

EN26 Total Primary Energy Consumption by Fuel

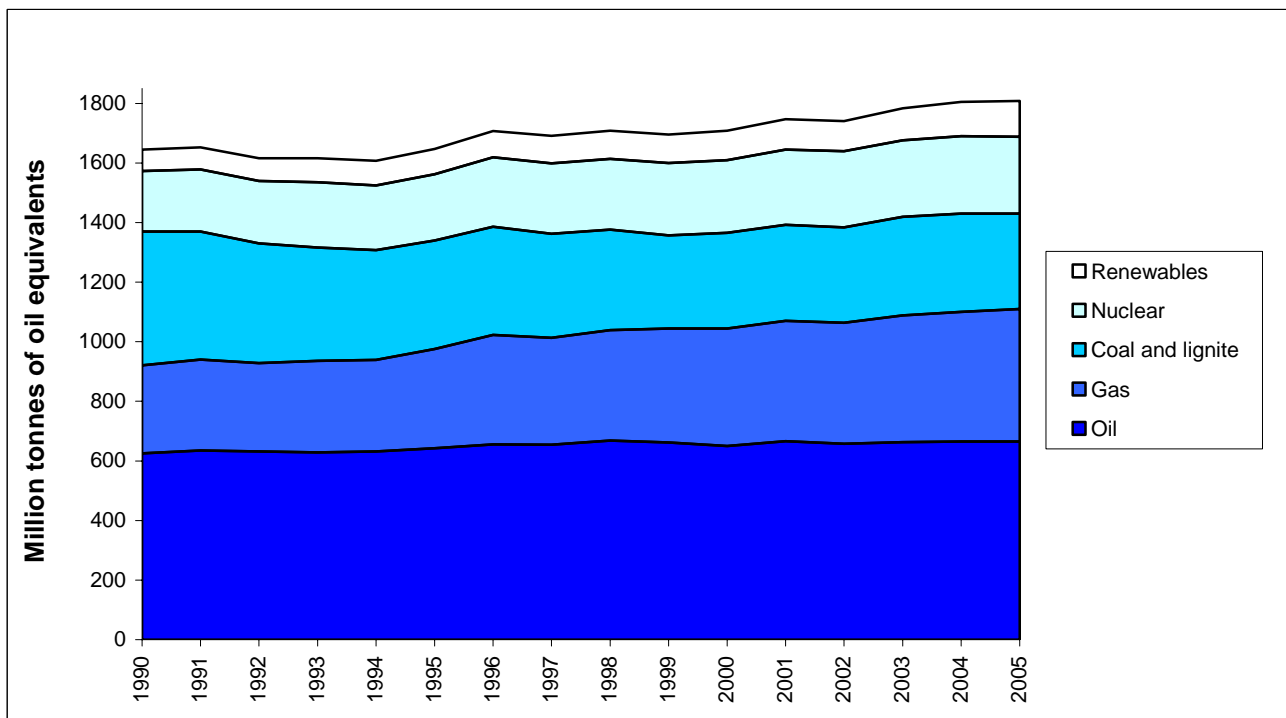
Key message

Fossil fuels continue to dominate total energy consumption, but environmental pressures have been reduced, partly due to a significant switch from coal and lignite to relatively cleaner natural gas in the 1990s. The share of renewable energy sources remains small despite an increase in absolute terms. Overall, total primary energy consumption increased by an average of 0.6 % per annum during the period 1990-2005 (9.8 % overall) thus counteracting some of the environmental benefits from fuel switching.

Rationale

The indicator provides an indication of the environmental pressures originating from energy consumption. The environmental impacts such as resource depletion, greenhouse gas emissions, air pollutant emissions and radioactive waste generation strongly depend on the type and amount of fuel consumed.

Fig. 1: Total energy consumption by fuel, EU-27



Data source: EEA, Eurostat (historic data)

1. Indicator assessment

Total primary energy consumption in the EU-27 increased by 9.8 % between 1990 and 2005. Over the same period, the share of fossil fuels, including coal, lignite, oil and natural gas, in primary energy consumption declined slightly from 83 % in 1990 to 79.0 % in 2005, although fossil fuel consumption increased in absolute terms (by more than 4 %). The use of fossil fuels has considerable impact on the environment and is the main cause of greenhouse gas emissions. Nevertheless, changes in the fossil fuel mix have brought environmental benefits. Overall, the share of coal has decreased and coal has been to some extent replaced by relatively cleaner natural gas. However, coal consumption has remained stable since 1999 and gas consumption continued increasing.

Most of the switching from coal to gas occurred in the power generation sector (but not exclusively). In the pre-2004 EU-15 Member States this was supported by implementation of environmental legislation and liberalisation of electricity markets, which stimulated the use of combined-cycle gas plants due to their high efficiency, low capital cost and low gas prices in the early 1990s, and by the expansion of the trans-EU gas network. Fuel mix changes in the new Member States were induced by the process of economic transformation, which led to changes in fuel prices, taxation, the removal of energy subsidies and introduction of policies to privatise and restructure the energy sector.

Oil accounted for around 37 % of primary energy consumption in 2005 and continues to be the major fuel in the transport sector. Consumption increased at an average annual rate of 0.4 % over the period 1990-2005, mainly as a result of increased demand for petrol and diesel in the transport sector, although this was tempered by a decline in the use of oil in other sectors, such as for power generation.

Renewable energy, which typically has lower environmental impacts than fossil fuels, has seen rapid growth in absolute terms, but from a low starting point. Renewables (together with natural gas) were the fastest growing energy source between 1990 and 2005, but despite increased support at the EU and national level, their contribution to total primary energy consumption remains low at just 6.7 % in 2005.

The share of nuclear power has remained stable over the last few years, accounting for 14 % of primary energy consumption in 2005. While nuclear power produces little atmospheric pollution during electricity production (although it generates thermic pollution) there is a risk of accidental radioactive releases, and highly radioactive wastes are accumulating for which no generally acceptable disposal route has yet been established.

Changes in the fuel mix have helped reducing otherwise higher greenhouse gas emissions, particularly in the production of heat and electricity. However, rising total primary energy consumption in absolute terms (0.6 % per year during 1990-2005) has counteracted some of the environmental benefits of the fuel switch.

Projections:

All projections from POLES and IEA indicate an overall increase of the total energy consumption. In comparison with the POLES scenarios, the WEO scenarios project the slower increase of total energy consumption.

Fig 2: Final Energy Consumption by sector and per capita, EU-27, 2020 (million TOE)

| | (IPTS) POLES | | (IEA) WEO | |
|--|------------------|------------------|------------------|--------------------|
| | Baseline | GHG Reduction | Reference | Alternative Policy |
| Coal and lignite | 16.5 | 10.9 | 15.4 | 10.4 |
| Oil | 30.1 | 29.7 | 34.8 | 34.1 |
| Gas | 25.7 | 26.2 | 28.1 | 27.3 |
| Nuclear | 12.2 | 15.1 | 10.0 | 14.3 |
| Renewables + industrial waste | 15.5 | 18.1 | 11.7 | 13.9 |
| Imports-exports of electricity | 0.0 | 0.0 | 0.0 | 0.0 |
| Total energy consumption (1000 TOE) | 2,055,000 | 1,861,000 | 1,944,000 | 1,863,000 |

Data source: IPTS, IEA

2. Indicator rationale

2.1 Environmental context

Total energy consumption is a driving force indicator providing an indication of the extent of environmental pressures caused (or at the risk of being caused) by energy production and consumption. It is disaggregated by fuel source as the environmental impact of each fuel is very specific.

The consumption of fossil fuels (such as crude oil, oil products, hard coal, lignite and natural and derived gas) provides a proxy indicator of resource depletion, CO₂ and other greenhouse gas emissions and air pollution levels (e.g. SO₂ and NO_x). The degree of environmental impact depends on the relative share of different fossil fuels and the extent to which pollution abatement measures are used. Natural gas, for instance, has approximately 40 % less carbon than coal per unit of energy content, and 25 % less carbon content than oil, and contains only marginal quantities of sulphur.

The level of nuclear energy consumption provides an indication of the trends in the amount of nuclear waste generated and of the risks associated with radioactive leaks and accidents. Increasing consumption of nuclear energy at the expense of fossil fuels would on the other hand contribute to reductions in CO₂ emissions.

Renewable energy consumption is a measure of the contribution from technologies that are, in general, more environmentally benign, as they produce no (or very little) net CO₂ and usually significantly lower levels of other pollutants. Renewable energy can, however, have impacts on landscapes and ecosystems (for example, potential flooding and changed water levels from large hydro power) and the incineration of municipal waste (which is generally made up of both renewable and non-renewable material) may also generate local air pollution.

2.2 Policy context

Total energy consumption disaggregated by fuel type is valuable in determining the overall environmental burden of energy consumption in the EU. Trends in the shares of different fuels and the level of total energy consumption will be one of the major determinants of whether the EU meets its target of reduction in greenhouse gas emissions as agreed in 1997 under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC). The overall Kyoto target for the pre-2004 EU-15 Member States requires an 8 % reduction by 2008-2012 from base year levels (1990 for most greenhouse gases), while most new Member States have individual targets under the Kyoto Protocol. For 2020 the Commission and the Council have set a target of 20 - 30% reduction (COM(2007)2 final).

On January 23rd 2008 the European Commission presented a new comprehensive package on climate change and energy (COM(2008)16, 17 and 19). This package is a bundle of legislative proposals aimed at realising at least a 20% reduction in emissions of greenhouse gases by 2020. It includes an improvement of the EU Emissions Trading Scheme (with a binding target of a 21% emission reduction of greenhouse gases in 2020 vs. 2005 for large sources of CO₂-emissions), targets for Member States for emissions outside the EU-ETS and targets for the use of renewable energy sources. A shift to less carbon intensive fuels will strongly contribute to achieving these targets.

Furthermore, in its 'Energy Policy for Europe' the Commission has set targets for energy-efficiency (20% lower use of energy compared to the reference-situation) in 2020, which also influences consumption of these fuels (COM(2006)545 final).

The Large Combustion Plant Directive (2001/80/EC), which aims to control emissions of SO_x NO_x and particulate matter from large (>50MW) combustion plants, will also have an effect on the shares of energy consumption by fuel type, as it effectively favours the use of higher efficiency gas plant as opposed to coal plants.

Fig. 3: Share of total energy consumption by fuel in 2005

| | Coal and lignite | Oil | Gas | Nuclear | Renewables | Industrial waste | Imports-exports of electricity | Total energy consumption (thousand TOE) |
|----------------|------------------|-------|------|---------|------------|------------------|--------------------------------|---|
| EEA | 17.8 | 36.8 | 24.5 | 13.3 | 7.6 | 0.1 | 0.0 | 1,932,283 |
| EU-27 | 17.7 | 36.7 | 24.6 | 14.2 | 6.7 | 0.1 | 0.1 | 1,811,324 |
| EU-15 | 14.1 | 38.8 | 25.0 | 15.1 | 6.7 | 0.1 | 0.3 | 1,536,645 |
| World | 25.3 | 35.0 | 20.7 | 6.3 | 12.7 | - | 0.0 | 11,433,918 |
| MENA | 2.3 | 53.4 | 43.0 | 0.0 | 1.3 | - | 0.0 | 640,716 |
| United States | 23.7 | 40.7 | 21.8 | 9.0 | 4.7 | - | 0.1 | 2,340,286 |
| China | 63.1 | 18.8 | 2.4 | 0.8 | 14.9 | - | 0.0 | 1,735,230 |
| Russia | 16.0 | 20.6 | 54.1 | 6.1 | 3.4 | - | -0.2 | 646,680 |
| Belgium | 9.9 | 37.4 | 25.7 | 22.3 | 3.5 | 0.2 | 1.0 | 54,952 |
| Bulgaria | 34.7 | 24.4 | 14.1 | 24.2 | 5.6 | 0.3 | -3.3 | 19,884 |
| Czech Republic | 44.9 | 21.8 | 17.2 | 14.2 | 4.1 | 0.3 | -2.4 | 44,795 |
| Denmark | 19.0 | 41.6 | 22.5 | 0.0 | 16.2 | 0.0 | 0.6 | 19,538 |
| Germany | 24.0 | 35.7 | 23.4 | 12.2 | 4.8 | 0.0 | -0.1 | 345,451 |
| Estonia | 57.4 | 19.6 | 14.4 | 0.0 | 11.2 | 0.0 | -2.5 | 5,563 |
| Ireland | 17.8 | 55.5 | 22.9 | 0.0 | 2.7 | 0.0 | 1.2 | 15,121 |
| Greece | 28.7 | 57.5 | 7.5 | 0.0 | 5.2 | 0.1 | 1.0 | 31,240 |
| Spain | 14.4 | 48.4 | 20.8 | 10.3 | 6.1 | 0.0 | -0.1 | 143,486 |
| France | 5.2 | 33.4 | 14.9 | 42.3 | 6.0 | 0.0 | -1.9 | 275,438 |
| Italy | 8.8 | 44.5 | 37.8 | 0.0 | 6.5 | 0.1 | 2.3 | 186,766 |
| Cyprus | 1.5 | 96.5 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 2,461 |
| Latvia | 1.7 | 29.2 | 28.8 | 0.0 | 36.3 | 0.1 | 3.9 | 4,718 |
| Lithuania | 2.3 | 32.0 | 28.8 | 31.0 | 8.8 | 0.0 | -3.0 | 8,592 |
| Luxembourg | 1.7 | 65.6 | 25.1 | 0.0 | 1.6 | 0.0 | 6.0 | 4,698 |
| Hungary | 11.1 | 26.6 | 43.3 | 12.8 | 4.2 | 0.1 | 1.9 | 27,920 |
| Malta | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 953 |
| Netherlands | 10.1 | 39.6 | 43.6 | 1.3 | 3.5 | 0.0 | 1.9 | 80,969 |
| Austria | 11.9 | 41.6 | 24.3 | 0.0 | 20.5 | 1.0 | 0.7 | 33,980 |
| Poland | 58.7 | 24.0 | 13.0 | 0.0 | 4.8 | 0.5 | -1.0 | 93,935 |
| Portugal | 12.5 | 57.8 | 14.1 | 0.0 | 13.4 | 0.0 | 2.2 | 26,677 |
| Romania | 22.4 | 26.0 | 35.6 | 3.7 | 12.8 | 0.2 | -0.6 | 39,146 |
| Slovenia | 21.1 | 35.0 | 12.7 | 20.8 | 10.6 | 0.2 | -0.4 | 7,305 |
| Slovakia | 22.1 | 20.8 | 30.5 | 23.6 | 4.3 | 0.2 | -1.4 | 19,407 |
| Finland | 14.3 | 30.4 | 10.4 | 17.4 | 23.2 | 0.2 | 4.2 | 34,515 |
| Sweden | 5.1 | 28.4 | 1.6 | 36.2 | 29.8 | 0.1 | -1.2 | 51,555 |
| United Kingdom | 16.4 | 35.6 | 36.6 | 9.1 | 1.7 | 0.3 | 0.3 | 232,259 |
| Turkey | 26.2 | 35.2 | 26.8 | 0.0 | 11.9 | 0.0 | -0.1 | 85,159 |
| Iceland | 2.8 | 24.2 | 0.0 | 0.0 | 73.0 | 0.0 | 0.0 | 3,610 |
| Norway | 2.4 | 44.3 | 16.0 | 0.0 | 40.4 | 0.0 | -3.2 | 32,190 |

Data source: EEA, Eurostat, IEA

Notes: Negative values mean there were more exports than imports of electricity. No data was available for industrial waste for the non-european countries. The value for renewables for the non-european countries is inclusive industrial waste. No data was available from Eurostat for Switzerland. No data was available from IEA for Djibouti, Iran or Palestinian territories.

TOE refers to Ton of Oil equivalent. MENA refers to Middle East and North Africa

References

COM (2006) 545 final – Action Plan for Energy Efficiency, realising the potential

COM (2007)2 final – Limiting Global Climate Change to 2 degrees Celsius. The way ahead for 2020 and beyond.

COM(2008) 16 Proposal for a Directive amending Directive 2003/87/EC (EU ETS)

COM(2008) 17 Proposal for a Decision on the effort of Member States to reduce their greenhouse gas emissions

COM(2008) 19 Proposal for a Directive on the promotion of use of renewable energy sources

Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants

UNFCCC (1997) Kyoto Protocol to the United Nations Framework Convention on Climate Change adopted at COP3 in Kyoto, Japan, on 11 December 1997

Meta data

Technical information

1. Data source:

Energy Consumption by fuel and total: Eurostat (historical data): <http://europa.eu.int/comm/eurostat/>

Total primary energy supply by product: IEA: <http://data.iea.org/IEASTORE/DEFAULT.ASP>

Total energy consumption by fuel is one of the European Environment Agency's core-set indicators. More information can be found at <http://themes.eea.eu.int/IMS/CSI>.

2. Description of data/Indicator definition:

Total energy consumption or gross inland energy consumption represents the quantity of energy necessary to satisfy the inland consumption of a country. It is calculated as the sum of the gross inland consumption of energy from solid fuels, oil, gas, nuclear and renewable sources, and a small component of 'other' sources (industrial waste and net imports of electricity). The relative contribution of a specific fuel is measured by the ratio between the energy consumption originating from that specific fuel and the total gross inland energy consumption calculated for a calendar year.

Units: Energy consumption is measured in thousand tonnes of oil equivalent (ktoe). The share of each fuel in total energy consumption is presented in the form of a percentage.

Projections are for 2020 from the POLES (IPTS) Baseline and GHG Reduction Scenario and from the WEO 2007 (IEA) Reference and Alternative Policy Scenario.

3. Geographical coverage:

The Agency had 32 member countries at the time of writing of this fact sheet. These are the 27 European Union Member States and Turkey, plus the EFTA4 countries (Iceland, Switzerland and Norway). There are 20 MENA (Middle East and North Africa) countries. No energy data available for Switzerland, Djibouti, Iran and Palestinian territories.

4. Temporal coverage: 1990-2005, Projections 2020

5. Methodology and frequency of data collection:

Data collected annually.

Eurostat definitions for energy statistics <http://forum.europa.eu.int/irc/dsis/coded/info/data/coded/en/Theme9.htm>

Eurostat metadata for energy statistics http://europa.eu.int/estatref/info/sdds/en/sirene/energy_base.htm

6. Methodology of data manipulation:

Average annual rate of growth calculated using: $[(\text{last year}/\text{base year})^{(1/\text{number of years})} - 1] \times 100$

The coding (used in the Eurostat New Cronos database) and specific components of the indicator are:

- Numerator: solid fuels 2000 gross inland consumption 100900 + oil 3000 gross inland consumption 100900 + gas 4000 gross inland consumption 100900 + nuclear energy 5100 gross inland consumption 100900 + renewable energies 5500 gross inland consumption 100900 + industrial waste 7100 gross inland consumption + 6000 electrical energy 100900 gross inland consumption.

- Denominator: (total) gross inland consumption (of energy) 100900

The coding (used in the IEA database) and specific components of the indicator are:

- Numerator: total primary energy supply Coal and coal products + total primary energy supply Coal and coal products Crude, NGL and Feedstocks + total primary energy supply Petroleum products + total primary energy supply Natural Gas + total primary energy supply Nuclear + total primary energy supply Hydro + total primary energy supply Geothermal + total primary energy supply Solar/Wind/Other + total primary energy supply Combustible Renewables and Waste + total primary energy supply Production from non-specified comb.fuels + total primary energy supply Heat

- Denominator: total primary energy supply Total

POLES: Gross inland consumption (Mtoe)

WEO 2007: Total primary energy demand (Mtoe)

Qualitative information

7. Strengths and weaknesses (at data level)

Officially reported data, updated annually. No obvious weaknesses.

Data have been traditionally compiled by Eurostat through the annual Joint Questionnaires, shared by Eurostat and the International

Energy Agency, following a well established and harmonised methodology. Methodological information on the annual Joint Questionnaires and data compilation can be found in Eurostat's web page for metadata on energy statistics.

http://europa.eu.int/estatref/info/sdds/en/sirene/energy_sm1.htm

8. Reliability, accuracy, robustness, uncertainty (at data level):

Indicator uncertainty (historic data)

The share of energy consumption for a particular fuel could decrease even though the actual amount of energy used from that fuel grows, as the development of the share for a particular fuel depends on the change in its consumption relative to the total consumption of energy.

From an environmental point of view, however, the relative contribution of each fuel has to be put in the wider context. Absolute (as opposed to relative) volumes of energy consumption for each fuel are the key to understanding the environmental pressures. These depend on the total amount of energy consumption as well as on the fuel mix used and the extent to which pollution abatement technologies are used.

Total energy consumption may not accurately represent the energy needs of a country (in terms of final energy demand). Fuel switching may in some cases have a significant effect in changing total energy consumption even though there is no change in (final) energy demand. This is because different fuels and different technologies convert primary energy into useful energy with different efficiency rates.

9. Overall scoring – historical data (1 = no major problems, 3 = major reservations):

Relevance: 1

Accuracy: 1

Comparability over time: 1

Comparability over space: 1