2.9 ENERGY

Energy production and consumption exert various types of pressure on the environment and public health, pressure that in some cases is now declining in both Europe and Spain. Energy, electricity and transport are the greatest sources of greenhouse gas emissions (GHGs). Between 1990 and 2005, emissions of these gases in the EU-27 fell appreciably. For example, CO_2 emissions from conventional thermal power stations in the EU-27 decreased by 27% as a result of improvements in efficiency and replacement of coal by natural gas in the electricity-generating sector. There was also a reduction in energy-related emissions of acidifying substances, tropospheric ozone precursors and particulate matter.

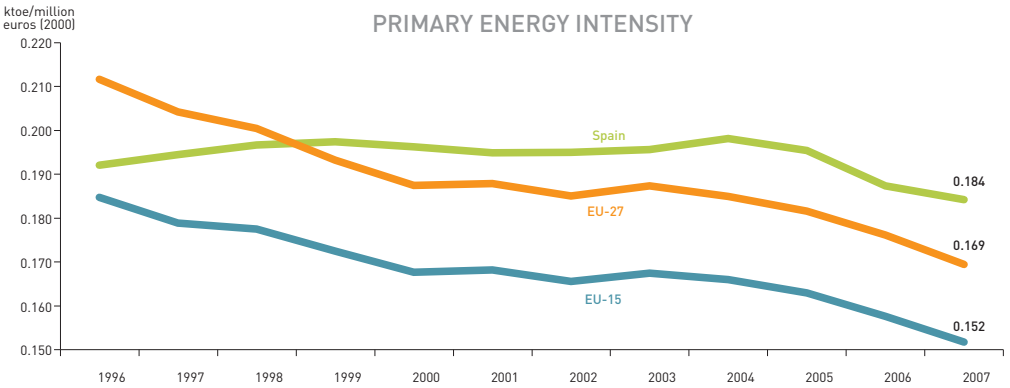
Spain's primary energy intensity (the ratio of primary energy consumption to gross domestic product) is decreasing steadily, albeit at a slower rate than in the EU-27 or EU-15. According to Eurostat data, in 2008 total primary energy consumption decreased by 3.58% year-on-year. Use of coal as an energy source fell by a significant 26.14%, while use of natural gas rose by 14.03%, nuclear energy by 11% and renewable energy by 9.09%. For the first time, in 2008 use of renewable energy (hydro, wind, biomass, solar and other forms of power) exceeded coal as a source of electricity.

The increase in renewable energy production meant that Spain's energy self-sufficiency rose from 20.9% in 2007 to 21.6% in 2008. At the same time, in 2008 GDP increased more slowly than in 2007, primary energy consumption declined and GHG emissions associated with energy production and transformation fell.

INDICATOR	GOAL	TREND
Primary energy intensity	Weaken the link between energy consumption and GDP	Primary energy intensity decreased in Spain, albeit more slowly than the European average
Energy-related GHG emissions intensity	Decouple economic growth from GHG emissions	Energy-related GHG emissions intensity fell sharply
Renewable energy	Generate 12.1% of all primary energy from renewable sources by 2010	In 2008, renewable energy accounted for 3.6% of total primary energy consumption, still far below the target set
Eco-efficiency of energy	Decouple economic growth from the environmental pressure exerted by the sector	GDP is increasing while primary energy consumption and energy-related GHG emissions are falling

Primary energy intensity

Spain's energy intensity is decreasing, albeit more slowly than the European average



Source: Eurostat

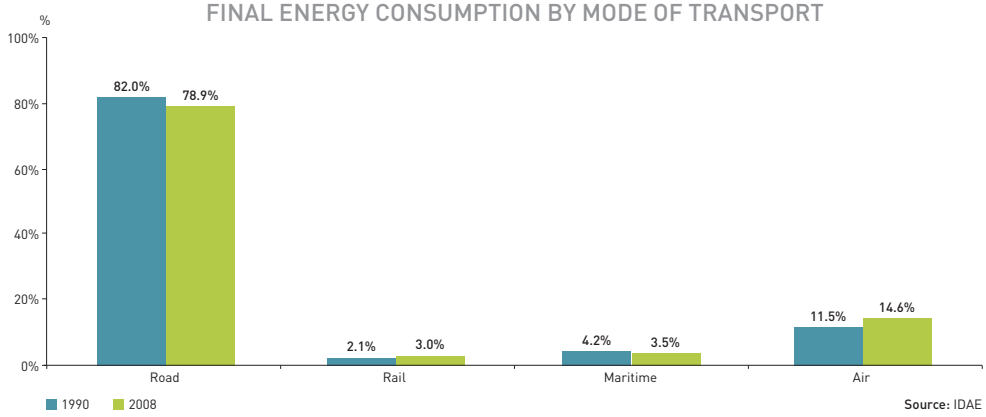
In 2008, primary energy consumption in Spain fell by 3.6% on 2007 to 137,836 ktoe. The year's minimal economic growth, combined with the decline in primary energy consumption, resulted in a reduction in primary energy intensity. For its part, final energy consumption decreased by 2.9% on the previous year to 98,737 ktoe. The result was a 3.99% drop in final energy intensity. These reductions in both primary and final energy intensity are in keeping with the trend across the rest of the EU.

Between 2000 and 2008, primary energy consumption per unit of GDP in Spain dropped by 11.36%, falling from consumption of 121,558 ktoe and GDP of €630.3 billion (at constant prices, 2000) to consumption of 137,836 ktoe and GDP of €806 billion (at constant prices, 2000).

By sector, in 2008 transport continued to consume 40.2% of final energy, a greater proportion than the previous year, although in absolute terms it fell from 40,804 ktoe in 2007 to 39,617 ktoe in 2008, a 2.90% decrease. Industry's consumption remained practically unchanged (29,957 ktoe in 2007 and 29,962 ktoe in 2008) and accounted for 30.4% of final energy consumption. Final energy consumption by the residential sector decreased very slightly (2.1%) from 16,830 ktoe in 2007 to 16,471 ktoe in 2008 and represented 16.7% of total consumption. The service sector's final energy consumption dropped by 6.4% from 9,841 ktoe in 2007 to 9,211 in 2008 and accounted for 9.3% of total final energy consumption. Consumption by agriculture also decreased, in this case by

12.6%, falling from 3,869 ktoe in 2007 to 3,382 ktoe in 2008 and representing 3.4% of the total.

FINAL ENERGY CONSUMPTION BY MODE OF TRANSPORT



Source: IDAE

The transport sector, which is Spain's biggest consumer of final energy, relies overwhelmingly on petroleum products, which represented 38,529 ktoe of the sector's final consumption of 39,617 ktoe in 2008. By mode, in 2008 road transport was again the biggest consumer, accounting for 78.9% of the sector's total. Its consumption rose from 18,346 ktoe in 1990 to 31,256 ktoe in 2008. The second-biggest was air transport, which consumed 14.6% of the sector's total and went up from 2,575 ktoe in 1990 to 5,789 ktoe in 2008. Maritime transport accounted for 3.5% of the sector's total and its consumption increased from 938 ktoe in 1990 to 1,390 ktoe in 2008. Finally, rail represented 3% of the sector's total and over 1990–2008 rose from 477 ktoe to 1,182 ktoe.

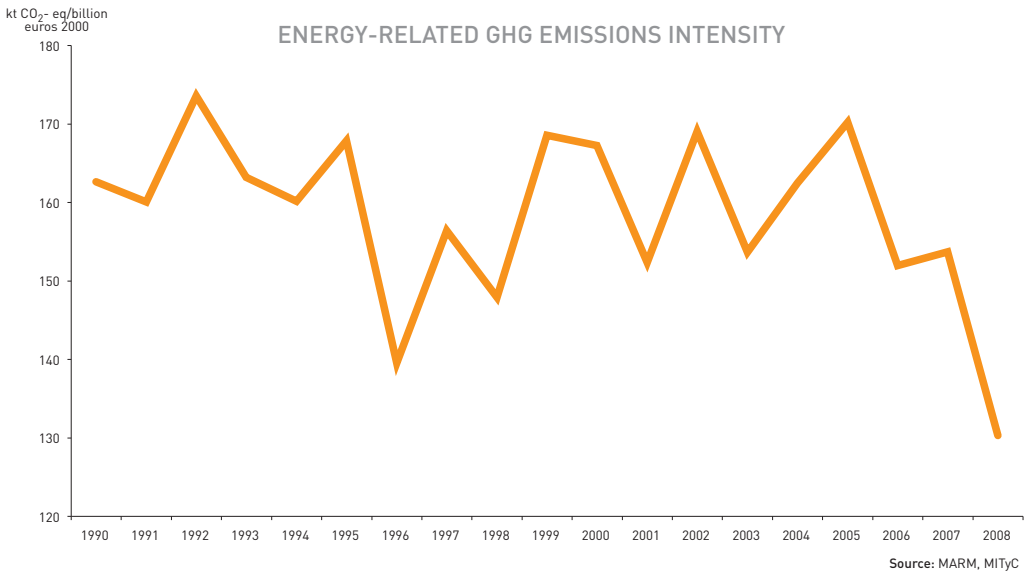
NOTES
- The Eurostat data in the graph only goes as far as 2007.

SOURCES
- Eurostat. Structural indicators. Short list. Environment, Energy intensity (Indicator 13).
- GDP: La energía en España 2008. MITyC.
- MITyC. IDAE electronic bulletin (various editions).
- MITyC. Secretariat-General for Energy. La Energía en España 2008.
- IDAE. Eficiencia energética y energías renovables. IDAE bulletin (various issues).

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

Energy-related GHG emissions intensity

Energy-related GHG emissions intensity fell sharply in 2008



Source: MARM, MITyC

In 2008, there was a notable decline in energy-related greenhouse gas (GHG) emissions intensity (the ratio between total emissions of CO_2-eq by energy transformation and processing industries and gross domestic product). The wide fluctuations in this indicator, which analyses the impact of energy production in relation to the country's economic growth, are frequently caused by meteorological phenomena that affect hydroelectric output and consumption of fossil fuels.

Total emissions of greenhouse gases associated with energy production and transformation fell from 122,468 kt of CO_2-eq in 2007 to 105,044 kt of CO_2-eq, a 14.2% reduction in a single year. This resulted in a fall of 15.2% in energy-related CO_2-eq emissions intensity.

Analysis of the individual figures for the various greenhouse gases reveals that the overall reduction is attributable mainly to the decrease in CO_2 emissions (energy-related CH_4 emissions increased by 6.4% between 2007 and 2008, while those of N_2O decreased by 1.6%). Public power stations were principally responsible for

the fall in energy-related CO_2 emissions, as their output of these gases decreased from 106,705 kt of CO_2 in 2007 to 89,655 kt of CO_2 in 2008, a reduction of 16% in a single year.

NOTES

- For the purpose of calculating this indicator, CO_2-equivalent emissions refer to total emissions from combustion in the energy-sector industries included under the Energy heading (as per the IPCC categories) and comprise the six greenhouse gases expressed as CO_2-equivalent. The Energy category includes combustion processes, among them electricity generation, combustion at refineries and transformation of combustible fuels, as well as combustion in mining.
- The six main greenhouse gases covered by the Kyoto Protocol are, in order of importance, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases, which include perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF_6), although the latter have no impact in the energy sector as they are only emitted in industrial processes.

SOURCES

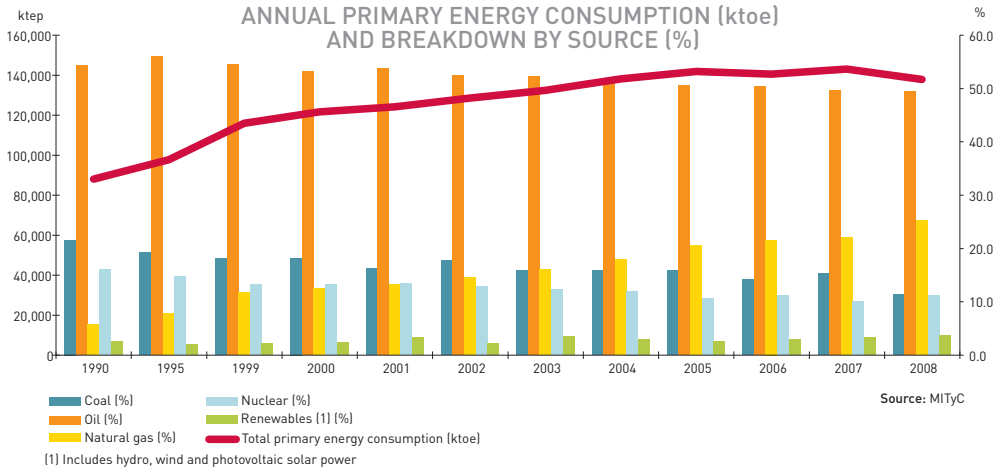
- Emissions data: National Air Pollutant Emissions Inventory. Directorate-General for Environmental Quality and Assessment. MARM.
- GDP data 1990–2008: MITyC. La Energía en España 2008.
- IDAE. Eficiencia energética y energías renovables. IDAE bulletin.

FURTHER INFORMATION

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

Renewable energy

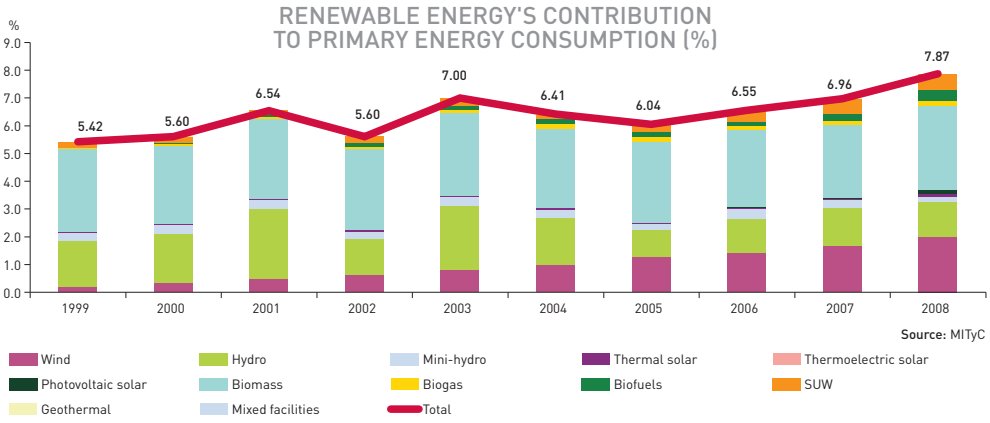
In 2008, for the first time in Spain renewable energy exceeded coal as a source of electricity



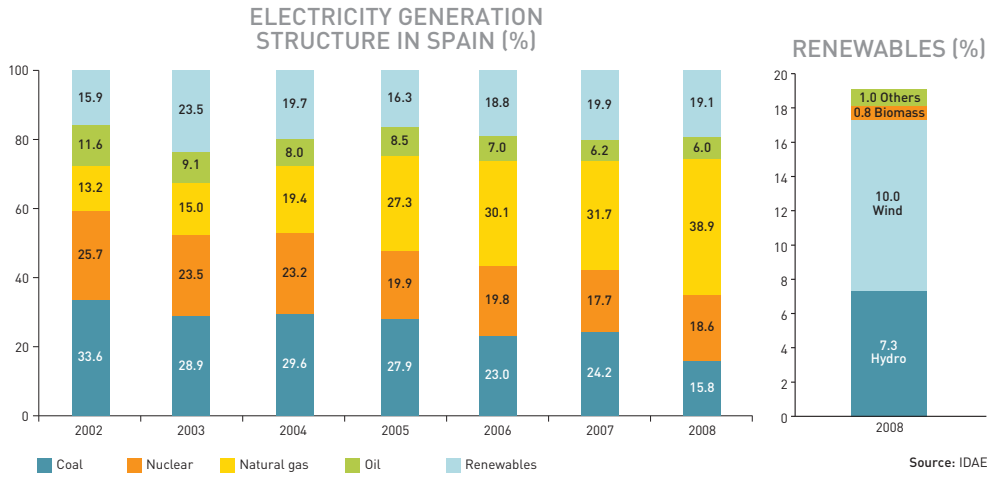
In 2008, the share of energy consumption met by renewable energy, natural gas and nuclear energy increased, while that of coal and oil fell. Among the sources used in electricity generation, not only was there a shift from coal to gas at thermal power stations, but there was also a substantial increase in the amount of electricity generated from renewable sources other than hydroelectric power, particularly wind and photovoltaic energy. These increases compensated for the fall in hydroelectric power generation and raised renewable sources' contribution to net electricity output (after plants' own consumption is deducted) by 20.5%. This percentage is almost one point lower if power stations' own consumption is not deducted.

In terms of electricity generation, in 2008 gross nuclear output represented 18.6% of the total, while that of coal-powered plants represented 15.8% and that of natural-gas-fired power stations accounted for 38.9%.

In 2008, Spain had the largest installed capacity for solar thermal energy, the second-largest for wind and photovoltaic power, and the third-largest for mini hydroelectric power. Spain's installed wind energy capacity, which represented 14% of the world total in 2008, reduced the country's imports of fossil fuels by around 5.5 million tonnes of oil equivalent and lowered its CO_2 emissions by almost 18 million tonnes.



In 2008, there were also significant changes in relation to the year before as regards sources of electricity generation. In 2007, coal accounted for 24.2% of electricity generation, a proportion that fell to 15.8% in 2008. This reduction was mainly offset by the increase in use of natural gas, which rose from 31.7% to 38.9%. There was also a slight increase in the proportion of electricity produced from nuclear energy, while the percentage generated from oil and renewable sources dropped. Within the latter group, hydroelectric power's contribution decreased notably from 9.8% to 7.3%, while wind power's share rose from 8.7% to 10%. The proportions provided by other forms of renewable energy did not change significantly.



NOTES

- The renewable energy total includes hydroelectric, mini-hydroelectric, wind, biomass and urban waste, as well as thermal and photovoltaic solar power and biogas.
- 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 achieved by cutting emissions of greenhouse gases, particularly CO_2, as well as lowering those of other pollutants (SO_2, NO_X, particulate matter, etc.). Increasing renewable energy's contribution to the energy balance also reduces the country's dependence on petroleum products and diversifies its sources of supply by encouraging use of inexhaustible and widely available resources. This in turn also reduces the need for transformation and transport, bringing a corresponding reduction in environmental impact.

SOURCES

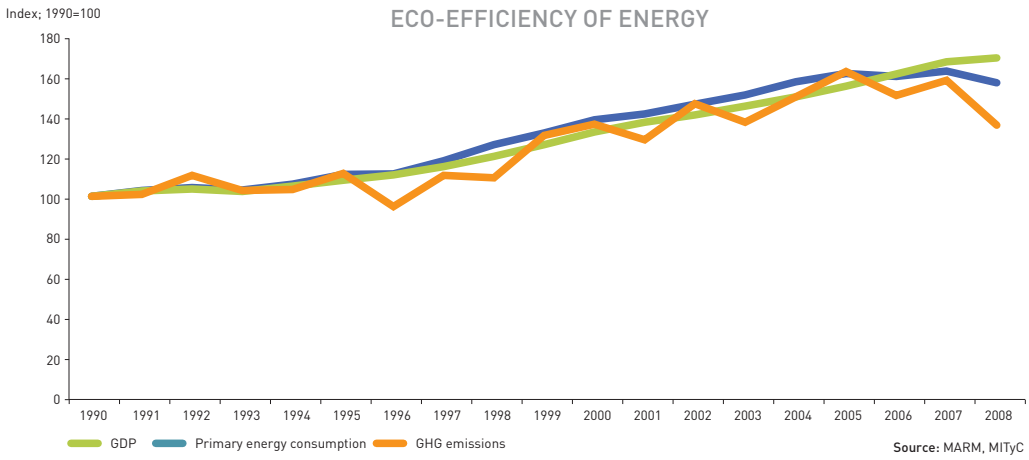
- Data provided by the Dept. of Baseline Studies and Information. IDAE. MITyC.
- MITyC. Secretariat-General for Energy. La Energía en España 2008.
- EEA. Energy and environment report 2008.

FURTHER INFORMATION

- **http://www.mityc.es**
- **http://www.idae.es**
- **http://www.mma.es**
- **http://www.eea.europa.eu**
- **http://epp.eurostat.cec.eu.int/**

Eco-efficiency of energy

In 2008, GDP rose and primary energy consumption and energy-related GHG emissions fell significantly



As in previous years, analysis of the energy sector's eco-efficiency takes three factors into account — GDP, primary energy consumption and greenhouse gas emissions associated with energy production and transformation. The changes in 2008 were significant — GDP did not grow as it had in previous years and primary energy consumption dropped by almost six percentage points (5.81). The most important change, however, occurred in GHG emissions associated with energy production and transformation, which fell by over 14% in a single year (from 122,468 kt of CO_2-eq in 2007 to 105,044 kt of CO_2-eq in 2008). Throughout the period analysed, the three categories performed very similarly and, with the exception of 2008, there was a strong link between economic growth, energy consumption and GHG emissions.

According to data provided by the European Environment Agency (*Energy and environment report 2008*), in Spain the percentage of final energy available to users in relation to primary energy was above the average for the EU-27. In other words, in this regard Spain's energy system was more efficient than the European average.

NOTES

- In energy production, CO_2 accounts for the vast majority of greenhouse gas emissions, meaning that it makes no difference if total GHG emissions (CO_2-eq) or CO_2 emissions are used to analyse the sector's eco-efficiency and produce the graph. In this case, emissions of CO_2, CH_4 and N_2O in the SNAP subgroups related to combustion in energy and transformation industries have been used (public power; district heating plants; petroleum-refining plants; solid-fuel transformation plants; and coal mining, oil/gas extraction, pipeline compressors).

SOURCES

- Spanish Greenhouse Gas Emissions Inventory. Directorate-General for Environmental Quality and Assessment. MARM. Data on total emissions from combustion in the energy-sector industries included under the Energy heading (as per the IPCC categories).
- MITyC. Secretariat-General for Energy. La Energía en España 2008.
- EEA: Energy and environment report 2008.

FUTHER INFORMATION

- **http://www.idae.es;**
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- **http:// www.mma.es;**
- **http://www.eea.eu.int;**