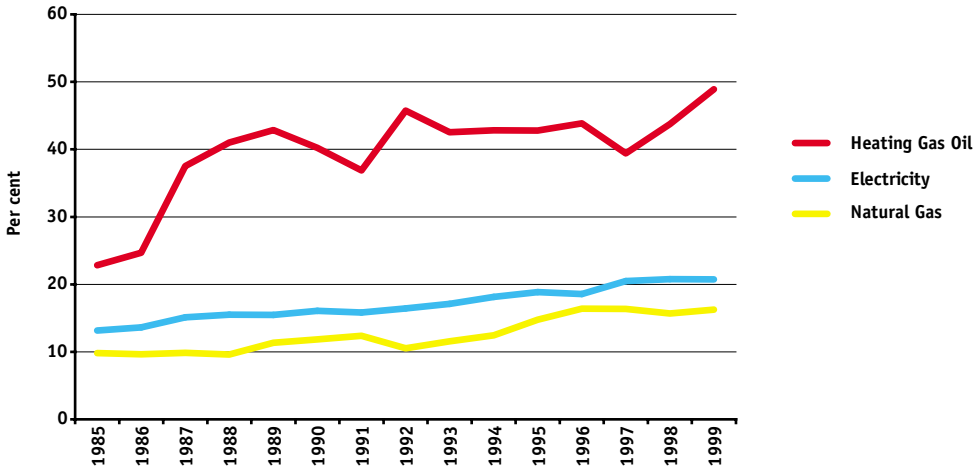

table 7.6 Tax Component of Domestic Fuel Prices

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Heating Gas Oil	22.8	24.7	37.5	41.0	42.8	40.2	36.9	45.7	42.5	42.8	42.8	43.8	39.4	43.8	48.9
Electricity	13.2	13.6	15.1	15.5	15.5	16.1	15.8	16.4	17.1	18.1	18.9	18.6	20.5	20.8	20.7
Natural Gas	9.8	9.6	9.8	9.6	11.4	11.9	12.4	10.5	11.5	12.5	14.8	16.4	16.4	15.7	16.2

Units: Per cent

The levels of tax on energy prices are set by individual Member States, and in fact vary significantly between countries.

From 1990 to 1999 the rate of tax on all domestic fuels increased across the EU. The greatest increase was in the tax on heating gas oil, 8.7 percentage points to reach 48.9% and this fuel was by far the most heavily taxed throughout the decade.

Over the same period, the tax rate on electricity (the second most heavily taxed fuel) increased by 4.6 percentage points to reach 20.7% in 1999. The tax rate on natural gas increased by 4.3 percentage points, and this remains the least taxed fuel at 16.2%.

The increase in taxes on domestic fuels across the EU contrasts with the fall in tax-inclusive energy prices over the same period.

indicator 7.7 Constant Retail Prices of Transport Fuels

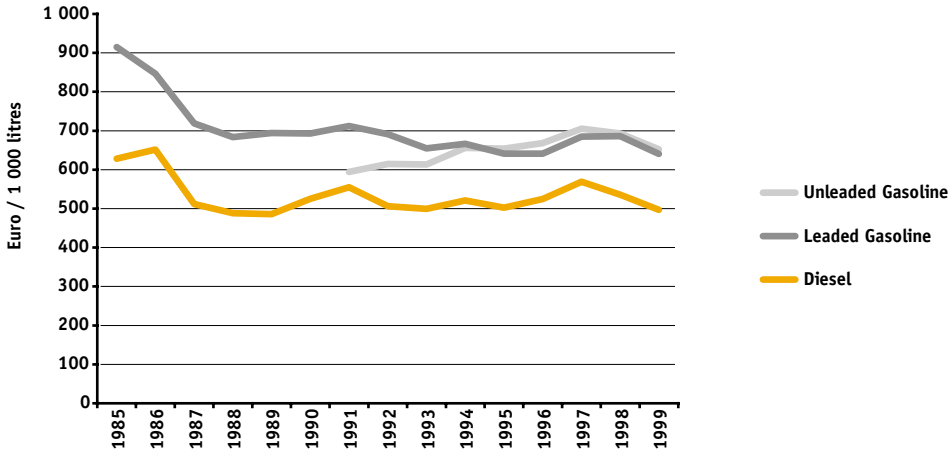

table 7.7 Constant Retail Prices of Transport Fuels

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Unleaded Gasoline	*	*	*	*	*	*	594	615	613	656	654	668	706	693	653
Leaded Gasoline	915	846	719	684	694	693	712	691	655	666	641	641	685	686	641
Diesel	628	652	512	488	486	525	555	506	499	521	503	525	569	535	497

Units: Euro / 1 000 litres Constant (1990) prices

** Data not available*

On the basis of constant prices, the retail (tax inclusive) prices of diesel and leaded gasoline fell during the period 1991 to 1999, whereas the equivalent price of unleaded gasoline rose by 10%, although it fell during the last two of the years under consideration.

Diesel fuel decreased in price by 10% between 1991 and 1999, and remains by far the cheapest transport fuel. The price of diesel was 76% of that of unleaded gasoline in 1999.

The above data show that unleaded gasoline is actually more expensive than leaded gasoline. This indication is somewhat misleading however, because in those Member States where there is still considerable consumption of leaded and unleaded gasoline, the average price of unleaded gasoline is always the lower of the two. The main reason for this anomaly is that Greece and Spain, who consume about 25% of the leaded gasoline used, have some of the lowest gasoline prices in EU-15.

indicator 7.8 Tax Component of Transport Fuel Costs

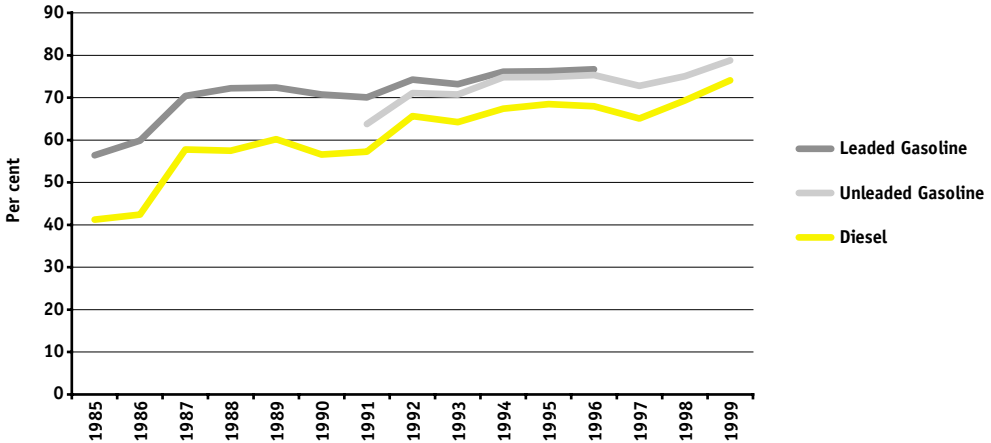

table 7.8 Tax Component of Transport Fuel Costs

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Leaded Gasoline	56	60	70	72	72	71	70	74	73	76	76	77	*	*	*
Unleaded Gasoline	*	*	*	*	*	*	64	71	71	75	75	75	73	75	79
Diesel	41	42	58	57	60	57	57	66	64	67	68	68	65	69	74

Units: Per cent

** Data not available*

The tax component of all transport fuels has increased steadily over the past decade.

It is likely that leaded gasoline remains the most heavily taxed fuel, in order to maintain a differential between the tax-inclusive prices of unleaded and leaded (which is being phased out).

Over the period from 1990 to 1999, the tax rate on diesel increased by 17 percentage points to reach 74%, only 5 percentage points less than the tax on unleaded gasoline (in 1991 the differential was 7 percentage points).

The increase in all transport fuel taxes between 1998 and 1999 is in contrast with the falling retail prices (see 7.7). This and the high overall fuel tax rates in the transport sector show the use of taxation as a means of discouraging transport and so reducing its environmental impacts.

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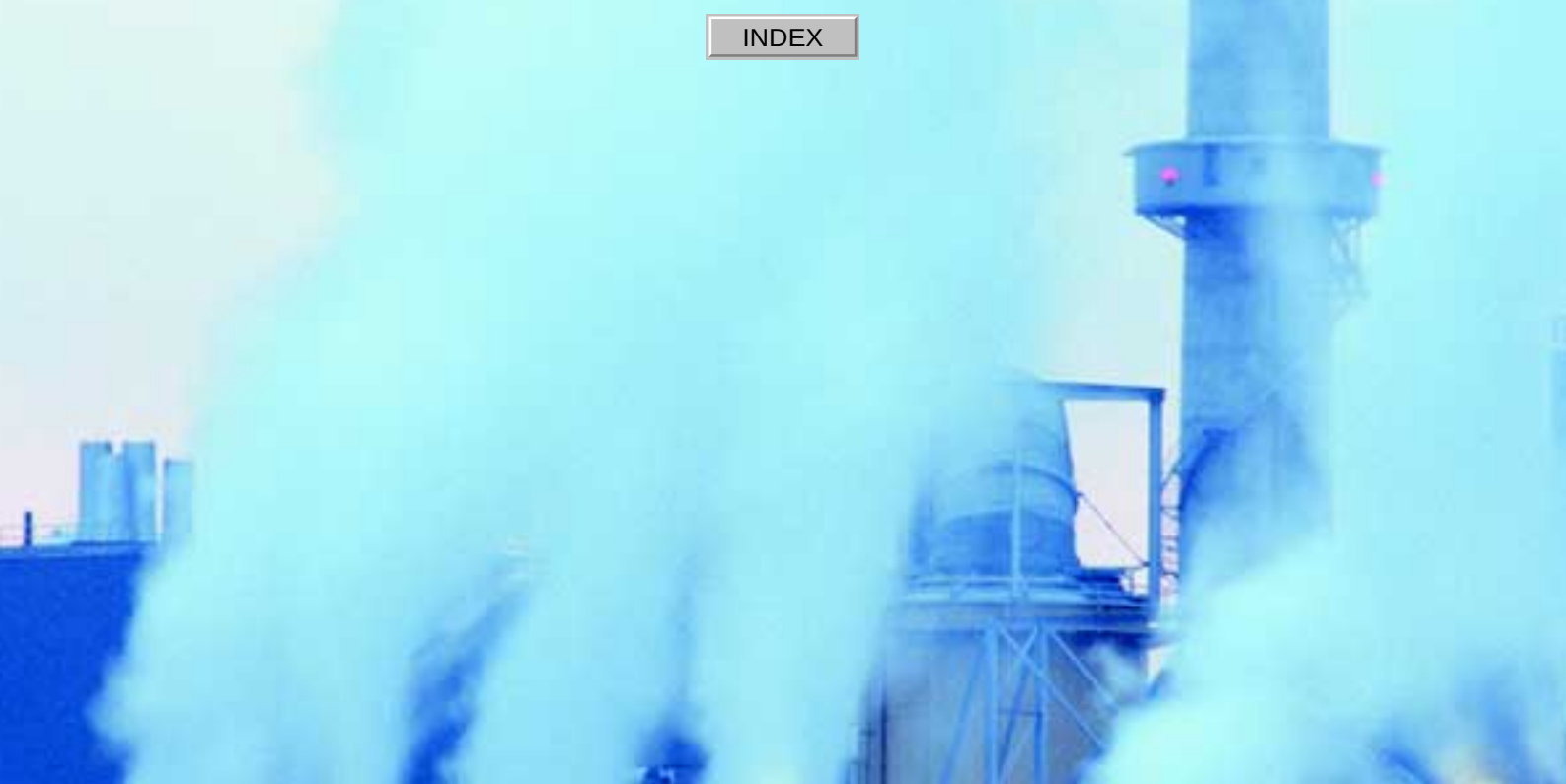

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8 Energy & Emissions

indicator 8.1 Contribution of Energy System to Total Emissions of Greenhouse Gases

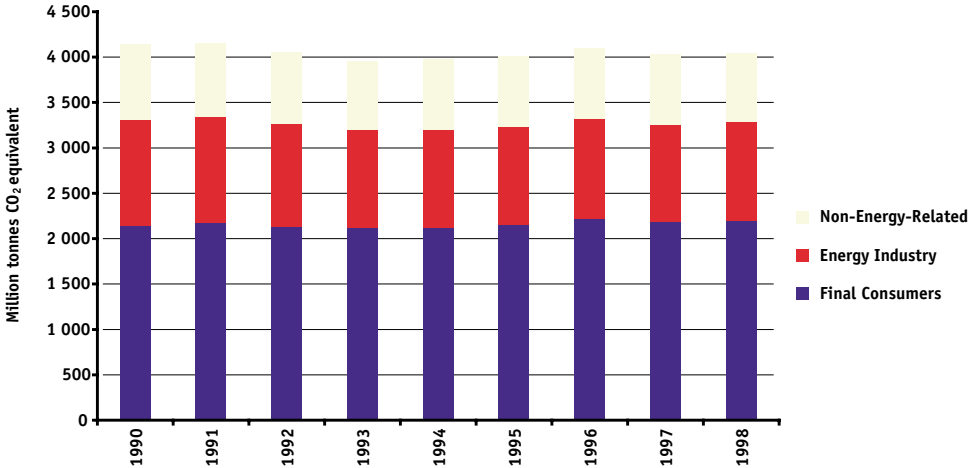

table 8.1 Contribution of Energy System to Total Emissions of Greenhouse Gases

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related	839 529	811 715	782 496	756 646	772 070	772 925	777 369	775 655	752 361
Energy Industry	1 165 853	1 168 373	1 133 925	1 078 635	1 080 720	1 088 893	1 096 134	1 059 547	1 091 242
Final Consumers	2 143 764	2 173 035	2 132 483	2 120 139	2 117 651	2 149 539	2 219 449	2 192 051	2 202 036

Units: Thousand tonnes CO_2 equivalent

In this context, the term "Energy System" refers to the combination of the energy industry (i.e. the energy transformation sector) and the energy consumed by final consumers. Greenhouse gas emissions are widely acknowledged to give rise to climate change. The greenhouse gases considered for this indicator are carbon dioxide, nitrous oxide and methane.

Total emissions of greenhouse gases have decreased by 2.5% over the period 1990 to 1998; however the contribution of the energy system to these emissions has risen from 80% to 81%.

Emissions from the energy industry accounted for 27% of total emissions in 1998. Despite an increase in energy output, the associated emissions have decreased by 6% between 1990 and 1998. This decrease reflects improvements in the efficiency of energy transformation and changes in the fuels used for generating electricity.

Greenhouse gas emissions associated with energy use by final consumers have increased by 3% over the period, mainly as a result of increased consumption in the transport sector. Emissions from other activities fell by 10%, mainly over the period from 1990 to 1993.

indicator 8.2 Contribution of Energy System to Total Emissions of Acidifying Gases

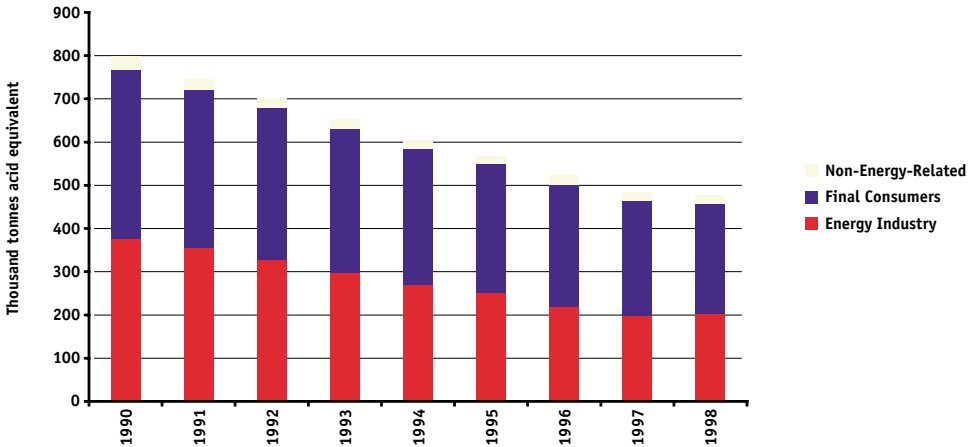

table 8.2 Contribution of Energy System to Total Emissions of Acidifying Gases

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related	31	24	23	23	21	19	21	20	20
Energy Industry	376	354	329	297	269	251	219	199	202
Final Consumers	391	367	350	333	315	299	282	265	256

Units: Thousand tonnes acid equivalent

The units used adjust the tonnes of emissions by their relative potential acid (hydrogen ion) production, i.e. tonnes x 1/32 (for SO_2) and tonnes x 1/46 (for NOx, as NO_2). Emissions of acidifying gases (sulphur dioxide and nitrogen oxides) contribute to acidification, eutrophication and ground level ozone. Another important acidifying gas is ammonia (NH_3), but as the predominant source of this gas is the agricultural sector, its contribution is not included in this analysis.

Total emissions of acidifying gases fell by 40% over the period from 1990 to 1998, although the contribution of the energy system to these emissions remained unchanged at 96%.

Emissions of acidifying gases from the energy industry fell by 46% over the period, mainly due to the installation of flue gas desulphurisation (FGD) equipment at power stations and to the move away from solid fuels (e.g. lignite and coal) to fuels such as natural gas containing less sulphur. These emissions fell from 47% of the total in 1990 to 42% in 1998.

Acidifying gas emissions from the use of energy by final consumers fell by 35% over the same period. This resulted principally from a reduction in industrial energy use, from a trend away from the use of solid fuels, and from legislation to reduce the sulphur content of liquid fuels. Acidifying gas emissions from non-energy-related activities are also down by 37% over this period.

indicator 8.3 Indices of Energy System and Energy Industry Emissions

Reference Year = 1990

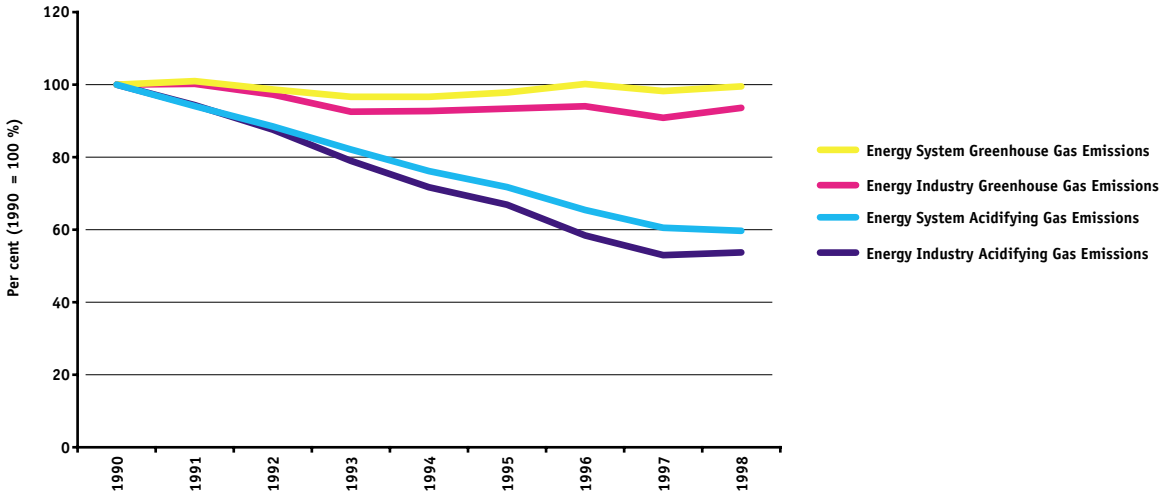

table 8.3 Indices of Energy System and Energy Industry Emissions

Reference Year = 1990

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy System Greenhouse Gas Emissions	100	101	99	97	97	98	100	98	100
Energy Industry Greenhouse Gas Emissions	100	100	97	93	93	93	94	91	94
Energy System Acidifying Gas Emissions	100	94	88	82	76	72	65	61	60
Energy Industry Acidifying Gas Emissions	100	94	88	79	72	67	58	53	54

Units: Per cent (1990 = 100%)

These indicators further demonstrate the trends that have already been described (see 8.1 and 8.2).

Greenhouse gas emissions were virtually the same in 1998 as they were in 1990, although there was a modest reduction during the recession of the early 1990s. Another factor which contributed to this reduction was the economic restructuring and the overall improvements in energy efficiency which occurred in Germany following reunification. Despite an increase in end-user energy consumption, the energy industry achieved a 6% reduction in greenhouse gas emissions by switching to fuels with low or zero carbon content and, to a lesser extent, by more efficient power generation.

The drop in acidifying gas emissions was much more significant, with a 40% reduction over the period from 1990 to 1998. Within the energy industry the reduction was even greater (46%). This resulted from a combination of the increased use of low sulphur fuels such as natural gas, the fitting of flue gas desulphurisation equipment to much of the remaining solid fuel fired electricity generation plant, and legislation limiting the sulphur content of fuels.

indicator 8.4 Energy System Contribution to Total Carbon Dioxide Emissions

table 8.4 Energy System Contribution to Total Carbon Dioxide Emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related	163 431	154 447	150 865	145 074	153 963	158 815	156 529	159 455	163 649
Energy System	3 156 310	3 189 580	3 116 540	3 058 189	3 063 268	3 101 215	3 179 349	3 118 891	3 163 824

Units: Thousand tonnes

Emissions of carbon dioxide are generated largely by the energy system, which accounted for 95% of the total in both 1990 and 1998. Over this period total carbon dioxide emissions increased marginally (0.2%), and there was a modest (3.5%) reduction between 1990 and 1993 due to the recession throughout Europe in general, and also to the overall improvements in energy efficiency which occurred in Germany following reunification.

Carbon dioxide emissions from the energy system can be reduced by improving efficiency or by switching to fuels with low or zero carbon content.

The fact that carbon dioxide emissions have increased less than energy consumption is mainly due to switches from high carbon content fuels (e.g. coal and lignite) to fuels with a lower carbon content (e.g. natural gas).

Carbon dioxide emissions from sources outside the energy system account for only 5% of the total, and have remained at a very similar level throughout the period.

indicator 8.5 Energy System Contribution to Total Methane Emissions

table 8.5 Energy System Contribution to Total Methane Emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy System	4 812	4 722	4 592	4 152	3 787	3 779	3 638	3 576	3 541
Non-Energy-Related	15 963	15 435	14 971	14 645	14 511	14 372	14 049	13 924	13 806

Units: Thousand tonnes

Methane (CH_4) is a powerful greenhouse gas with each tonne of methane equivalent in global warming terms to 21 tonnes of carbon dioxide, over a time span of 100 years. The main sources of methane within the energy system are coal mining and the production and transmission of natural gas. Sources outside the energy system include agriculture (mainly ruminant animals) and landfill sites used for waste disposal. As well as being a direct greenhouse gas, methane is also a precursor of tropospheric ozone which also is an important greenhouse gas.

Over the period from 1990 to 1998, total methane emissions fell by 17%. However, methane emissions from the energy system fell by 26% while methane emissions from other sources fell by only 14%. The contribution of the energy system to total methane emissions fell from 23% in 1990 to 20% in 1998.

The reduced methane emissions came about mainly as a result of the reduction in coal mining throughout the EU, improved control of methane emissions from landfill sites, reduced leakage from gas transmission/distribution pipelines and improvements in oil and gas extraction processes.

indicator 8.6 Energy System Contribution to Total Nitrous Oxide Emissions

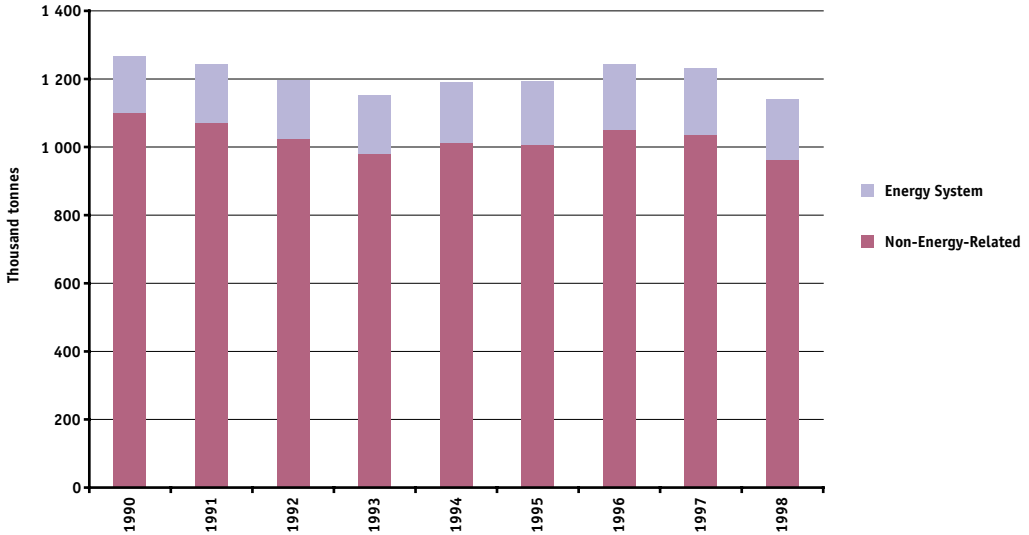

table 8.6 Energy System Contribution to Total Nitrous Oxide Emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy System	167	173	173	172	179	187	192	195	178
Non-Energy-Related	1 101	1 072	1 023	981	1 011	1 008	1 052	1 036	964

Units: Thousand tonnes

Nitrous oxide (N_2O) is a very powerful greenhouse gas, with each tonne equivalent in global warming terms to 310 tonnes of carbon dioxide, over a time span of 100 years. The main sources of nitrous oxide are industrial processes (particularly nitric and adipic acid production), agriculture and fuel combustion.

Over the period from 1990 to 1998, total emissions of nitrous oxide fell by 10%. However, nitrous oxide emissions from the energy system increased by 6% over the same period, so that the contribution of the energy system to the total has increased from 13% in 1990 to 16% in 1998. This compares with a 9% rise in total energy use (see 2.9), demonstrating that the level of nitrous oxide emissions per unit of energy used has actually fallen. An important factor behind the increase in nitrous oxide emissions from the energy sector is the fact that N_2O emissions from petrol-engined cars fitted with three-way catalytic converters are higher than those from older cars without such converters.

There was a significant (7%) reduction in nitrous oxide emissions from outside the energy system between 1997 and 1998, following a period of relative stability. This resulted mainly from the installation of N_2O removal equipment at German adipic acid plants (adipic acid is used in the production of nylon and plasticizers).

indicator 8.7 Energy System Contribution to Total Sulphur Dioxide Emissions

table 8.7 Energy System Contribution to Total Sulphur Dioxide Emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related	810	618	578	558	549	531	483	464	449
Energy System	15 504	14 111	12 949	11 793	10 604	9 760	8 371	7 506	7 444

Units: Thousand tonnes

Sulphur dioxide (SO_2) emissions contribute to acidification and also to the production in the atmosphere of fine particulate matter which is associated with major health and mortality effects.

The majority of sulphur dioxide emissions (95% in 1990 and 94% in 1998) come from the energy system. The major source of these emissions is the combustion of solid fuels and some oils.

Over the period from 1990 to 1998, total emissions of sulphur dioxide decreased by 52%. Emissions of SO_2 from the energy system also fell by 52%, despite a 9% increase in total energy use (see 2.9).

It follows that the amount of sulphur dioxide emitted per unit of energy used has fallen significantly. The main reason for this fall is the reduction in the use of coal and lignite with a relatively high sulphur content (obtained mainly from sources within the EU). The installation of flue gas de-sulphurisation equipment at many solid fuel power stations and the reduced sulphur content of liquid fuels (both driven by legislation) have also made a significant contribution to the reduction in SO_2 emissions.

indicator 8.8 Energy System Contribution to Total NO_x Emissions

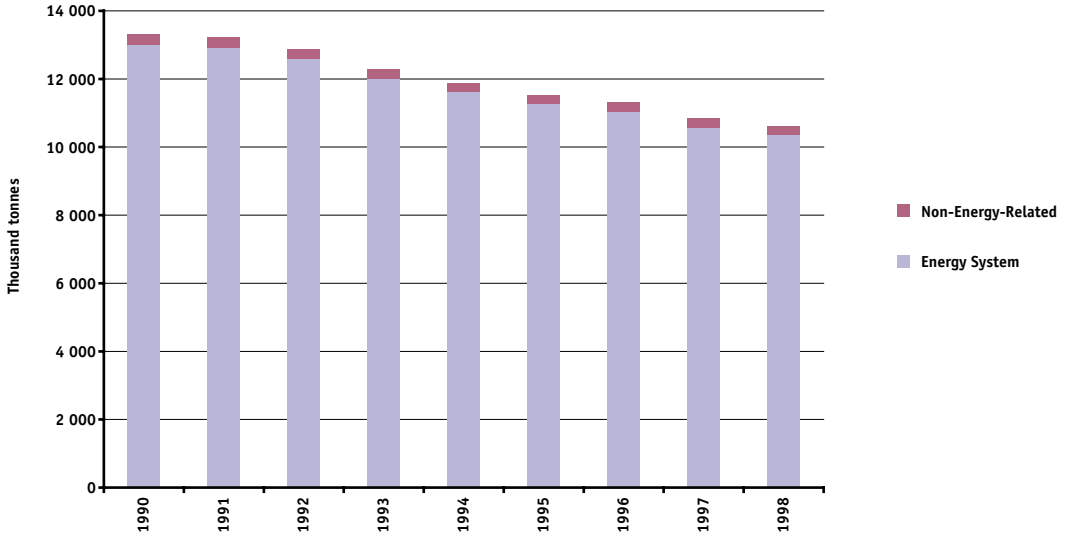

table 8.8 Energy System Contribution to Total NO_x Emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related	313	303	288	271	257	257	282	267	264
Energy System	12 989	12 907	12 602	12 010	11 631	11 280	11 050	10 560	10 357

Units: Thousand tonnes

Nitrogen oxides (which should not be confused with nitrous oxide: see 8.6) are partly responsible for a series of environmental problems. These include acidification, eutrophication and photochemical smog, including ground level ozone which is a threat to human health. Nitrogen oxides also contribute to the build-up of tropospheric ozone which is a potent greenhouse gas.

The majority (almost 98% from 1990 to1998) of nitrogen oxide emissions are produced by the energy system, with the major source being the combustion of fossil fuels.

Over the period from 1990 to 1998, total emissions of nitrogen oxides fell by 20%. Emissions from the energy system fell by the same amount, despite a 9% rise in total energy use (see 2.9). It follows that the level of nitrogen oxide emissions per unit of energy used has decreased. This decrease results mainly from the increased use of 'low NO_x' combustion technology, together with the use of three-way catalytic converters on petrol cars - although these have increased the emissions of the potent greenhouse gas nitrous oxide (see 8.6).

indicator 8.9 Energy System Contribution to Total NMVOC Emissions

table 8.9 Energy System Contribution to Total NMVOC Emissions

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Non-Energy-Related	6 742	6 510	6 298	6 100	6 146	6 030	5 689	5 659	5 629
Energy System	8 407	8 073	7 845	7 414	7 133	6 790	6 563	6 256	6 054

Units: Thousand tonnes

Non Methane Volatile Organic Compounds (NMVOCs) include gaseous hydrocarbons and other gaseous organic compounds which (in combination with nitrogen oxides) contribute to the formation of photo-chemical smog and tropospheric ozone. NMVOCs therefore contribute indirectly to global warming because of the fact that tropospheric ozone is a greenhouse gas.

Over half of NMVOC emissions originate from the energy system (55% in 1990 and 52% in 1998). Major sources include fossil fuel combustion (particularly in the transport sector), evaporative emissions from industrial processes and non-industrial uses of organic solvents.

Over the period from 1990 to 1998, total emissions of NMVOCs fell by 23%. Emissions from the energy system fell by 28%, while emissions from other sources reduced by only 17%. As in the case of other gases, this reduction in emissions from the energy sector contrasts with the 9% rise in total energy use (see 2.9), showing that emissions per unit of energy used have decreased in this instance also. This results mainly from the fitting of catalytic converters to the exhaust systems of petrol-engined cars.

The introduction of legislation to reduce fugitive emissions from petrol stations and to control the storage and use of solvents is also a contributory factor in the reduction of NMVOC emissions.

indicator 8.10 Greenhouse Gas Emissions from the Energy System

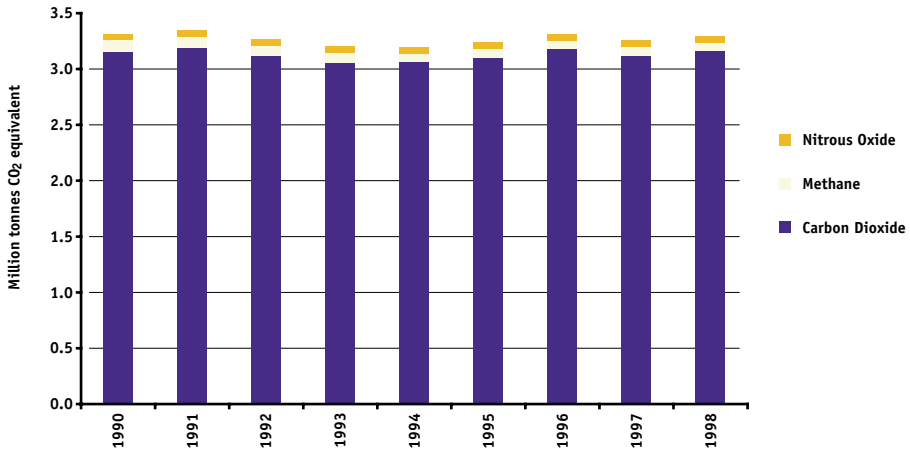

table 8.10 Greenhouse Gas Emissions from the Energy System

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Nitrous Oxide	51 916	53 549	53 545	53 315	55 526	57 828	59 540	60 313	55 041
Methane	101 051	99 162	96 429	87 202	79 533	79 355	76 388	75 091	74 354
Carbon Dioxide	3 156 310	3 189 580	3 116 540	3 058 189	3 063 268	3 101 215	3 179 349	3 118 891	3 163 824

Units: Thousand tonnes CO_2 equivalent

As in the case of indicator 8.1 earlier, methane (CH_4) and nitrous oxide (N_2O) emissions are expressed in terms of carbon dioxide (CO_2) equivalents. This takes into account the higher global warming potential of these greenhouse gases compared with that of carbon dioxide.

Between 1990 and 1998 total greenhouse gas emissions from the energy sector have changed very little, although there was a fall of around 3% in the early 1990s due to the recession throughout Europe in general, and also to the improvements in energy efficiency which occurred in Germany following reunification. Overall there was a reduction of just 0.5%, despite the 9% increase in the total amount of energy consumed over the same period (see 2.9).

As already noted, increased consumption of energy was offset by the switch to fuels with a low or zero carbon content.

Carbon dioxide emissions were by far the largest source of greenhouse gases (95% in 1990 and 96% in 1998), even after taking account of the much greater global warming potential of nitrous oxide and methane. Methane now accounts for just 2.3% of the total and nitrous oxide for 1.7%.

indicator 8.11 Indices of Greenhouse Gas Emissions from the Energy System

Reference Year = 1990

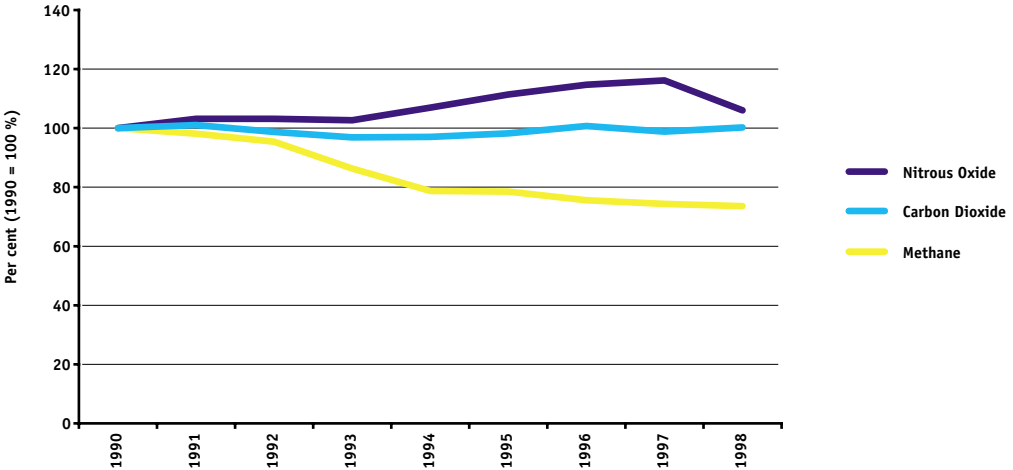

table 8.11 Indices of Greenhouse Gas Emissions from the Energy System

Reference Year = 1990

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Nitrous Oxide	100	103	103	103	107	111	115	116	106
Carbon Dioxide	100	101	99	97	97	98	101	99	100
Methane	100	98	95	86	79	79	76	74	74

Units: Per cent (1990 = 100%)

These indices clearly demonstrate the ways in which emissions of different greenhouse gases have changed over the period from 1990 to 1998.

Emissions of carbon dioxide, the most significant greenhouse gas, remained at a similar level throughout the period, although there was a small (up to 3%) reduction in emissions during the early 1990s. As already noted (see 8.10), the potential for higher emissions as a result of increased energy use was offset by the increased use of fuels with a low or zero carbon content.

Emissions of nitrous oxide (N_2O) increased by 6% over the period, despite a significant (8.7%) drop between 1997 and 1998. This increase results primarily from the increased number of petrol-engined cars fitted with three-way catalytic converters, which produce higher nitrous oxide emissions than cars without converters.

Methane emissions fell by 26% over the period. This resulted mainly from the reduction in coal mining across the EU and to improvements in the control of emissions from gas transmission/distribution pipelines and improvements in oil and gas extraction processes.

indicator 8.12 Greenhouse Gas Emissions per Capita

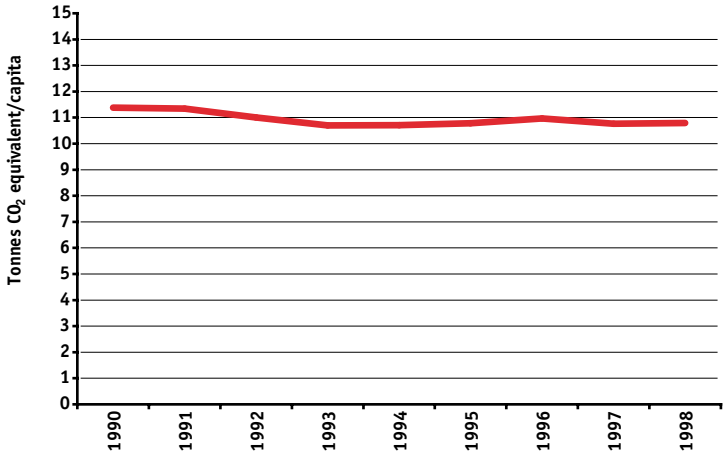

table 8.12 Greenhouse Gas Emissions per Capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998
GHG Emissions/Capita	11.38	11.34	11.00	10.70	10.71	10.78	10.97	10.76	10.79

Units: Tonnes CO_2 equivalent/capita

Total greenhouse gas emissions per person across the EU fell by 5% between 1990 and 1998. This reflects a combination of a 2.8% increase in the population, and a reduction of 2.5% in total greenhouse gas emissions.

The decline in per capita emissions was steepest in the early part of the decade and emissions per capita in 1998 were only 0.9% higher than the minimum level of 10.7 tonnes per capita which was achieved in 1993. The peak in 1996 (10.97 tonnes per capita) is linked to the severity of the winter in that year.

While greenhouse gas emissions from sources outside the energy system fell by 10% over the period 1990 to 1998, they accounted for only 19% of the total in 1998 (see 8.1).

indicator 8.13 Greenhouse Gas Emissions per Unit of GDP

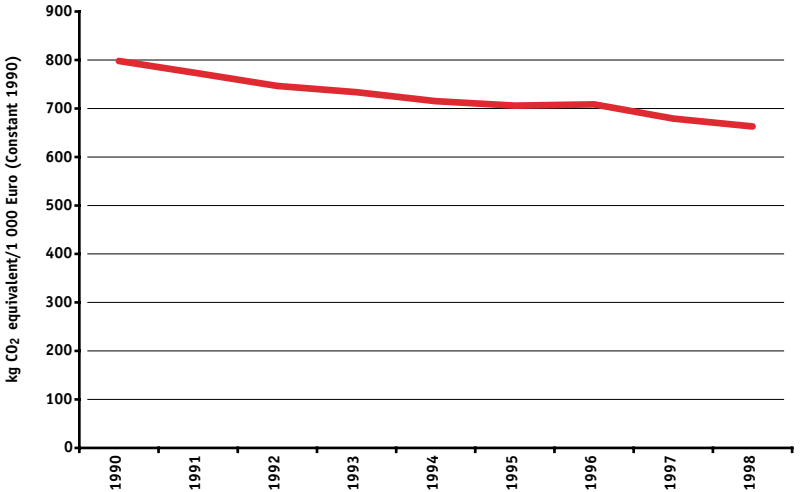

table 8.13 Greenhouse Gas Emissions per Unit of GDP

	1990	1991	1992	1993	1994	1995	1996	1997	1998
GHG Emissions / GDP	798	773	746	734	715	706	708	679	663

Units: kg CO_2 equivalent/1 000 Euro (constant 1990 prices)

The greenhouse gas emissions per unit output of gross domestic product (GDP) link emissions with economic output.

Emissions per unit of GDP fell by 17% between 1990 and 1998, reflecting a combination of a 17% increase in GDP and a 2.5% drop in total greenhouse gas emissions. These contrasting changes are not inconsistent. They reflect the fact that the increase in GDP took place mainly in sectors that are less energy intensive, such as the service sector. There has also been a contraction in the traditional heavy industries, which are more intensive in terms of energy used per unit of output, and also in mining, which contributes directly through methane emissions.

The increased use of lower carbon content fuels, some improvements in energy efficiency and better controls over landfill gas emissions have also contributed to the reduction in greenhouse gas emissions per unit of GDP. The accelerated rate of reduction since 1996 reflects mainly the reduction in emissions of greenhouse gases from power generation that have been achieved largely through the substitution of natural gas for coal as a fuel.

indicator 8.14 Greenhouse Gas Emissions per Unit of Gross Inland Consumption of Energy

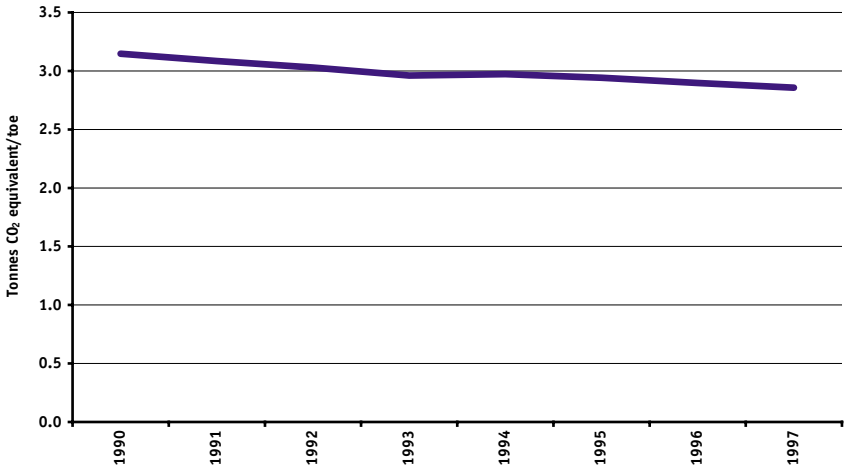

table 8.14 Greenhouse Gas Emissions per Unit of Gross Inland Consumption of Energy

	1990	1991	1992	1993	1994	1995	1996	1997	1998
GHG Emissions / GIC	3.15	3.08	3.03	2.96	2.97	2.94	2.90	2.86	2.82

Units: Tonnes CO_2 equivalent /tonne oil equivalent (toe)

Total greenhouse gas emissions per unit of gross inland consumption (GIC) of energy fell by 10% over the period from 1990 to 1998, despite the 9% increase in GIC over the same period (see 2.9).

It follows that the EU as an entity is consuming more energy but actually emitting lower volumes of greenhouse gases. This results mainly from the switch away from fuels such as coal and lignite which emit higher levels of greenhouse gases (particularly CO_2) per unit consumed, towards fuels such as gas which produce lower emissions. The increase in the use of renewable energy and the continued role of nuclear power are also factors in the reduction, since neither produces greenhouse gas emissions except in cases where the combustion of wastes is involved.

indicator 8.15 Indices of Carbon Dioxide Emissions from Energy Transformation and Consumption, by Fuel

Reference Year = 1990

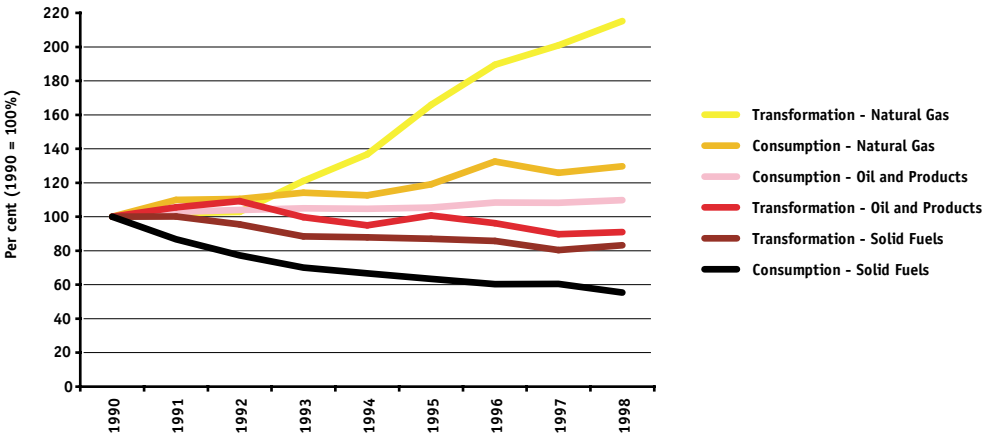

table 8.15 Indices of Carbon Dioxide Emissions from Energy Transformation and Consumption, by Fuel Reference Year = 1990

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Transformation – Natural Gas	79	79	86	85	95	100	102	103	121	137	166	189	201	215
Transformation - Petroleum Products	97	89	92	87	99	100	106	109	100	95	101	96	90	91
Transformation - Solid Fuels	94	96	97	96	98	100	100	96	88	88	87	86	80	83
Final Consumption - Natural Gas	88	91	96	94	97	100	110	111	114	113	119	132	126	130
Final Consumption - - Petroleum Products	94	98	98	100	98	100	103	104	105	105	105	108	108	110
Final Consumption - Solid Fuels	126	116	115	111	107	100	87	77	70	67	63	60	60	55

Units: Per cent (1990 = 100%)

Indices relating to transformation cover fuels used in areas such as thermal power stations, district heating systems and oil refineries, while those relating to final energy consumption cover energy use by final consumers. There has been a 17% decline in CO_2 emissions from the use of solid fuels in energy transformation between 1990 and 1998, while emissions from the use of oil fuels for this purpose decreased by 9% over the same period. This contrasts with the very significant (115%) growth in emissions from natural gas used within the energy transformation sector, mainly for electricity generation.

The use of solid fuels has declined even more rapidly across the final energy consuming sectors, with a 45% fall in emissions of CO_2 between 1990 and 1998. Despite the decreased use of oil in both industry and households, rapid growth in the transport sector has led to a 10% overall increase in CO_2 emissions from the consumption of this fuel. The use of natural gas has increased in all sectors, and has contributed to a 30% increase in the associated CO_2 emissions.

indicator 8.16 Carbon Dioxide Emissions, by Sector

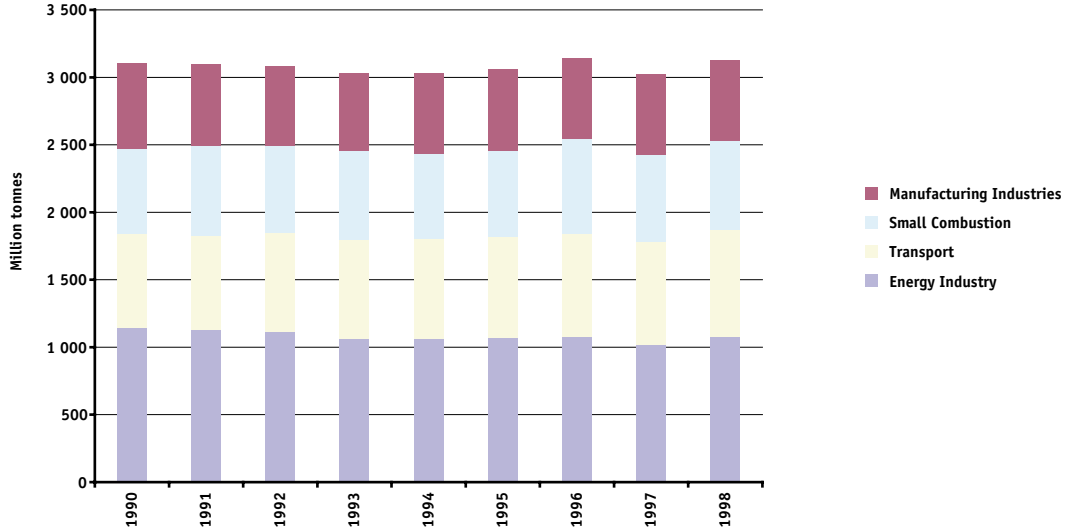

table 8.16 Carbon Dioxide Emissions, by Sector

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Manufacturing Industries	635 832	600 808	591 243	571 925	594 131	606 384	595 737	596 566	599 878
Small Combustion	632 981	671 277	647 251	656 832	629 095	638 214	703 780	641 496	652 164
Transport	692 346	694 004	729 389	734 907	742 131	748 803	766 744	766 322	798 166
Energy Industry	1 148 052	1 133 010	1 116 580	1 061 719	1 063 530	1 070 474	1 076 937	1 017 219	1 076 337

Units: Thousand tonnes

There are significant differences between the trends in CO_2 emissions from different sectors. Emissions from the energy industry and from manufacturing industries both fell between 1990 and 1998, by 6.2% and 5.7% respectively. In the case of the energy industry this occurred mainly as a result of switching from fossil fuels to gas, the increased use of renewable energy and nuclear generation, and improvements in energy efficiency in general. Manufacturing industries have restructured and become more efficient, and have also switched from solid fuels to gas.

In the transport sector emissions have increased significantly (15%) between 1990 and 1998. This resulted mainly from the increase in energy consumption in road transport. (In accordance with the guidelines of the United Nations Framework Convention on Climate Change, data for the transport sector do not include emissions from international aviation or international marine transport.)

With small combustion energy use (mainly in the commercial and service sectors, households, agriculture and public institutions), there was an increase of just 3% between 1990 and 1998. Consumption (and thus CO_2 emissions) in this sector are closely linked to winter temperatures, with particularly cold winters across Europe leading to the peaks in 1991, 1993 and 1996.

indicator 8.17 Indices of Carbon Dioxide Emissions, by Sector Reference Year = 1990

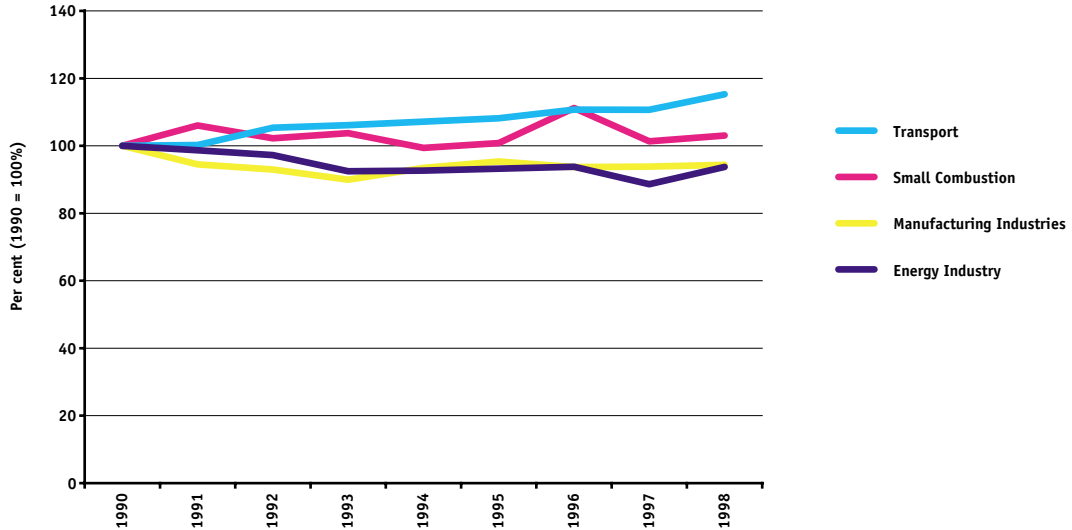

table 8.17 Indices of Carbon Dioxide Emissions, by Sector Reference Year = 1990

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Transport	100	100	105	106	107	108	111	111	115
Small Combustion	100	106	102	104	99	101	111	101	103
Manufacturing Industries	100	94	93	90	93	95	94	94	94
Energy Industry	100	99	97	92	93	93	94	89	94

Units: Per cent (1990 = 100%)

The trends that have already been described (see 8.16) are clearly illustrated here.

Emissions from the transport sector have increased steadily year-on-year. Since the data for this sector exclude emissions associated with fuel consumption in both the international aviation and international marine subsectors, all of the increase can therefore be attributed to increased road traffic.

Emissions from manufacturing industries have declined, with the most rapid decreases occurring during the early 1990s. The minimum level of emissions was reached in 1993, but emissions have risen (by 5% in 1998) since then as the economy recovered and energy use increased.

Emissions from the energy industry also fell during the early 1990s, but have remained relatively stable since 1994 except for a significant dip in 1997. The relative volatility of emissions from small combustion plants is clearly seen, with peaks in 1991, 1993 and 1996 corresponding to cold winters throughout Europe.

indicator 8.18 Carbon Dioxide Emissions from Electricity Generation

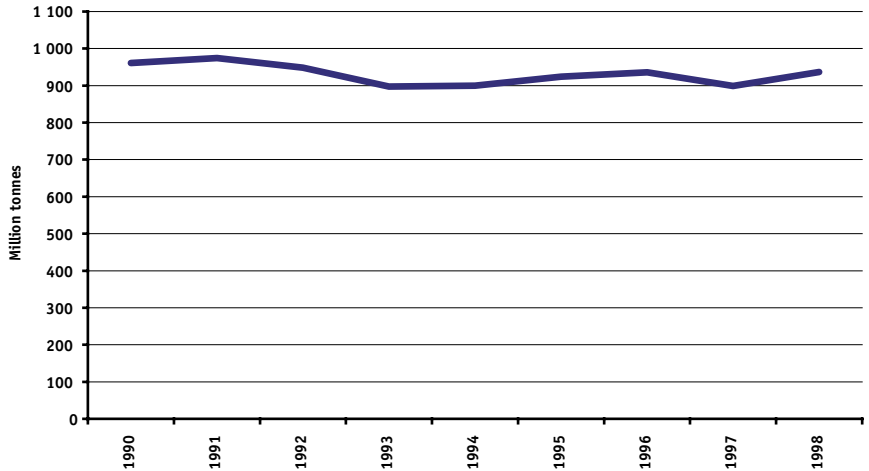

table 8.18 Carbon Dioxide Emissions from Electricity Generation

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 Emissions	961 257	974 738	948 498	897 134	899 630	924 433	936 089	898 959	936 823

Units: Thousand tonnes

The emissions of carbon dioxide associated with the generation of electricity decreased by 2.5% between 1990 and 1998. During that period this activity consistently contributed about 30% of the CO_2 emissions from the energy system, which in turn contributed a consistent 95% of total CO_2 emissions.

This decrease in the CO_2 emissions associated with electricity generation was achieved despite a 22% increase in the total amount of electricity generated (see 4.1). This results mainly from the switch to fuels with a relatively low carbon content (e.g. natural gas) at the expense of solid fuels such as coal and lignite which have a higher carbon content. Factors which contributed to the reduced level of CO_2 emissions included the modest expansion in the role of renewable and nuclear energy for power generation, improvements in the efficiency of electricity generating plants (combined cycle gas turbine technology etc.) and the decommissioning of older, less efficient generating plants.

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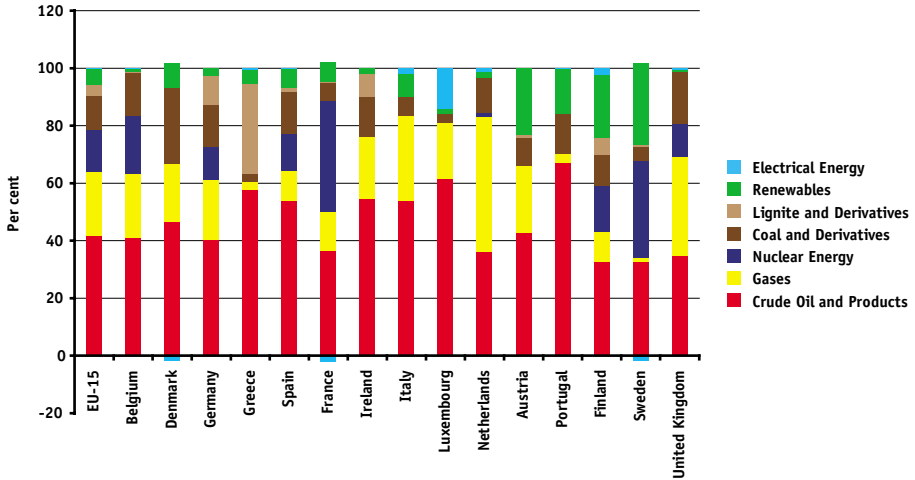
9 Member State Data

indicator 9.1 Gross Inland Consumption, by Fuel (1998)



Negative values of Gross Inland Consumption of electrical energy indicate that exports exceed imports

table 9.1 Gross Inland Consumption, by Fuel (1998)

	Crude Oil and Products	Gases	Nuclear Energy	Coal and Derivatives	Lignite and Derivatives	Renewables	Electrical Energy
EU-15	601 167	315 499	209 664	173 102	49 617	84 816	1 127
Belgium	22 945	12 474	11 394	8 396	42	660	120
Denmark	9 875	4 224	0	5 642	1	1 768	- 371
Germany	137 660	72 729	38 912	49 839	35 587	8 501	- 55
Greece	15 525	725	0	833	8 322	1 355	138
Spain	59 577	11 609	14 418	16 131	1 643	7 001	293
France	91 628	33 413	96 636	16 240	447	16 890	- 4 949
Ireland	7 125	2 803	0	1 823	1 025	259	7
Italy	92 914	51 126	0	11 681	25	13 278	3 502
Luxembourg	2 013	633	0	106	0	50	466
Netherlands	27 091	34 946	937	9 236	0	1 454	1 016
Austria	12 428	6 730	0	2 895	253	6 765	- 14
Portugal	15 334	697	0	3 171	0	3 591	24
Finland	10 835	3 336	5 370	3 511	1 930	7 247	800
Sweden	15 754	712	16 166	2 356	339	13 734	- 920
United Kingdom	80 462	79 342	25 831	41 241	0	2 263	1 072

Units: Thousand tonnes of oil equivalent (ktoe)

Crude oil and products are the main source of energy in all Member States except Sweden and France (nuclear energy) and the Netherlands (gas). Oil accounts for 42% of total gross inland consumption across the EU. Gas is the second most commonly used fuel overall (22%), although it is used only to a very limited extent in Sweden, Greece and Portugal.

Nuclear energy accounts for 15% of EU total energy consumption. The percentage contribution of nuclear energy is however much higher in France (39%) and Sweden (34%), while seven Member States make no use of nuclear energy. Solid fuels (coal and lignite) account for 16% of total energy consumption within EU-15, but again there are significant variations between countries. The total in Greece is 34%, 27% in Denmark and 25% in Germany, but only 7% in Italy and France, 6% in Sweden and 3% in Luxembourg. Renewable energy accounts for 6% of total energy consumption within EU-15 (see 9.2).

indicator 9.2 Contribution of Renewable Energy Sources to Gross Inland Consumption (1998)

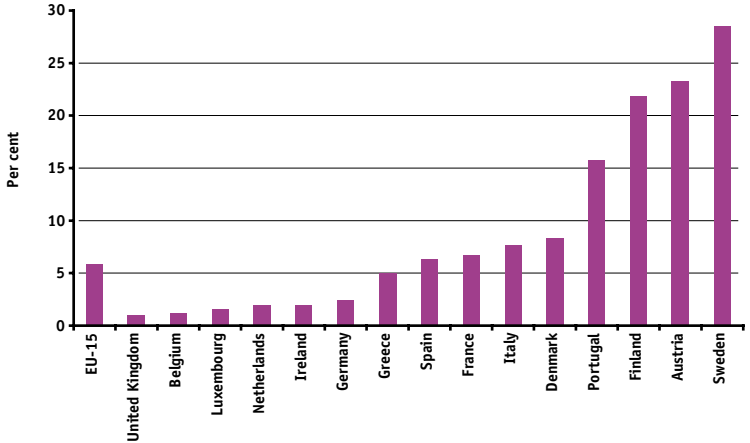


table 9.2 Contribution of Renewable Energy Sources to Gross Inland Consumption (1998)

	EU-15	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy	Luxembourg	Netherlands	Austria	Portugal	Finland	Sweden	United Kingdom
Contribution	5.9	1.2	8.4	2.5	5.0	6.3	6.7	2.0	7.7	1.5	1.9	23.3	15.7	21.8	28.5	1.0

Units : Per cent

The contribution of renewable energy sources to gross inland consumption varies widely between Member States. Renewables are the second largest source of energy in Finland, Portugal, and Austria (together with gas), and the third largest in Sweden where it contributes 28.5% to gross inland consumption.

The contribution of renewable energy sources to gross inland consumption is generally about one third of their contribution to electricity generation.

indicator 9.3 Contribution of Renewable Energy Sources to Electricity Generation, by Source (1998)

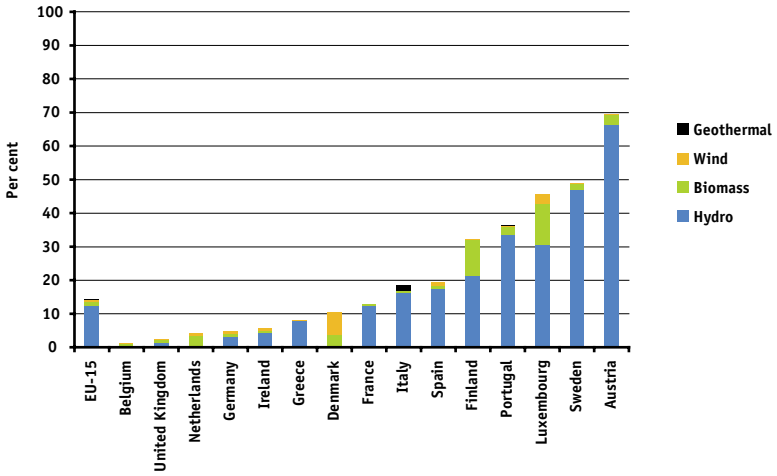


table 9.3 Contribution of Renewable Energy Sources to Electricity Generation, by Source (1998)

	EU-15	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy	Luxembourg	Netherlands	Austria	Portugal	Finland	Sweden	United Kingdom
Geothermal	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Wind	0.5	0.0	6.8	0.8	0.2	1.1	0.0	0.8	0.1	2.9	0.7	0.1	0.2	0.0	0.2	0.2
Biomass	1.3	0.6	3.5	0.9	0.0	0.8	0.4	0.4	0.5	12.0	3.4	3.0	2.6	10.7	1.8	0.8
Hydro	12.4	0.5	0.1	3.2	8.0	17.5	12.4	4.4	16.3	30.7	0.1	66.4	33.4	21.4	47.0	1.5
Total	14.3	1.1	10.4	4.9	8.2	19.5	12.8	5.6	18.5	45.6	4.2	69.5	36.4	32.2	48.9	2.5

Units: Per cent

Hydro-electric power is the most significant source of renewable electricity across the EU, accounting for 12.4% of all electricity generated, and making the largest contribution in all countries except Denmark and the Netherlands.

Biomass is the second most significant source of renewable electricity, but still accounts for only 1.3% of total electricity generation across the EU. The contribution of biomass is increasing, and is particularly significant in Finland where it accounts for 10.7% of electricity generation.

The contribution of wind power is also increasing, but remains at only 0.5% of total electricity generated across the EU. Wind makes the greatest percentage contribution in Denmark (6.8%), although the amount of electricity generated from wind power in Germany is now 1.7 times as great as in Denmark. Italy is the only Member State where geothermal energy is used to generate electricity to any significant extent.

The contribution of renewables to electricity generation in Luxembourg is high because of the low overall level of electricity generation within that Member State, as most of its electricity needs are met by imports.

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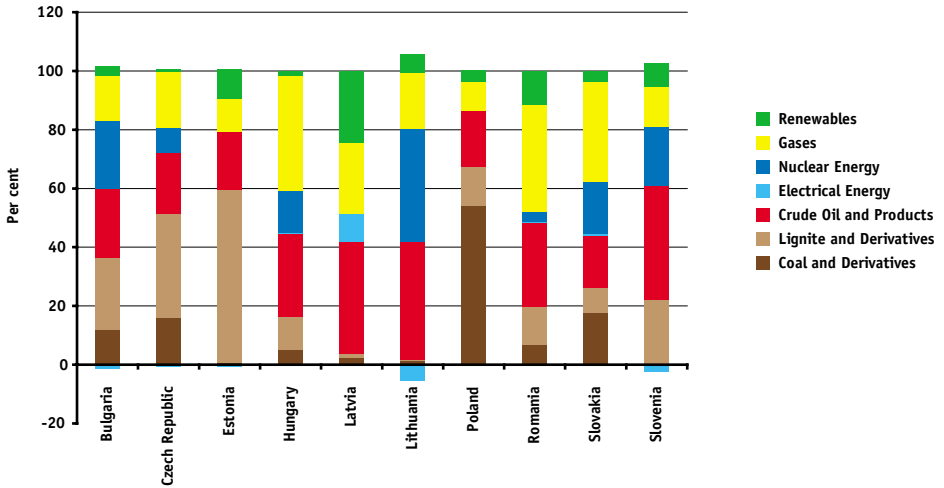
10 Enlargement Countries Data

indicator 10.1 Gross Inland Consumption, by Fuel (1998)



Negative values of Gross Inland Consumption of electrical energy indicate that exports exceed imports

table 10.1 Gross Inland Consumption, by Fuel (1998)

	Coal and Derivatives	Lignite and Derivatives	Crude Oil and Products	Electrical Energy	Nuclear Energy	Gases	Renewables	Total
Bulgaria	2 448	5 031	4 846	-313	4 727	3 130	678	20 547
Czech Republic	6 381	14 412	8 293	-212	3 454	7 685	327	40 340
Estonia	26	3 045	1 004	- 33	0	592	507	5 141
Hungary	1 279	2 835	7 088	64	3 620	9 787	407	25 079
Latvia	106	60	1 636	417	0	1 044	1 047	4 310
Lithuania	138	18	3 737	-523	3 592	1 754	591	9 307
Poland	52 493	12 889	18 579	-299	0	9 514	3 870	97 046
Romania	2 767	5 226	11 789	40	1 390	14 923	4 660	40 795
Slovakia	3 279	1 580	3 201	194	3 204	6 337	662	18 456
Slovenia	27	1 402	2 549	-163	1 308	864	521	6 507

Units: Thousand tonnes of oil equivalent (ktoe)

In the enlargement countries listed above, the contribution of crude oil and products to gross inland consumption varies between 17% and 40%. This is significantly less than in EU-15 where it accounts for 42% of total gross inland consumption (see 9.1).

In general, gas is used less commonly than in EU-15, with notable exceptions in the cases of Hungary, Romania and Slovakia where this is the most heavily used fuel. The contribution of renewable energy sources to gross inland consumption in the enlargement countries varies between 1% and 24%, and the overall contribution of all the countries listed is 5%. This is comparable with the overall contribution in EU-15 where renewable energy accounts for 5.9% of gross inland consumption (see 9.2).

Nuclear energy makes a significant contribution in countries such as Bulgaria, Lithuania and Slovenia, although its contribution across all of the countries listed is only 8%. This is less than the 15% which applies in the case of EU-15. Solid fuels (coal and lignite) account for a much greater proportion of gross inland consumption in the enlargement countries listed above than they do within EU-15. The overall contribution of solid fuels to the gross inland consumption of all of the countries listed is 43%, which is considerably larger than the equivalent contribution of 16% in EU-15.

indicator 10.2 Electricity Generation, by Type of Plant (1999)

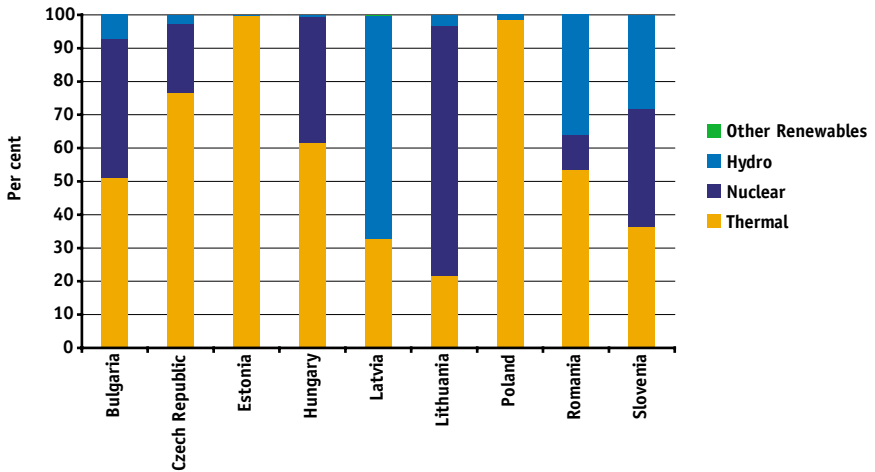


table 10.2 Electricity Generation, by Type of Plant (1999)

	Thermal	Nuclear	Hydro	Wind	Geothermal	Other Fuel Sources	Total
Bulgaria	19 452	15 814	2 753	0	0	0	38 019
Czech Republic	49 117	13 357	1 680	1	0	3	64 158
Estonia	8 263	0	4	1	0	0	8 268
Hungary	22 877	14 096	181	0	0	0	37 154
Latvia	1 350	0	2 757	2	0	1	4 110
Lithuania	2 812	9 862	414	0	0	0	13 088
Poland	137 842	0	2 155	4	0	0	140 001
Romania	27 222	5 198	18 290	0	3	0	50 713
Slovakia	*	*	*	*	*	*	*
Slovenia	4 825	4 696	3 740	0	0	0	13 262

Units: GWh *(*data not available)*

Combustible fuels used in thermal power stations are the dominant means of electricity generation in the enlargement countries for which data has been presented. Notable exceptions however are the use of nuclear energy in Lithuania, and the use of hydropower in Latvia.

The most significant source of renewable energy is hydropower which makes a contribution of 67% in Latvia, 36% in Romania and 28% in Slovenia, but significantly smaller contributions in the other countries. Wind powered generation makes a small (up to 0.05%) contribution in four of the countries listed. As in the case of EU-15, the use of geothermal heat for electricity generation is very limited.

indicator 10.3 Greenhouse Gas Emissions (1997)

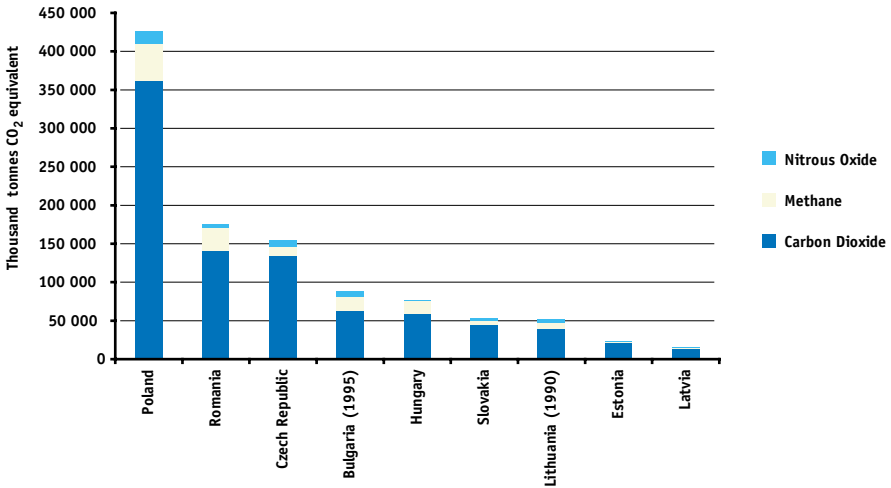


table 10.3 Greenhouse Gas Emissions (1997)

	Carbon Dioxide	Methane	Nitrous Oxide
Bulgaria (1995)	62 227	18 929	6 386
Czech Republic	134 585	11 761	8 882
Estonia	20 716	2 164	217
Hungary	58 893	16 542	1 364
Latvia	12 842	2 138	1 184
Lithuania (1990)	39 535	7 937	4 077
Poland	361 626	47 845	16 743
Romania	141 177	29 852	4 721
Slovakia	44 376	5 817	3 884

Units: Thousand tonnes CO_2 equivalent

Total greenhouse gas emissions from the enlargement countries listed amount to 1 066 million tonnes of CO_2 equivalent, while total emissions from EU-15 Member States were 4 046 million tonnes in 1998 (see 8.1) The relative contributions of the three greenhouse gases are different for the enlargement countries by comparison with those of the Member States. Carbon dioxide is still by far the most significant and, as in the case of EU-15, accounts for 82% of the total. However, the contribution of methane in the enlargement countries (13%) is higher than in EU-15 (9%), while the contribution of nitrous oxide (4.5%) is lower than the 9% which applies in the case of EU-15.

Annex A: Methodology for the calculation of EU-wide average fuel prices

All available price data has been used in the calculation of EU-wide fuel price averages in the section on energy prices. However, in the majority of the series in this section, price data for the three countries most recently acceded to the Union (Sweden, Finland and Austria) are not available before 1993. (This is not the case for the data presented in the other sections which include all Member States for the entire period, including, unless otherwise stated, the former East Germany). Since the overall EU price is an average of the prices in the individual countries weighted by their consumption, the impact on the EU price of these Member States will be minimal due to their relatively low consumption.

Electricity

Electricity prices are collected by Eurostat from the Member States of EU-15. The prices are as of 1 January in the year shown. Prices are collected at a variety of locations in each country and for a number of different consumers. For *domestic* prices, the standard consumer used is Dd - one with an annual consumption of 7 500 kWh which corresponds to a standard dwelling of 100m^2 with 4-5 rooms plus a kitchen. For *industrial* prices, the standard consumer used is Ig - one with an annual consumption of 24 000 000 kWh. More detailed information on the survey can be found in Eurostat's Electricity Prices publication.

The average price in each country is calculated as the median of the prices in the various locations. The average EU price is then calculated by taking a weighted average of the prices in individual countries. *Domestic* prices are weighted by the final energy consumption of electricity in households recorded annually by Eurostat. *Industrial* prices are weighted by the final energy consumption of electricity in industry recorded by the same survey. Since price data are available for 1998 and 1999 but consumption data are not, the prices for 1998 and 1999 have been weighted by 1997 consumption; this should have only a small effect on the EU average.

The survey collects final selling prices, prices less VAT and prices less all taxes. The *domestic* prices shown here are final selling prices while *industrial* prices are shown less VAT (i.e. what industry will actually pay for the energy).

Gas

Natural gas prices are collected by Eurostat on a similar basis to electricity prices. The EU averages are also calculated in the same way albeit using different standard consumers and different consumption measures to weight the country prices. For *domestic* consumers, the standard consumer used is D2 (annual consumption of 16.74 GJ i.e. 4 652 kWh) while for *industrial* consumers it is I4-1 (annual consumption of 418 600 GJ i.e. 116.30 GWh).

Domestic natural gas prices are weighted by final energy consumption of gas in households while *industrial* prices are weighted by final consumption in industry.

The survey collects final selling prices, prices less VAT and prices less all taxes. The *domestic* prices shown here are final selling prices while *industrial* prices are shown less VAT (i.e. what industry will actually pay for the energy).

Petroleum products

The heating gasoil, residual fuel oil and gasoline and automotive diesel prices are supplied to DG-TREN of the Commission by the Member States as those being the most frequently encountered for the specific categories of sale listed below. The prices given are as of 15 January in each year.

The heating gasoil prices given are for deliveries of between 2 000 and 5 000 litres while those for residual fuel oil are for monthly deliveries of less than 2 000 tonnes or annual deliveries of less than 24 000 tonnes. Average pump prices are given for premium (leaded) gasoline, unleaded gasoline and automotive diesel fuel.

The EU average prices are calculated by weighting the prices from each country by the final energy consumption of gasoil in households, of residual fuel oil in industry and of the three automotive fuels (separately) in transport for the respective products.

EU-wide prices for premium gasoline are not given for 1997 to 1999 because falling consumption means that some of the prices have become unreliable.

The price of oil shown is the annual average of Brent crude spot prices.

Coal

The average import prices of steam coal are taken from Eurostat's Comext database of trade in goods of EU Member States. The prices include imports from within and outside the EU. They are calculated by taking the total value of imports to each Member State and dividing it by the total quantity. The EU average is then calculated by weighting the results from each Member State by the coal input into conventional thermal power stations (for steam coal) and by coal input into coking plants (for coking coal).

Annex B: Glossary of Terms Used in this Publication

Acid Equivalent:

The acid equivalent of a gas is a measure of the acidifying effect of that gas. The concept is used in order to determine the acidifying effect of a combination of different gases. This is achieved by first multiplying the quantities of the individual gases by their respective acid equivalents and then adding these equivalent quantities together. For the gases included in this publication, the acid equivalent of sulphur dioxide (SO_2) is 1/32, and that of oxides of nitrogen (NO_x) is 1/46.

Acidifying Gases:

The acidifying gases considered in this publication are sulphur dioxide (SO_2) and oxides of nitrogen (NO_x). Emissions of these gases are associated with the formation of acid rain.

Added Value:

See "Value Added"

CHP:

See "Combined Heat and Power"

CO_2 Equivalent:

The CO_2 equivalent of a greenhouse gas is obtained by multiplying the quantity of that gas by its global warming potential (q.v.). The concept is used in order to determine the global warming potential of a combination of different greenhouse gases. This is achieved by first multiplying the quantities of the individual gases by their respective global warming potentials and then adding these equivalent quantities together.

Cogeneration:

See "Combined Heat and Power"

Combined Heat and Power:

A combined heat and power (also referred to as a cogeneration or a CHP) unit is an installation in which heat energy released from fuel is transmitted to electrical generator sets which are designed and operated in such a way that energy is partly used for generating electrical energy and partly for supplying heat for various purposes. The thermal efficiency of a combined heat and power unit is significantly higher than that of an electricity-only unit.

Constant Price:

The constant (or real) price of a commodity is its price considered in constant terms, taking account of inflation.

Current Price:

The current (or nominal) price of a commodity is its price considered in current terms, without taking account of inflation.

Energy Dependency:

Energy dependency shows the extent to which a country relies upon imports in order to meet its energy needs. It is calculated using the following formula:

net imports / gross inland consumption

Energy Intensity:

Energy intensity gives an indication of the effectiveness with which energy is being used to produce added value. It is defined as the ratio of Gross Inland Consumption to Gross Domestic Product.

Energy System:

The energy system is the combination of the energy industry, i.e. the energy transformation sector, and the final energy consumers.

Final Energy Consumption:

Final energy consumption is the energy consumed in the transport, industrial, commercial, agricultural, public authority and household sectors. It excludes deliveries to the energy transformation sector and to the energy producing industries themselves.

GCV:

See "Gross Calorific Value"

GDP:

See "Gross Domestic Product"

Global Warming Potential:

The global warming potential of a greenhouse gas is a measure of its ability to trap heat in the earth's atmosphere over a 100-year period. This is quoted relative to that of carbon dioxide which has a global warming potential of 1. Of the other gases included in this publication, the global warming potential of methane (CH_4) is 21, and that of nitrous oxide (N_2O) is 310.

Greenhouse Gases:

The main greenhouse gas emissions considered in this publication are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Emissions of these gases are associated with the "Greenhouse Effect" which gives rise to an increase in the Earth's temperature.

Gross Calorific Value:

The gross calorific value (GCV) is the total amount of heat released by a unit quantity of fuel, when it is burned completely with oxygen, and the products of combustion are returned to ambient temperature. This quantity includes the heat of condensation of any water vapour contained in the fuel and of the water vapour formed by the combustion of any hydrogen contained in the fuel.

Gross Domestic Product:

The gross domestic product (GDP) is the value of the output of all goods and services produced within the borders of a country.

Gross Inland Consumption:

Gross inland consumption is the quantity of energy consumed within the borders of a country. It is calculated using the following formula:

> primary production + recovered products + imports + stock changes – exports – bunkers (i.e. quantities supplied to sea-going ships)

Hard Coal and Derived Products:

Hard coal and derived products include hard coal, patent fuels, hard coke, gas-works coke and coal semi-coke.

Lignite and Derived Products:

Lignite and derived products include lignite, peat, brown coal briquettes and peat briquettes.

Natural Gas:

Natural gas occurs in natural underground deposits, and may or may not be associated with oil deposits. It contains essentially methane, but also small proportions of other gases. It also covers methane recovered in coal mines.

NCV:

See “Net Calorific Value”

Net Calorific Value:

The net calorific value (NCV) is the amount of heat released by a unit quantity of fuel, when it is burned completely with oxygen, and the products of combustion are returned to ambient temperature. This quantity does not include the heat of condensation of any water vapour contained in the fuel nor of the water vapour formed by the combustion of any hydrogen contained in the fuel.

Nominal Price:

See “Current Price”

Power Station Efficiency:

The efficiency of a thermal or nuclear power station is defined as the ratio between the output, i.e. the gross electricity generated, and the fuel input. In the case of a combined heat and power installation the output is considered to be the gross electricity generated plus the heat produced.

Primary Energy Production:

Primary energy production is the extraction of energy from a natural source. The precise definition depends on the fuel involved:

Hard coal, lignite: Quantities of fuels extracted or produced, calculated after any operation for removal of inert matter. In general, production includes the quantities consumed by the producer during the production process (e.g. for heating or operation of equipment and auxiliaries) as well as any quantities supplied to other on-site producers of energy for transformation or other uses.

Crude oil: Quantities of fuels extracted or produced within national boundaries, including off-shore production. Production includes only marketable production, and excludes any quantities returned to formation. Production includes all crude oil, natural gas liquids (NGL), condensates and oil from shale and tar sands, etc.

Petroleum products: Quantities of natural gasoline and other products obtained from the production, purification and stabilisation of natural gas, which can be consumed without refining.

Natural gas: Quantities of dry gas, measured after purification and extraction of natural gas liquids and sulphur. Production includes only marketable production, and excludes any quantities re-injected, vented and flared, and any extraction losses. Production includes all quantities used within the natural gas industry, in gas extraction, pipeline systems and processing plants.

Nuclear heat: Quantities of heat produced in a reactor. Production is the actual heat produced or the heat calculated on the basis of the gross electricity generated and the thermal efficiency of the nuclear plant.

Hydropower, Wind energy, Solar photovoltaic energy: Quantities of electricity generated. Production is calculated on the basis of the gross electricity generated and a conversion factor of 3 600 kJ/kWh.

Primary Energy Production, continued

Geothermal energy: Quantities of heat extracted from geothermal fluids. Production is calculated on the basis of the difference between the enthalpy of the fluid produced in the production borehole and that of the fluid disposed of via the reinjection borehole.

Biomass/Wastes: In the case of municipal solid wastes (MSW), wood, wood wastes and other solid wastes, production is the heat produced after combustion and corresponds to the heat content (NCV) of the fuel.

In the case of anaerobic digestion of wet wastes, production is the heat content (NCV) of the biogases produced. Production includes all quantities of gas consumed in the installation for the fermentation processes, and excludes all quantities of flared gases.

In the case of biofuels, production is the heat content (NCV) of the fuel.

Real Price:

See "Constant Price"

Renewable Energy:

Renewable energy includes hydroelectricity, biomass, wind, and solar, tidal and geothermal energies.

Value Added:

The value added (to a product, or added value of a product) is the increase in the value of that product as the result of a particular stage of a production process.