

2.7

ENERGY



The goal of achieving a new energy model which reduces pressure on the environment and human health without halting all economic activity is a long and gradual process with numerous ups and downs. Some of these variations, such as climatic conditions or emissions due to forest fires, which were particularly significant in the latter part of 2007, are not a direct consequence of economic activity, whereas others are due to the introduction of new factors, such as emissions rights trading.

The EU has proposed a fixed objective in terms of energy efficiency, namely a 20% reduction in greenhouse gas emissions with respect to the 1990 levels (or 30% if other developed countries agree to equivalent emissions reductions and developing countries make as great a contribution as possible) by 2020. Energy efficiency in Spain is increasing significantly. Thus, the final energy intensity dropped 0.7% and primary energy intensity 2.1% with respect to GDP in 2007 despite a 3.3% increase in final energy demand. By end-user sector, there was a greater increase in energy demand by industry and a moderate growth in transport, whereas domestic and tertiary demand was stable.

Once again a certain similarity between the evolution of primary energy intensity (in other words primary energy



consumption divided by GDP) in Spain and the EU average was noted. This dropped in both cases, although to a somewhat larger extent in Spain due to the greater increase in GDP.

The intensity of energy-derived CO₂ emissions usually varies a great deal, and in 2007 it grew again, although less quickly than in previous years.

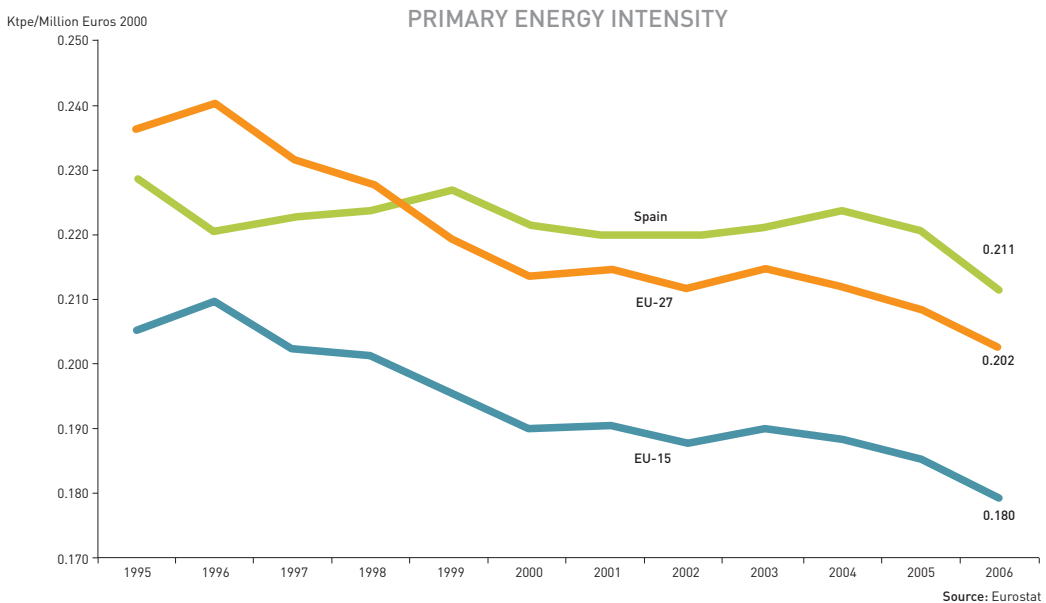
The most important measures adopted by Spain in 2007 include government approval of the Spanish Climate Change and Clean Energy Strategy 2007-2012-2020. The lines of action set out in this plan include energy efficiency and the promotion of renewable energy. The drawing up of a new Renewable Energies Plan 2011-202 will contribute to the above-mentioned European goal of renewable energy accounting for 20% of

| INDICATOR | GOAL | TREND |
|---|---|---|
| Primary Energy Intensity | Weaken the link between energy consumption and GDP | Confirms its drop for a second successive year |
| Intensity of energy-derived CO ₂ emissions | Decouple economic growth from CO ₂ emissions | Intensity of energy-based emissions increased slightly |
| Renewable energy | Achieve a renewable energy production level of 12.1% of all primary energy by 2010. | In 2007 renewables produced more electricity than nuclear energy for the first time |
| Eco-efficiency in the energy sector | Decouple economic growth from the pressures of this sector on the environment | A greater energy efficiency has been noted in 2007 |

energy production by 2020. As well as the Spanish Air Quality Strategy, other significant measures were approved in this field. The National Greenhouse Gas Emission Rights Assignment Plan 2008-2010 (PNA2) contemplates a 19.3% reduction in emission rights with respect to the average assignment in the 2005-2007 Plan, mainly in the electricity production sector.

Primary energy intensity

After rising and then stabilising, energy intensity is now decreasing in Spain



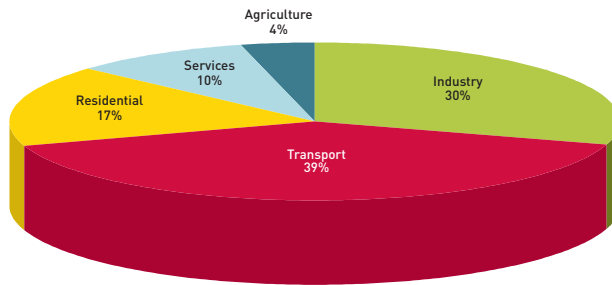
Primary Energy Intensity (PEI) is defined as the ratio of primary energy consumption to Gross Domestic Product (GDP). PEI allows the degree of energy efficiency to be analysed as it links economic growth for primary energy consumption (primary energy is the energy contained in natural sources which has not been altered anthropogenically). Primary energy consumption is calculated on the basis of five sources: coal, oil, natural gas, nuclear energy and renewable energies. GDP is considered at constant prices to avoid the impact of inflation (base year, 2000).

Growth in primary energy consumption in 2007 was accompanied by an economic growth of 3.8%, which resulted in a reduction in energy intensity per unit GDP of 1.9%. This improvement was due both to the slowdown in energy consumption and the continual growth in GDP (up to 2007).

The decrease in primary energy intensity in Spain, which began in 2004 and increased in 2006, is thus confirmed. After the stabilization experienced in previous years, 2005 saw a decrease which was more notable in 2006, in line with the trends observed in the other countries of the European Union. Between 2000 and 2006, the

decrease in primary energy consumption per unit GDP in Spain was 4.6% (5.5% between 2004 and 2006). This points to ever-greater economic efficiency, and therefore increasing economic efficiency and improved sustainability.

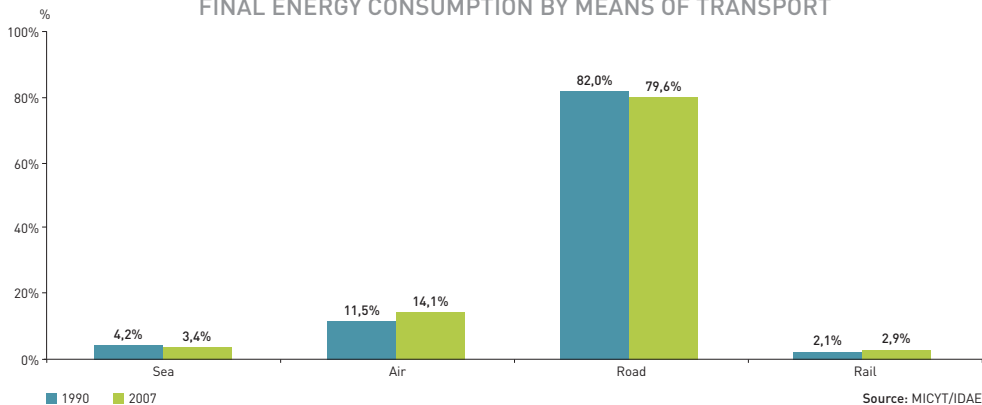
FINAL ENERGY CONSUMPTION BY SECTOR 2007



Source: IDAE

The analysis of final energy consumption by sector in 2007 highlights transport, with a consumption of 40,795 ktpe, followed by industry (30,038 ktpe), the residential sector (16,868 ktpe), the service sector (9,764 ktpe) and agriculture (3,878 ktpe). Road transport consumes most energy, although the amount dropped slightly between 1990 and 2007. In the same period consumption due to air transport increased and that due to maritime transport decreased.

FINAL ENERGY CONSUMPTION BY MEANS OF TRANSPORT



Source: MICYT/IDAE

SOURCES

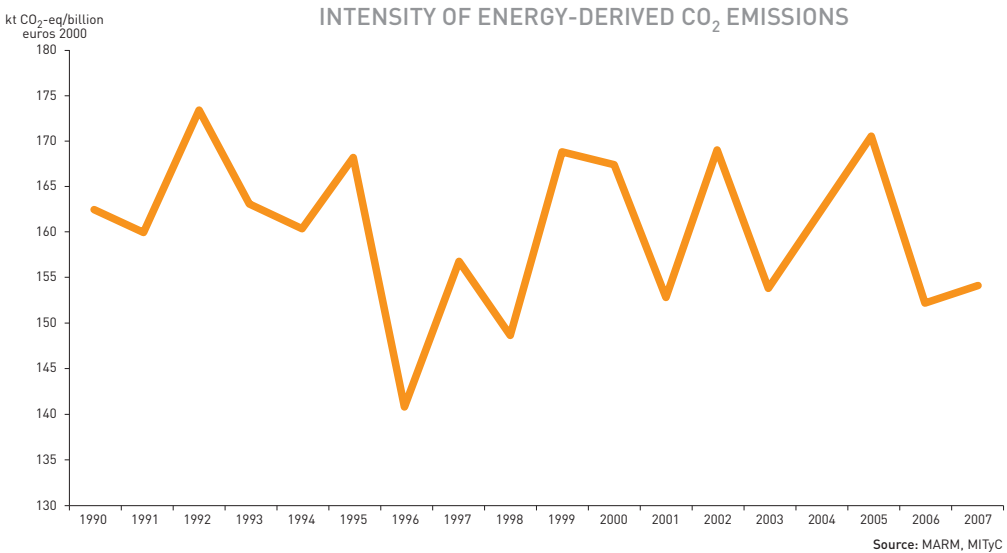
- Eurostat. Structural indicators. Short list. Environment, Energy Intensity (Indicator 13).
- Spanish Ministry of Industry, Tourism and Trade (MITyC). Secretariat General for Energy. "Energy in Spain 2007".
- Spanish Institute for Energy Saving and Diversification (IDAE). Spanish Ministry of Industry, Tourism and Trade (MITyC). "Energy efficiency and renewable energies". IDAE bulletin (Various editions).

MORE INFORMATION

- <http://www.idae.es>
- <http://www.cne.es/medioambiente.html>
- <http://www.mityc.es>
- <http://epp.eurostat.cec.eu.int/>

Intensity of energy-derived CO₂ emissions

The intensity of energy-derived CO₂ emissions increased slightly in 2007



Energy-related CO₂ emissions intensity is defined as the ratio between total CO₂-equivalent emissions produced by energy-transformation or -processing industries and GDP. This indicator is very useful for analysing the impact of energy production in relation to a country's economic growth.

This indicator increased slightly (1.21%) with respect to 2006, in contrast to the sharp increase (10.77%) experienced between 2003 and 2005. As can be seen from the graph, inter-annual variations are significant. Meteorological changes are the main source of these variations as cold winters lead to greater energy consumption. The increase, or decrease, of the input from hydroelectric energy, which depends to a large extent on the precipitation during the hydrological year, also leads to a variable consumption of fossil fuels and therefore to a variation in emissions.

The intensity of energy-based emissions over the whole period covered (1990-2007) dropped by 5.41%, although this figure cannot be considered definitive due to the size of the variations. On the other hand, electricity production from nuclear energy dropped 8.4% in 2007 due above all to programmed fuel reloads at various plants;

this decrease was compensated mainly by an increase in coal-based electricity production. Total greenhouse gas emissions arising from energy production and transformation rose from 77,583 kilotonnes of CO₂ equivalents in 1990 to 122,504 kt in 2007. A new factor which affects the results of this indicator is emission rights trading, an energy-related activity which also has an economic component.

NOTES

- The energy-related CO₂ emissions intensity is defined as the ratio between total CO₂ emissions from the energy transformation and processing industries and GDP. This indicator is very useful for analysing the impact of energy production in relation to a country's economic growth.
- The CO₂ emissions used to calculate the indicator refer to total combustion emissions in the energy production sector of the six greenhouse gases (expressed as CO₂ equivalents) arising from energy processing (according to IPCC categories). Energy processing covers combustion processes, including electricity generation, combustion at refineries and fuel transformation, as well as combustion in mining.
- The six main greenhouse gases covered by the Kyoto Protocol, in order of relevance, are as follows: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and fluorinated gases, including perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF₆), although the latter have no impact in the energy sector as they are only emitted by industrial processes.

SOURCES

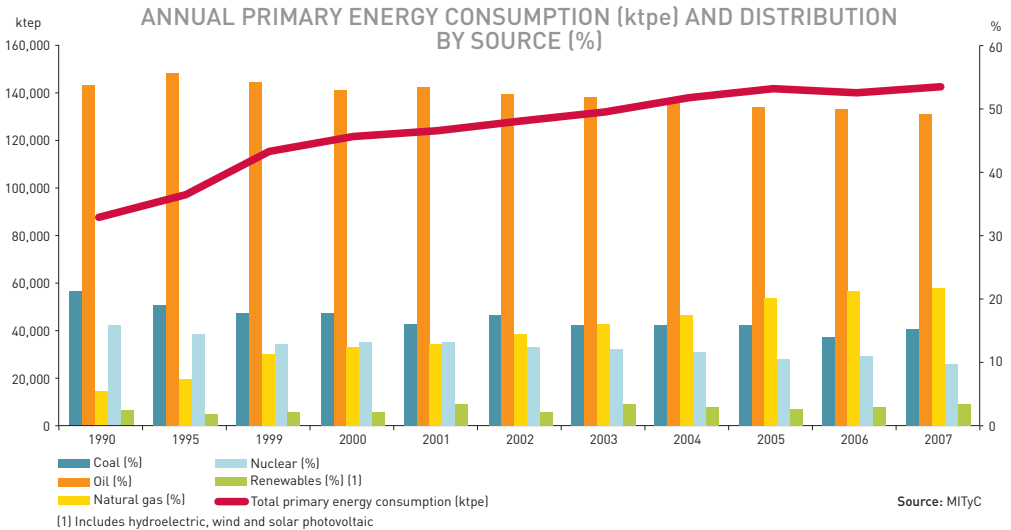
- Emissions figures: Spain's Atmospheric Emissions Inventory, Edition 2009 (series 1990-2007). Directorate General of Environmental Quality and Assessment. MARM.
- GDP figures: 1990-2007: Ministry of Industry, Tourism and Trade. "Energy in Spain 2007".
- Spanish Institute for Energy Saving and Diversification (IDAE). Ministry of Industry, Tourism and Trade. "Energy efficiency and renewable energies". IDAE bulletin.

MORE INFORMATION

- <http://www.idae.es>
- <http://www.mityc.es>
- <http://www.ine.es>
- <http://www.mma.es>

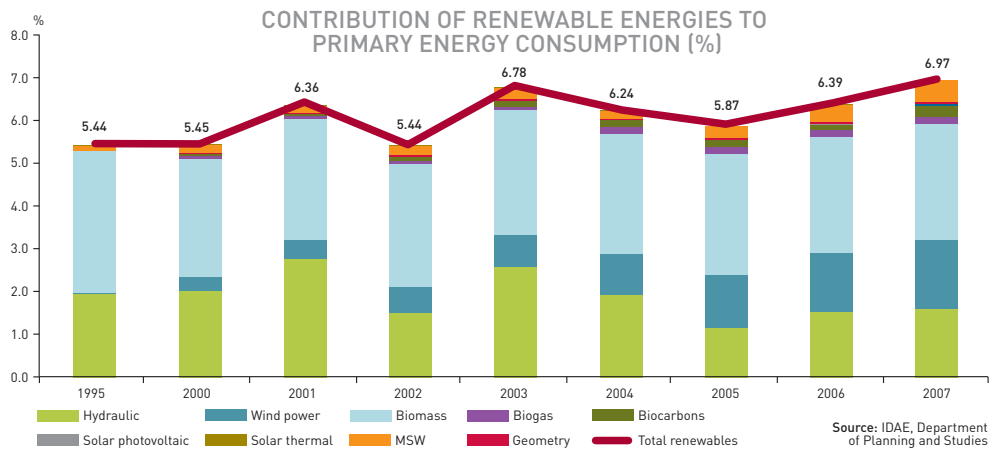
Renewable energies

In 2007, renewable energies were for the first time responsible for a greater proportion of Spanish electricity production than nuclear



energy

Fossil fuels maintain their leading role in production of the primary energy consumed in Spain, with a few minor variations: a notable increase in coal and renewable energies, a similarly notable reduction in nuclear energy and a slight reduction in oil. Total primary energy consumption rose 1.8% in 2007 with respect to the previous year, with the use of coal increasing by 9.5%, oil decreasing by 0.1%, natural gas

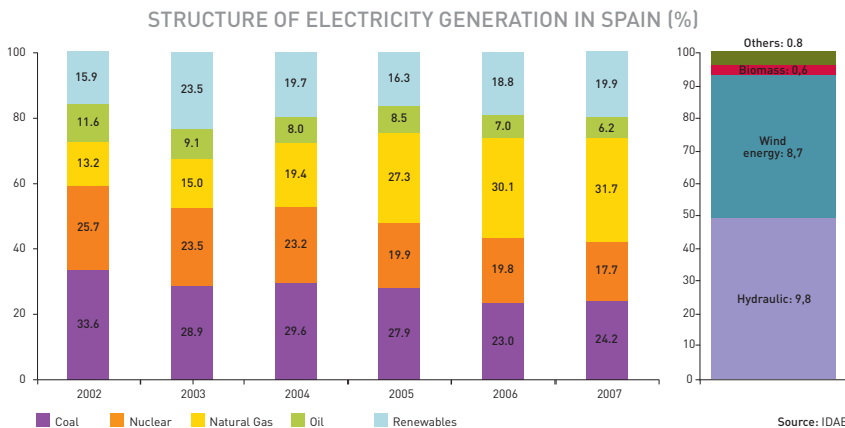


increasing by 4.3%, nuclear decreasing by 8.4% and renewable energies (hydroelectric, wind and solar photovoltaic) increasing by 11%.

The evolution over the past few years, especially since 2004, shows an upward trend in the use of natural gas and renewable energies to cover energy demand. Thus, the participation of renewable energies in total primary energy consumption has risen from 5.87% in 2005 to 6.97% in 2007. This energy source passed the 10,000 ktpe barrier for the first time in 2007.

Within the renewable energies, the proportion of hydroelectric energy has risen again after the drop experienced in 2005. Wind energy has continued its continual and notable rise (it has more than doubled between 2003 and 2007). Biomass has remained relatively stable, with a slight increase with respect to 2006, and biofuels and solar energy (both thermal and photovoltaic) have also increased, although to a lesser extent.

An analysis of the electricity generated in Spain by source shows that the proportion due to coal, natural gas and renewable sources has risen whereas the contribution of nuclear energy and oil has dropped. The evolution of natural gas, which increased its



quota by 2.4 times between 2002 and 2007, should be noted.

NOTES

- The total for renewable energies takes into account: hydroelectric, mini-hydroelectric, wind power, biomass and urban waste, along with thermal and photovoltaic solar power and biogas.
- Development of renewable energy sources is a key aspect of national energy policy as they make an efficient contribution to reducing the environmental impact of energy production and transformation, mainly in terms of greenhouse gas emissions, in particular CO₂, and emissions of other pollutants (SO₂, NO_x, particulate matter, etc.). Furthermore, the greater role of renewable energies in the overall energy balance also reduces the country's dependence on petroleum products and diversifies supply sources through the development of inexhaustible and widely distributed supplies. This, in turn, also reduces the need for transformation and transport, with a concomitant reduction in environmental impact.
- The development of renewable energies is supported by the existence of an appropriate regulatory framework to guarantee private investment in this type of energy source. Spain offers a series of incentives to encourage electricity generation from renewable sources, promoting the development of wind energy to such an extent that the country is now ranked second world-wide in terms of wind energy facilities. The changes made to the incentive system in Royal Decree 436/2004, of 12 March 2004, are driving a major increase in solar energy generation (both photovoltaic and thermoelectric). There is also considerable development in the field of biofuels for transport, with Spain now being Europe's leading producer of bioethanol, another of the targets of the PER 2005-2010 plan.

SOURCES

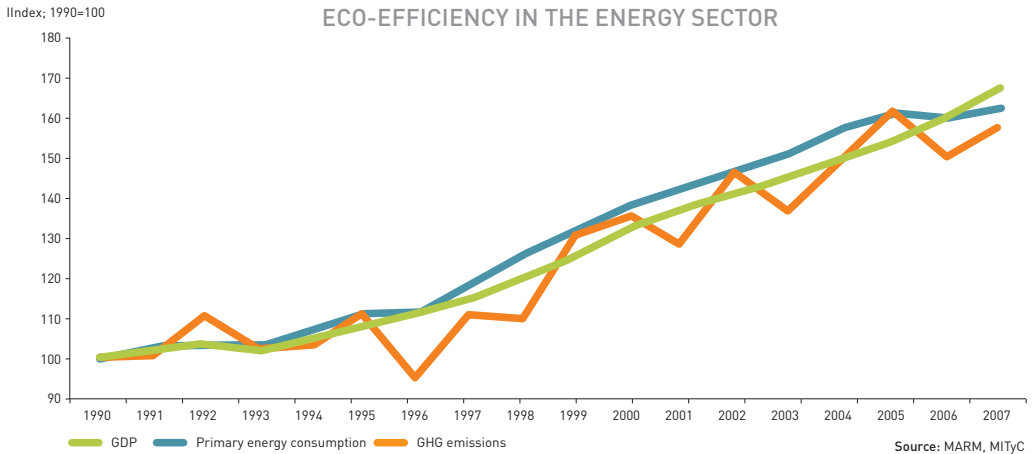
- Figures provided by the Dept. of Studies and Baseline Information. IDAE. Ministry of Industry, Tourism and Trade.
- Ministry of Industry, Tourism and Trade. Secretariat General for Energy. "Energy in Spain 2007".

MORE INFORMATION

- <http://www.mityc.es>
- <http://www.idae.es>
- <http://www.marm.es>
- <http://epp.eurostat.cec.eu.int/>

Eco-efficiency in the energy sector

GDP growth was maintained in 2007, primary energy consumption by the energy sector increased slightly and GHG emissions again increased



Total primary energy consumption rose slightly in 2007, with minor variations in the source of the electricity generated. Thus, hydroelectric and renewable energies production increased, particularly in the third quarter, whereas nuclear and oil-based production dropped. As can be seen from the graph, the country's economic growth in the time period considered is linked to an increase in primary energy consumption and GHG emissions, although this trend is beginning to decouple.

The current Renewable Energies Plan 2005-2010 has allowed Spain to initiate a series of measures which mean that renewable energies will represent around 7.6% of primary energy consumption by 2008 (provisional figures) and has helped Spain to be a market leader in wind- and solar-energy technologies.

In December 2008 the EU approved a new renewable energies directive which stipulates that 20% of final energy consumption should come from this type of source. It also establishes a minimum 10% participation of renewables in the transport sector (biofuels and electricity from renewable sources for electric vehicles, etc.). In light of this new directive, Spain has already begun to draw up a new Renewable Energies Plan (REP) 2011- 2020, at the same time as, and in coordination with, the draft Energy Efficiency and Renewable Energies Act. The new REP proposes to set specific renewable-energy targets for thermal use, electricity generation and transport, as well

as to further support the development of more mature and consolidated fields, such as wind and solar energy, and to incorporate new and emerging technologies such as geothermal energy and wave power.

NOTES

- CO₂ accounts for the vast majority of greenhouse gas emissions during energy production, therefore the use of total GHG emissions (CO₂-eq) or CO₂ emissions has little impact on the analysis of eco-efficiency in the sector and production of the graph.

SOURCES

- Spain's Atmospheric Emissions Inventory. Edition 2009 (series 1990-2007). Directorate General of Environmental Quality and Assessment. MARM. Data on total emissions from combustion in energy sector industries included within Energy (in accordance with IPCC categories).
- Ministry of Industry, Tourism and Trade. Secretariat General for Energy. Directorate General for Energy Policy and Mining. "Energy in Spain 2007".

MORE INFORMATION

- <http://www.idae.es>
- <http://www.mityc.es>
- <http://www.mma.es>
- <http://ine.es>

