EN18 Electricity Consumption

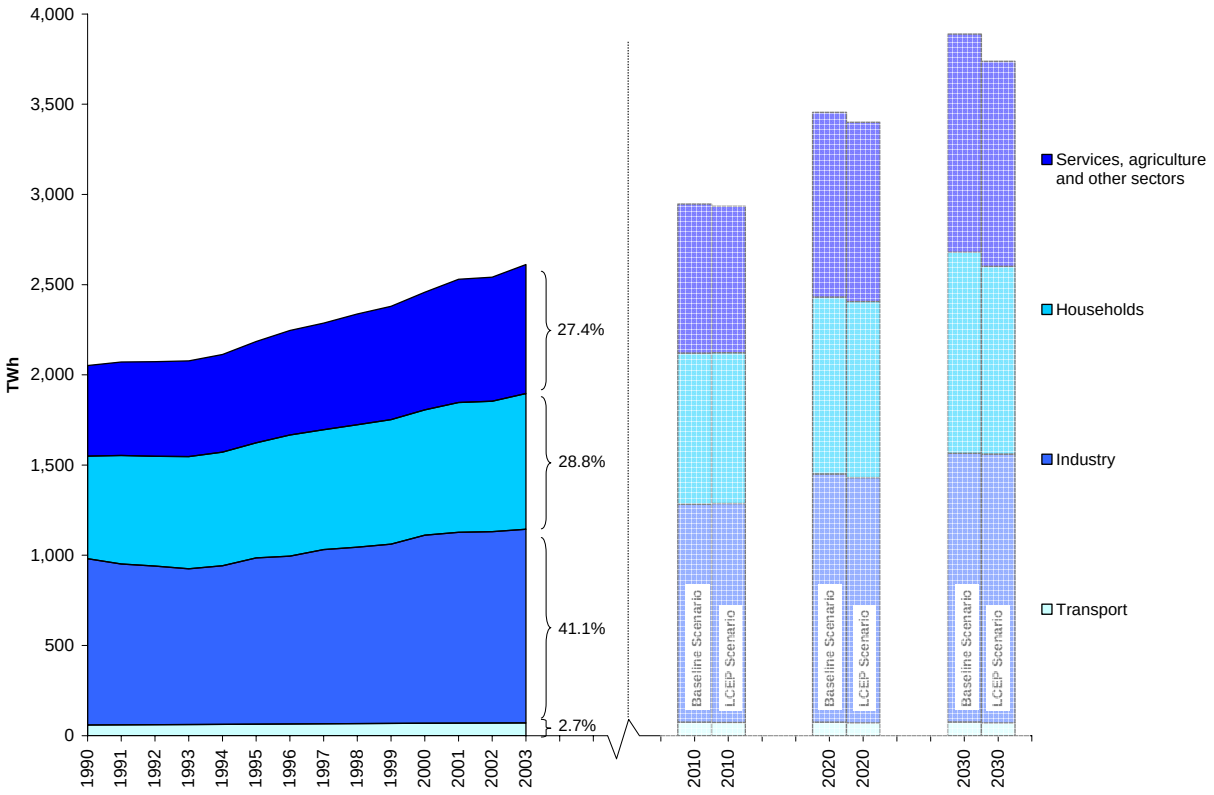
Key message

Final electricity consumption is increasing rapidly in all economic sectors, at an average of around 1.9% per year from 1990-2003, with a sharp increase of 2.8% from 2002 to 2003. This is the consequence of both the attractiveness of electricity as an energy carrier and continuing economic growth. Due to the high level of efficiency losses involved in both the production and transmission of electricity, particularly from conventional thermal generation, the rise in electricity consumption is of particular concern for the environment.

Rationale

The trend in final electricity consumption by sector monitors progress made in reducing electricity consumption. The associated environmental impacts, however, depend on both the amount of electricity consumption and the way the electricity is generated (in particular fuel mix, efficiency and the use of abatement technologies).

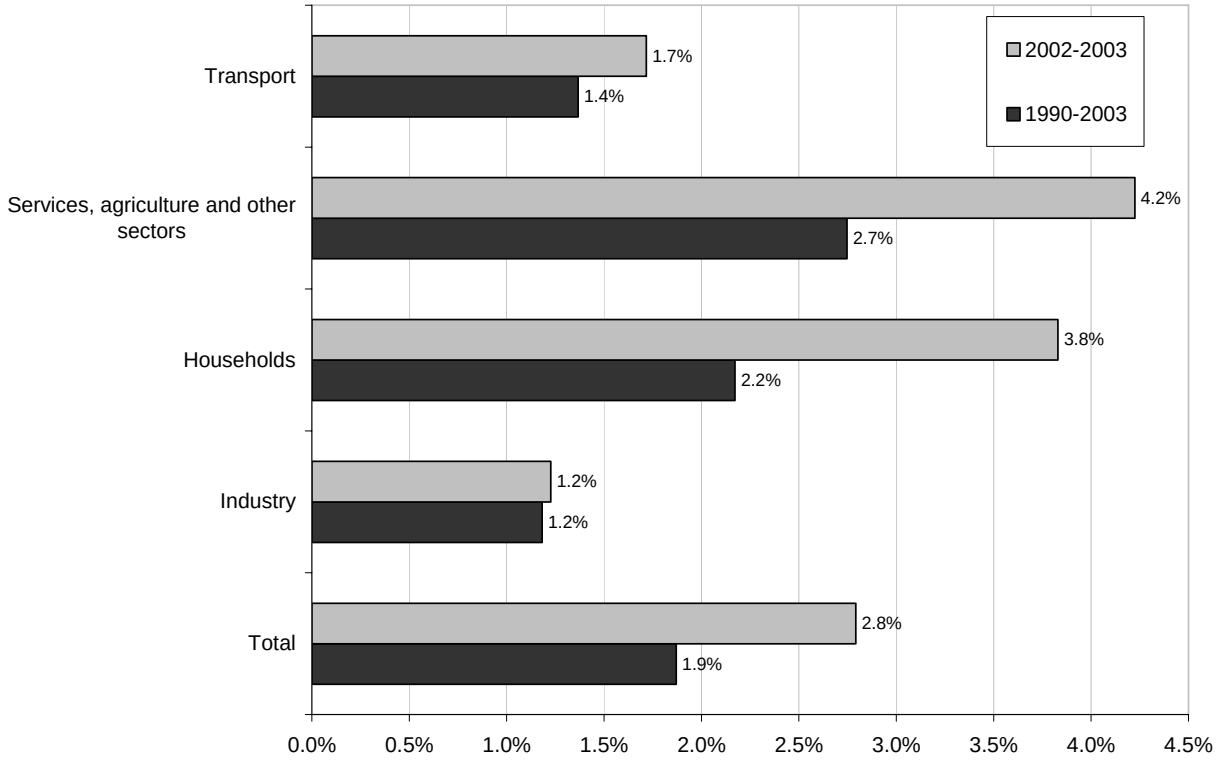
Fig. 1: Final electricity consumption by sector, EU 25



Data Source: Eurostat (historical data), EEA (2005) for projections.

Notes: Final electricity consumption is the electricity consumption of the final energy demand sectors, it does not include own use by electricity producers or transmission and distribution losses. EEA baseline projections are consistent with European Commission (2004). The Low-Carbon-Energy Pathway (LCEP) scenario assumes that ambitious future greenhouse gas emission reduction targets will be reached and thus assumes a CO_2 permit price of 30 €/t CO_2 and 65 €/t CO_2 in 2020 and 2030, respectively.

Fig 2: Average annual growth rate in electricity consumption by sector, 1990-2003 and 2002-2003



Data Source: Eurostat

1. Indicator assessment

Final electricity consumption grew across the EU-25 at an average annual rate of 1.9 % between 1990 and 2003 (overall increase: 27.2 %). This rate of increase was only slightly less than the average GDP growth rate over the same period, showing an apparent strong correlation between electricity consumption and economic growth. However, the increases in electricity consumption resulted not only from a growing economy, but also from an increasing share of electricity in final energy consumption, rising from 17.4 % in 1990 to 19.8 % in 2003. The attractiveness of electricity is due to its flexibility of use and the importance placed by consumers on the variety of energy services it provides. Furthermore, influenced by the liberalisation of the power market, electricity prices decreased considerably between 1990 and 2005.

For the EU-25 as a whole, growth in electricity consumption was particularly strong in the service sector, followed by households. The main reasons for increased electricity consumption in the service sector were the sustained growth of this sector throughout the EU, the increased use of electrical appliances (air conditioning, lighting, IT equipment, etc.) and the advent of new electrical devices. In the household sector, rising incomes, higher living standards and the trend towards smaller households led to more and larger dwellings and a growing demand for electrical appliances.

There have been continued technical improvements in the efficiency of large electrical appliances; a decrease in average specific consumption of 1.5 % per year in the case of refrigerators, freezers, washing machines, dishwashers, TVs and dryers. However, these improvements have been offset by increases in the use, numbers and size of large appliances as well as a growing number of smaller appliances such as videos and computers (Enerdata et al, 2003). Also of concern is the growing level of electricity consumption from appliances in “stand-by mode”, which are estimated to amount to approximately 5-10 % of EU household energy consumption (JRC, 2003).

Overall, prices for electricity for households in the EU-15 have fallen by 15 % from 1990 to 2005 (in constant prices; see EN31), primarily as a consequence of market liberalisation. This may have discouraged energy conservation and investments in energy efficiency, although more recent price rises in some countries may act to reverse this situation. By comparison, in many of the new EU-10 Member States household electricity prices rose substantially as price controls and subsidies were removed, although real wages (Galgoczi, 2001) also increased, which in part helped to mitigate much of the restraining effect of such price rises on electricity consumption.

In the industry sector electricity consumption grew, but at a slower rate compared with the services and household sectors. In the EU-15 this was partly because of an extensive switch towards electrification in industrial processes that had already occurred in the late 1980s and because in the 1990s the industry sector, unlike all other sectors, only increased its energy consumption slightly (see EN16). Industry electricity consumption in the new Member States fell sharply during the early 1990s

during the process of economic restructuring, although some growth has occurred more recently. Restructuring of the industry sector involved closing old and energy intensive plants that were uneconomic in a competitive market, the renewal of technologies and a shift to less energy intensive industries.

The transport sector is only responsible for around 2.7% of total electricity consumption in EU-25 and the increase in the 1990s can be attributed to growing consumption in the EU-15, due to increased electrification of Europe's railways (especially in France and the United Kingdom). The trend for the new Member States was opposite to that of EU-15, with a gradual decrease in electricity consumed for transport purposes due to lower usage of trains and other domestic public transport and an increase in car and air transport.

All countries in EU-25 saw increased electricity consumption over the period from 1990 to 2003, except for Latvia, Lithuania, Estonia, Hungary, and Slovakia. The growth rate of electricity consumption varied greatly by country, ranging from less than 1 % per year in the Czech Republic, Denmark, Poland, and Sweden to over 5 % in Malta, Cyprus and Ireland. The decrease or low growth in electricity consumption in the new Member States was as a result of economic restructuring in the1990s. The high rates of increase in Malta, Cyprus and Ireland are explained by their low per capita electricity consumption in 1990 and their increasing living standards over the period. Electricity consumption per capita also varies greatly between countries, with the lowest per capita consumption occurring in some new Member States of central and eastern Europe and southern European countries (Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Portugal). Although the use of air conditioning in southern European countries contributes to a large increase in electricity consumption during the summer months, the highest consumption per capita was in the most northerly countries, Norway, Iceland, Sweden and Finland, where electrical heating based on low cost electricity produced by hydropower meets a large part of the overall heating requirements.

Electricity consumption is expected to continue increasing into the future. Baseline projections for the EU-25 indicate that electricity consumption will grow on average by 1.8 % per year to 2010, but the rate of growth is expected to slow slightly thereafter to 2030, because of higher fossil fuel prices, in particular natural gas, which will carry through into electricity prices. Growth is expected to continue to be particularly rapid in the services sector, due to increasing levels of energy service demand. In the new Member States, predicted increases in real incomes and the increased use of electrical appliances are expected to result in electricity consumption also growing strongly in households. Industry electricity consumption is also expected to grow but at a slower rate than for services and households, reflecting the slow overall growth in industry energy consumption due to the shift away from energy-intensive industry, as well as the shift towards a more service-sector oriented economy. The transport sector's electricity consumption is expected to grow only slightly (due to electrification of trains and some use of electric cars).

The Low Carbon Energy Pathway (LCEP) scenario variant of the projections shows a similar, but slightly slower rate of growth in electricity consumption due primarily to a more rapid increase in end-use efficiency. This is the result of the assumed introduction of a carbon permit price that rises up to EUR 65/tCO_2 in this scenario. The most important relative decreases in electricity consumption, compared to the baseline scenario, occur in the service sector out to 2030 and also in the household sector from 2020 to 2030, indicating an important saving potential. The increasing carbon permit price carries through into a rising price for electricity and stimulates energy savings and efficiency improvements in electricity end-use consumption, such as those for appliances, which were not previously cost-effective under the baseline scenario.

2. Indicator rationale

2.1 Environmental context

The trend in final electricity consumption by sector provides a broad indication of progress made in reducing electricity consumption by the different end-use sectors transport, industry, households, and services (including agriculture and other sectors). Reducing electricity consumption is a robust way to lower the environmental impacts of electricity generation. This may result from reducing the electricity consumption for related activities (e.g. for lighting, appliances and information and communication technology equipment), or by using electricity in a more efficient way (thereby using less electricity per unit of demand), or from a combination of the two.

However, the type and extent of energy-related pressures on the environment depends not only on the amount of electricity consumed (and thus generated), but on the fuels used for electricity generation, which are predominantly still fossil fuels (see EN27 for more information about electricity production by fuel and its impacts) and how the electricity is produced (see EN06 on the extent to which pollution abatement technologies are used). The efficiency with which electricity is produced also strongly determines the size of the environmental impacts of electricity production and consumption (see EN19 and EN20), as it determines the amount of input fuel required to generate a given quantity of electricity.

The switch from other end-use fuels towards electricity increases the environmental pressure in many cases, as around three units of energy are needed to produce one unit of electricity, due to efficiency losses in electricity generation and transmission. However, if the electricity is generated by high efficiency, low emission technologies, such a switch could also reduce sufficiently the environmental consequences of electricity production. Electricity also offers a route for developing and exploiting non-fossil energy sources such as wind energy and hydropower, which are renewable energy sources that produce electricity directly.

2.2 Policy context

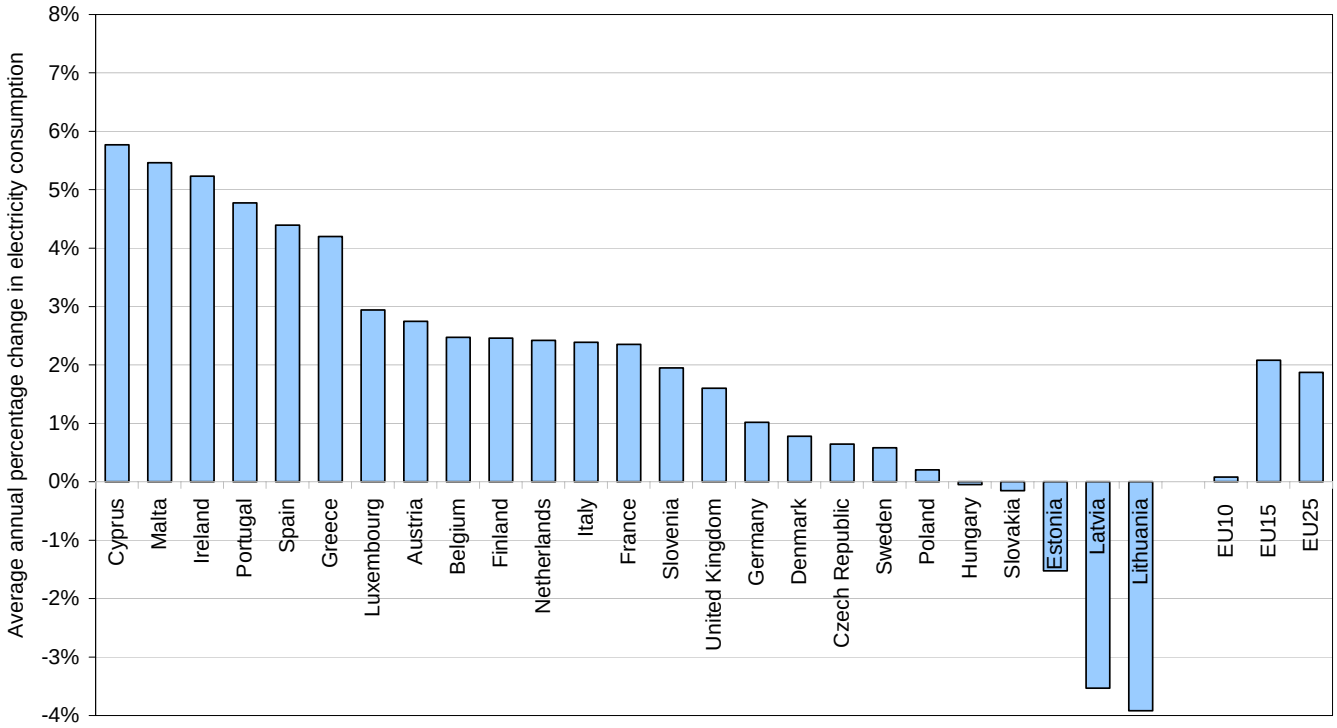
This indicator can be used to help monitor the success of key policies at EU and Member State level that attempt to influence electricity consumption and energy efficiency. However, it is at too aggregate a level to directly measure the influence of electricity-saving policies, such as the original EC energy label Directive (92/75/EEC) introducing mandatory labels stating the energy efficiency grade for specific household appliances, Directive (96/57/EC) on minimum energy efficiency requirements for household electric refrigerator and freezers, and the Directive 2003/66/EC introducing the new energy classes A+ and A++ for the most efficient appliances.

The reduction of electricity consumption is seen in the context of reaching the target of an 8 % reduction in greenhouse gas emissions (the power generation sector was responsible for 25 % of EU-15 emissions in 2003) by 2008-2012 from 1990 levels for the EU-15 and individual targets for most new Member-States, as agreed in 1997 under the Kyoto Protocol of the United Nations Framework Convention on Climate Change.

The recently adopted directive on energy end-use efficiency and energy services (2006/32/EC) aims at boosting the cost-effective and efficient use of energy in the EU. An indicative target is set for Member States to reduce energy consumption by 9 % after nine years of implementation of the directive above a development without any measures. A significant component of reducing electricity consumption will be in its use in appliances and information technologies in the household and service sector. Part of this may be achieved via Directive 2005/32/EC on the eco-design of Energy-using Products, such as electrical and electronic devices or heating equipment. This directive provides coherent EU-wide rules for eco-design and ensures that disparities among national regulations do not become obstacles to intra-EU trade. It does not introduce directly binding requirements for specific products, but defines conditions and criteria for setting, through subsequent implementing measures, requirements regarding environmentally relevant product characteristics, such as electricity consumption.

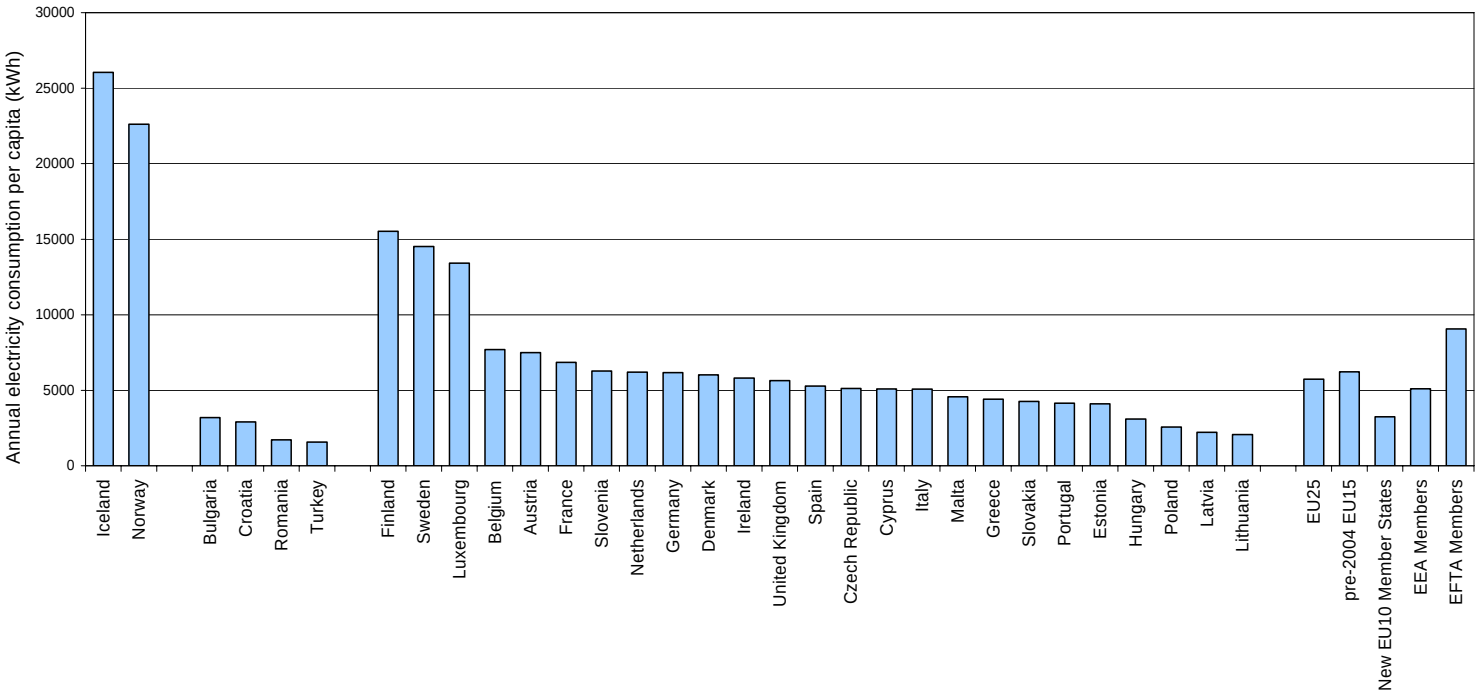
The EU's recent Green Paper on energy efficiency (COM(2005)265 final) also aims to expand the debate, particularly on the demand side, of energy efficiency policy – in relation to the three key areas of economic competitiveness, environmental protection (including the EU's Kyoto obligations) and energy security. It estimates that the EU could reduce its current level of energy consumption by up to 20 % in a cost-effective manner (with a technical potential of almost 40 %), and aims to identify and address the reasons why these cost effective improvements are not already being taken up (for example, lack of information or appropriate financing mechanisms) – as well as aiming to drive forward a new EU-wide energy efficiency initiative. On the electricity demand side the green paper focuses on reducing consumption in appliances, as well as other areas such as lighting, cooling and motors. It also makes the case for reducing the growing waste of electricity consumption when appliances are in standby mode. Furthermore, it expands on measures to introduce more efficient electricity generation and transmission in order to reduce environmental pressures.

Fig. 3: Average annual percentage change in final electricity consumption, EU-25 1990-2003



Data source: Eurostat

Fig 4: Electricity consumption per capita (kWh) in 2003



Source: Eurostat

References

COM(2003) 739 - Proposal for a Directive of the European Parliament and the Council on energy end-use efficiency and energy services.

COM(2005) 265 final – Green Paper on energy efficiency, or doing more with less , European Commission http://europa.eu.int/comm/energy/efficiency/doc/2005_06_green_paper_text_en.pdf

Council Decision 2002/358/EC to ratify the Kyoto Protocol under the United Nations Framework Convention on Climate Change

Directive (92/75/EEC) on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances

Directive (96/57/EC) on energy efficiency requirements for household electric refrigerators, freezers and combinations thereof.

Directive 2003/66/EC amending Directive 94/2/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations.

Directive 2005/32/EC (amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC) on the eco-design of Energy-using Products

ENERDATA/FhG-ISI (2003) Energy efficiency in the European Union 1990-2001, SAVE-ODYSSEE Project on Energy Efficiency Indicators.

European Commission (2003) European energy and transport, Trends to 2030, Directorate General for Energy and Transport.

European Commission (2004) European energy and transport – scenarios on key drivers, Directorate General for Transport and Energy

EEA (2005) Climate change and a low-carbon European energy system, European Environment Agency report No 1/2005.

Galgoczi B. (2001): Wage trend in Central and Eastern Europe, http://www.ilo.org/public/english/dialogue/actrav/publ/128/8.pdf

JRC (2003) Standby losses: the magnitude of the consumption, the planned policies and the technical solutions: is this enough?, EU Joint Research Centre. http://energyefficiency.jrc.cec.eu.int/pdf/publications/ACEEE2002%20paper%20569%20final.pdf

Meta data

Technical information

1. Data source:
   Final Electricity Consumption: Eurostat (historical data) http://europa.eu.int/comm/eurostat/ There were important corrections for the year 1990 in the energy balance. These changes for Latvia have been taken into account as much as possible. However, the EU-10 and EU-25 aggregates could not be updated. Changes to the EU aggregates are likely to be limited as in 1990 the total energy consumption in Latvia represented approximately 3 % and 0.5 % of the total energy consumption in the EU-10 and EU-25, respectively.
   Projection data: European Environment Agency (2005) – baseline projections are consistent with European Commission (2004)

2. Description of data/Indicator definition:
   Final electricity consumption covers electricity supplied to the final consumer's door for all energy uses, it does not include own use by electricity producers or transmission and distribution losses. It is calculated as the sum of final electricity consumption from all sectors. These are disaggregated to cover industry, transport, households, services (including agriculture and other sectors).
   Units: Final electricity consumption is measured in terawatt hours (TWh)
   The PRIMES model was used to analyse possible future developments of the European energy sector, including a baseline scenario without a permit price and the low carbon energy pathway (LCEP) scenario. It describes the least-cost response of the EU-25 energy system to the introduction of a carbon permit price that rises to EUR 65/t CO_2 by 2030.

3. Geographical coverage:
   The Agency had 31 member countries at the time of writing of this fact sheet. These are the 25 European Union Member States and Bulgaria, Romania and Turkey, plus Iceland, Norway and Liechtenstein. On 1 April 2006, Switzerland joined the EEA, bringing its number of member countries to 32.
   No energy data available for Switzerland and Liechtenstein. No projection data are available for Iceland, Liechtenstein.

4. Temporal coverage: 1990-2003, projections to 2030 in 10 year intervals.

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: [(last year/base year) ^ (1/number of years) –1]*100
   Electricity consumption per capita calculated by dividing final electricity consumption by population for each country.
   The coding (used in the Eurostat New Cronos database) and specific components of the indicator (in relation to the product '6000 - electrical energy') are:
   Numerator: final electricity consumption industry 101800 + final electricity consumption transport 101900 + final electricity consumption households 102010 + final electricity consumption services/agriculture calculated as (final electricity consumption households/services 102000 - final electricity consumption households 102010).
   Only if needed for shares; Denominator: (total) final electricity consumption 101700

Qualitative information

7. Strength 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 (historical data)
   Any cross-country comparison of the distribution of electricity consumption between sectors will have to be accompanied by a relevant measure of the importance of the sector in the economy, as the sectoral shares also depends on the country's economic circumstances. Because the focus is on the reduction of electricity consumption and not on the sectoral redistribution of such consumption, the trends in the absolute values (in TWh) should be preferred as a more meaningful indicator of progress. However, even if the same sectors in two countries are equally important to the economy, the gross (primary) consumption of energy needed to generate the electricity before it reaches the final user might draw from energy sources that pollute the environment in different ways. Thus, from an environmental point of view, the final electricity consumption of a sector should be analysed in that broader context.
   The sectoral breakdown of electricity consumption includes industry, transport, households, services, agriculture, fisheries and other sectors. As projections aggregate agriculture, fisheries and other sectors together with the services sector, the indicator uses the same aggregation. The inclusion of agriculture and fisheries together with the services sector is however questionable given their divergent trends. Separate assessments are therefore made where appropriate.
   It should also be noted that electricity consumption in 1990 for Germany refers only to the western part.

   Indicator uncertainty (scenarios/projections)
   Scenario analysis always includes many uncertainties and the results should thus be interpreted with care:
   - uncertainties related to future socioeconomic developments (e.g. GDP) and human choices;
   - uncertainties in the underlying statistical and empirical data (e.g. on future technology costs and performance);
   - uncertainties in the choice of indicators (representativeness);
   - uncertainties in the dynamic behaviour of systems and its translation into models;
   - uncertainties in future fuel costs and the impact on low carbon technologies.

   The LCEP scenario uses relatively optimistic assumptions on economic growth, compared with other scenarios. The same level of carbon prices as in the LCEP scenario would lead to higher CO2 emission reduction when simulated with other models (e.g. TIMER), which may partly result from the fact, that carbon capture and storage was not included in the PRIMES LCEP scenario.

9. Overall scoring - historical data (1 = no major problems, 3 = major reservations):
   Relevance: 1
   Accuracy: 1
   Comparability over time: 1
   Comparability over space: 1