

# 2.7

## ENERGY



The environmental impact of the energy sector is generally analysed in terms of two key aspects: energy structure and intensity of energy use. Recent trends and economic forecasts suggest that energy consumption in Spain will continue to rise over coming years. This growth will be determined by demand from various sectors (transport, industry, service and domestic), as well as by energy policy, available resources and their cost. It will also be conditioned by other sector-specific policies (Spanish National Emission Rights Allocation Plan (*Plan Nacional de Asignación de Derechos de Emisión*), Waste Management, etc.).

The Spanish Ministry of Trade, Industry and Tourism (*Ministerio de Industria, Turismo y Comercio*) has drawn up two lines of action focusing, respectively, on increasing renewable energies and energy efficiency. The Renewable Energy Plan 2005-2010 (*PER - Plan de Energías Renovables 2005-2010*), approved in August 2005, has been devised as the framework within which to support the development of renewable energy sources to provide more environmentally-friendly alternatives.

The underlying target is for 12.1% of primary energy to be produced from renewable sources by 2010. Action Plan 2005-2007 for Energy Saving and Efficiency (*Plan de Acción 2005-2007 de Ahorro y Eficiencia Energética*) under the Spanish Energy Efficiency Strategy (*E4 - Estrategia Española de Eficiencia Energética*), approved in



July 2005, took the first steps in developing an energy-saving policy for the period 2004-2012. For the initial period 2005-2007, the primary energy-saving target stands at 12,006 Ktoe, with measures aimed in particular at the transport, building and energy transformation sectors.

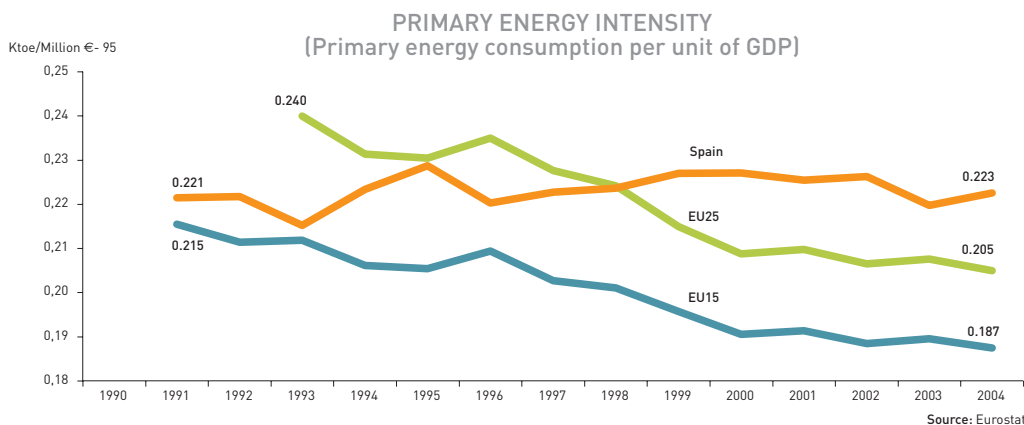
Working along the same lines, the Spanish Ministry of the Environment (*Ministerio de Medio Ambiente*) has, within the framework of the Water Management and Use Action Programme (*AGUA, Programa de Actuaciones para la Gestión y la Utilización del Agua*), developed plans for renewable energy use in desalination to compensate for energy consumed by desalination plants. The aim is to obtain an installed power capacity of 1,140 MW, well above the 260 MW level required for desalination operations.

The indicators used in this report to analyse the current situation and environmental pressures within the sector are as follows:

INDICATOR	GOAL	TREND
<b>Primary energy intensity</b>	Reduce the relationship between energy consumption and GDP	GDP growth remains coupled to energy consumption
<b>CO<sub>2</sub> emissions intensity</b>	Decouple economic growth from CO <sub>2</sub> emissions	Energy-related CO <sub>2</sub> emissions intensity rose by 8.4% between 1990 and 2005, with annual fluctuations
<b>Renewable energies</b>	Generate 12.1% of all primary energy from renewable sources by 2010	Rising energy demand means that the increase in renewable energies is barely perceptible
<b>Eco-efficiency in the energy sector</b>	Decouple economic growth from environmental pressures applied by the sector	GDP growth remains coupled to energy consumption and GHG emissions

## Primary energy intensity

Energy intensity in Spain has been rising by an average of 0.5% per year since 1990, whereas there is a clear downward trend within Europe



In Spain, economic growth over recent years has been accompanied by a greater rate of growth in energy consumption, indicating a situation of economic inefficiency which needs to be corrected.

By 1991, primary energy intensity in Spain was already above the average figure for the EU15, and since 1999 it has been above the EU25 average. While the trend in Spain has remained practically stable, with occasional fluctuations, the EU (both EU15 and EU25) has followed a more sustainable, progressively downward course.

According to the Spanish Ministry of Trade, Industry and Tourism, over the 16-year period 1990-2005, primary energy intensity grew by 8.2%, equivalent to average annual growth rate of 0.5%.

Action Plan 2005-2007 for Energy Saving and Efficiency (*Plan de Acción 2005-2007 de Ahorro y Eficiencia Energética*) established “energy saving” as one of its main targets. It sets the specific goal of achieving a reduction of 12 million toe over the period 2005-2007, and eliminating 32.5 Mt of associated CO<sub>2</sub> emissions, a key factor in tracking this indicator.

**NOTES**

- Primary Energy Intensity (PEI) is defined as the ratio of primary energy consumption to Gross Domestic Product (GDP), and allows us to analyse the degree of energy efficiency by linking energy consumption to the associated economic growth.
- The publication by the Spanish Ministry of Trade, Industry and Tourism "Energy in Spain 2005" (*"Energía en España 2005"*) provides a broader series of data (including 2005 figures) with different levels of Primary Energy Intensity and refers solely to Spain. The figures are higher for recent years: 0.236 Ktoe/million  $\alpha$  for 2004 and 0.234 Ktoe/million  $\alpha$  for 2005.

**SOURCES**

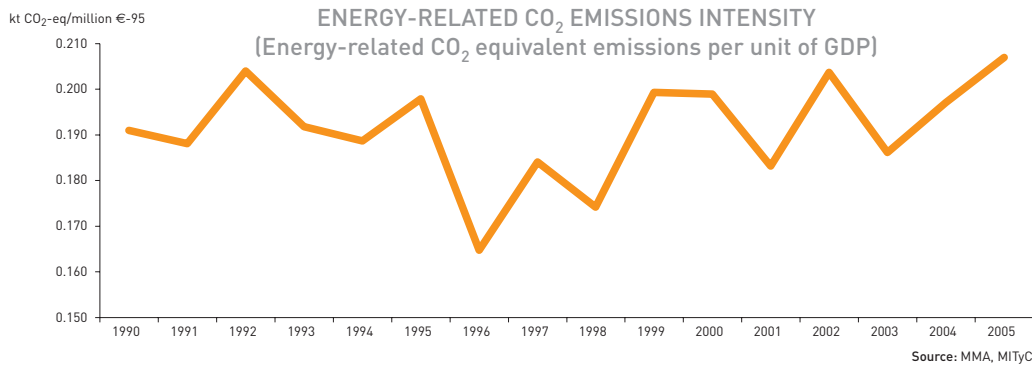
- EUROSTAT. Structural indicators. Short list. Environment, Energy Intensity (Indicator 13)

**FURTHER INFORMATION**

- [www.idae.es](http://www.idae.es)
- [www.cne.es/medioambiente.html](http://www.cne.es/medioambiente.html)
- [www.mityc.es](http://www.mityc.es)
- <http://epp.eurostat.ec.eu.int/>
- Spanish Ministry of Trade, Industry and Tourism. Secretariat General for Energy (*Secretaría General de Energía*). "Energy in Spain 2005".
- Spanish Institute for Energy Saving and Diversification (*IDAE - Instituto para la Diversificación y Ahorro de la Energía*). Spanish Ministry of Trade, Industry and Tourism. "Energy Efficiency and Renewable Energy" (*"Eficiencia energética y energías renovables"*). IDAE bulletin (Various editions)

## CO<sub>2</sub> emissions intensity

The intensity of energy-related CO<sub>2</sub> emissions fluctuates annually depending on meteorological conditions



The intensity of energy-related CO<sub>2</sub> equivalent emissions rose by 8.4% over the period 1990-2005. However, the graph reveals notable fluctuations in this trend, with the figure falling in some years as a result of lower emissions (in particular 1996, 2001 and 2003), in parallel with the continuous growth seen in GDP. This fall in emissions is related to rainfall that, by making more water available, raises hydroelectric power generation.

Over the period 1990-2005, total greenhouse gas (GHG) emissions from combustion in energy production and transformation rose by 61.6% (from 77,583 Kt to 125,352 Kt), a higher rate of increase than total GHG emissions, which rose by 52.16% over the same period.

In 2005, these emissions made up around 28.5% of overall GHG emissions, a slightly higher percentage than in 2004 (27.2%).

**NOTES**

- The intensity of energy-related CO<sub>2</sub> emissions is defined as the ratio between total CO<sub>2</sub> emissions from the energy and transformation industries and Gross Domestic Product. This indicator is particularly useful in analysing the impact of energy production in terms of a country's economic growth.
- The CO<sub>2</sub> emissions included in calculating the indicator refer to total emissions from "Combustion in energy and transformation industries" (SNAP 1 Group), comprising three of the six main greenhouse gases covered by the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrogen oxide (N<sub>2</sub>O). The other three gases (perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF<sub>6</sub>)) are excluded, since these are emitted only in industrial processes. The conversion of individual CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions to tonnes of CO<sub>2</sub> equivalent is performed according to the global warming potential of these gases: 1 for CO<sub>2</sub>, 21 for CH<sub>4</sub> and 310 for N<sub>2</sub>O.
- These coincide with those produced in "Energy" in accordance with IPCC categories, covering combustion processes which include the generation of electricity, combustion at refineries and the conversion of fossil fuels, as well as combustion in mining.

**SOURCES**

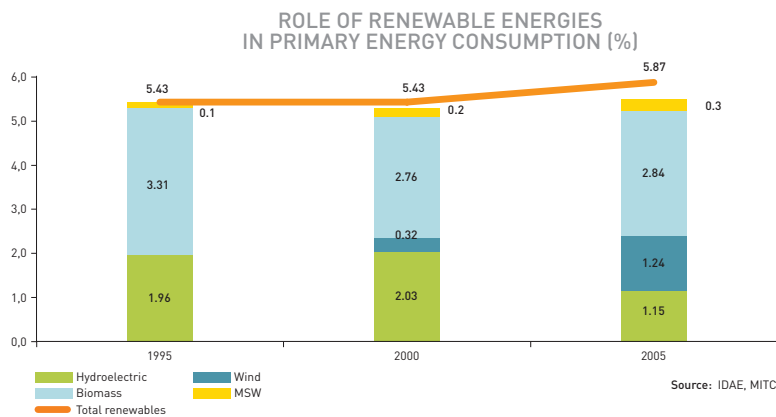
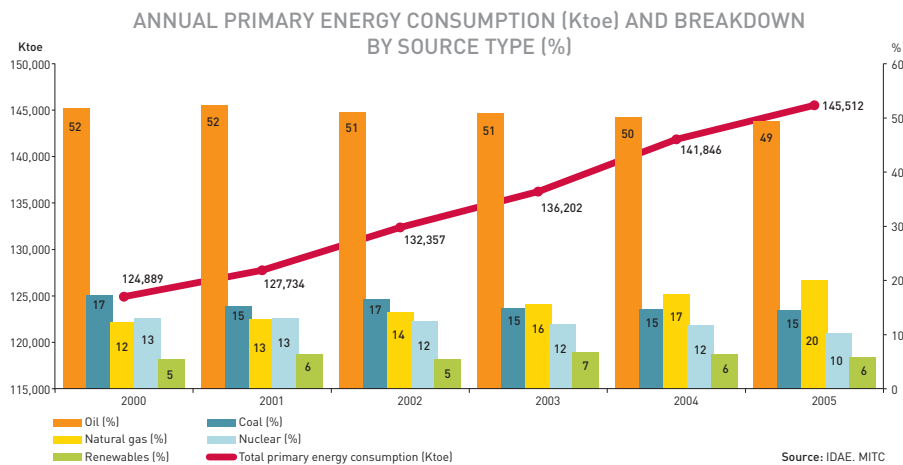
- Emissions figures: Spanish National Atmospheric Emissions Inventory (*Inventario Nacional de Emisiones a la Atmósfera*). Sub-Directorate General for Air Quality and Risk Prevention (*Subdirección General de Calidad del Aire y Prevención de Riesgos*). Spanish Ministry of the Environment.
- GDP figures: 1990-2005: Spanish Ministry of Trade, Industry and Tourism. "Energy in Spain 2005".
- Spanish Institute for Energy Saving and Diversification (IDAE). Spanish Ministry of Trade, Industry and Tourism. "Energy efficiency and renewable energy". IDAE bulletin.

**FURTHER INFORMATION**

- [www.idae.es](http://www.idae.es)
- [www.ine.es](http://www.ine.es)
- [www.mityc.es](http://www.mityc.es)
- [www.mma.es](http://www.mma.es)

## Renewable energies

The increase of renewable sources in primary energy production is offset by rising energy consumption and their contribution is largely dependent on rainfall



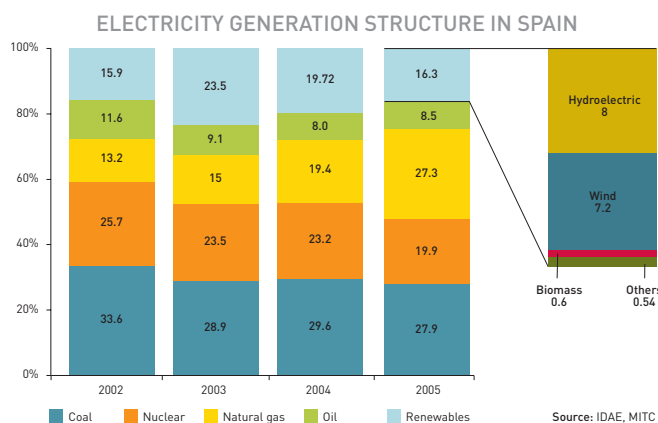
Primary energy consumption is dominated by fossil fuels. In 2005, oil was, as is regularly the case, the most commonly used source (49%), followed by natural gas (20%) and coal (15%). The increase in the use of natural gas is particularly significant, overtaking coal from 2003 onwards. The use of nuclear energy has remained constant, although there was a slight fall in 2005 compared with previous years.

The use of renewable energies is on the increase: in absolute terms, 6,776 Ktoe of primary energy were generated in 2000, while the output rose to 8,545 Ktoe in 2005, an increase of 26.11%. However, the relative contribution of renewable energies to total primary energy consumption remained steady at around 6% as a result of increasing primary energy demand.

The aim of Spain's Renewable Energies Plan (*Plan de Energías Renovables*) is to raise renewable energies' contribution to the country's primary energy provision to 12.1% by 2010.

On the other hand, part of Spain's renewable energy comes from hydroelectric sources, meaning that in years of low rainfall there is a reduction both in total renewable primary energy output and its contribution to the overall figure, with demand for other energy sources rising in order to guarantee supply and reserves.

As regards the country's electricity generation structure, electricity output from renewable sources has been falling since 2003, mainly as a result of low rainfall in 2004 and 2005 compared with 2003. In terms of energy sources, wind energy is experiencing notable growth, and is the most strongly developed in Spain after hydroelectric power.



#### NOTES

- The renewable energy sources included in calculating the indicator are: hydroelectric and mini-hydroelectric, wind, thermoelectric solar, photovoltaic solar, biomass, biogas and municipal waste.
- The development of renewable energy sources is a key aspect of national energy policy. These sources make an efficient contribution to reducing the environmental impact of energy production and transformation. This is mainly in terms of greenhouse gas emissions, in particular CO<sub>2</sub>, though emissions of other pollutants (SO<sub>2</sub>, NO<sub>x</sub>, particles, etc.) are also reduced. A greater role for renewable energies in the overall balance also reduces the country's dependence on petroleum products, diversifying supply sources promoting inexhaustible and widely distributed energy sources. This in turn also cuts the need for transformation and transport, with a corresponding reduction in environmental impact.
- The development of renewable energies is supported by the existence of an appropriate regulatory framework that guarantees 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 the extent that the country is now ranked second in the EU in terms of wind energy facilities. The changes made to the incentive system in Royal Decree 436/2004 (*Real Decreto 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, being Spain now Europe's leading producer of bioethanol, another of the targets of the 2005-2010 Renewable Energy Plan.

#### SOURCES

- Figures provided by IDAE - Dept. of Studies and Baseline Information (*Dpto. de Estudios e Información de Base*). Spanish Institute for Energy Saving and Diversification (IDAE). Spanish Ministry of Trade, Industry and Tourism.
- Spanish Ministry of Trade, Industry and Tourism. Secretariat General for Energy. "Energy in Spain 2005".

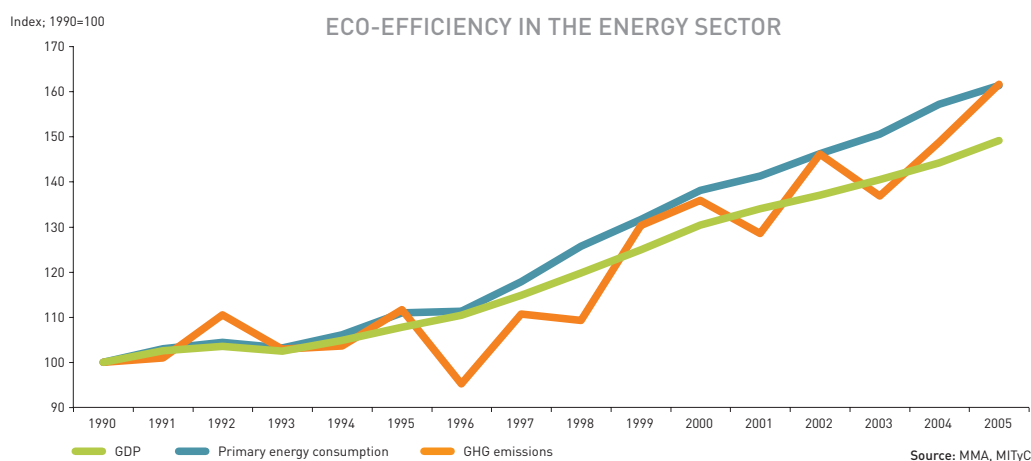
#### FURTHER INFORMATION

- [www.mityc.es](http://www.mityc.es)
- [www.idae.es](http://www.idae.es)
- [www.mma.es](http://www.mma.es)
- <http://epp.eurostat.cec.eu.int/>



## Eco-efficiency in the energy sector

The rise in energy consumption and GHG emissions rates is greater than GDP growth, a clear sign of environmental inefficiency in the energy sector



The analysis of the relationship between a country's economic growth and pressures derived from the development of a given productive sector provide a mean of assessing its environmental efficiency. This factor is fundamental, in terms of sustainable development, when analysing the integration policies adopted for each sector. In the case of energy, we find that pressures exerted in terms of Greenhouse Gas (GHG) emissions (total emissions of the 6 gases covered by the Kyoto Protocol) and primary energy consumption are rising in step with, and even outstripping, increases in Gross Domestic Product (GDP). This depicts a sector with poor environmental efficiency, exerting ever greater environmental pressure per unit of economic wealth.

Over the period 1990-2005, primary energy consumption grew by 61.3%, and GHG emissions by 61.6% (although with occasional sharp fluctuations), while GDP rose more slowly, by 49.1%. Decoupling energy consumption and CO<sub>2</sub> emissions from GDP necessarily involves appropriate energy efficiency and saving measures, and the promotion and development of renewable energy production sources.

**NOTES**

- In energy production, CO<sub>2</sub> accounts for the vast majority of Greenhouse Gas emissions, meaning that both the graph and the eco-efficiency analysis for the sector are practically identical whether we consider total GHG emissions (CO<sub>2</sub>-eq) or CO<sub>2</sub> emissions individually.

**SOURCES**

- Spanish National Atmospheric Emissions Inventory. Sub-Directorate General for Environmental Quality (*Subdirección General de Calidad Ambiental*). Spanish Ministry of the Environment. Data on total emissions from combustion in energy sector industries included within Energy Processing (in accordance with IPCC categories).
- Spanish Ministry of Trade, Industry and Tourism. Secretariat General for Energy. Directorate General for Energy Policy and Mining (*Dirección General de Política Energética y Minas*). "Energy in Spain 2005".

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