SPAIN

The energy sector

Spain is the second largest country in Europe, is not very densely populated, and most of the population is concentrated in the capital and in large cities in the coastal areas. Spain has enjoyed steady economic growth since the mid-1990s, with an average annual GDP growth 3.4% per year from 1995 to 1999 and an almost stabilized inflation at 2.25% since 1998, one of the lowest rates in the history of Spain. Unemployment remains high but has steadily decreased recently. Per capita income has grown sharply in the past decade, yet this was still 19% under the OECD average.

Energy balances in Spain (Source: Energy Policies of IEA Countries, 2001)

	1999	%
Population (millions)	**39.42**	
Energy consumption/capita	**2.11**	
Total energy production (Mtoe)	**30.7**	
Coal	8.6	28.0
Oil	0.3	1.0
Gas	0.1	0.3
Biomass & Wastes	4.1	13.4
Nuclear	15.3	49.8
Hydro	2.0	6.5
Geothermal	0.0	0.0
Solar/Wind/Other	0.3	1.0
Net energy imports (Mtoe)	**89.3**	
Coal	11.0	12.3
Oil	63.9	71.6
Gas	13.9	15.6
Electricity	0.5	0.6
Total supply - TPES (Mtoe)	**118.5**	
Coal	19.3	16.3
Oil	63.8	53.8
Gas	13.3	11.2
Biomass & Wastes	4.1	3.5
Nuclear	15.3	12.9
Hydro	2.0	1.7
Geothermal	0.0	0.0
Solar/Wind/Other	0.3	0.3
Electricity Trade	0.5	0.4
Electricity generation	**17.7**	
Electricity generation (TWh)	206.3	

	1999	%
Total final consumption	**83.2**	
Coal	1.3	1.6
Oil	53.4	64.2
Gas	10.1	12.1
Biomass & Wastes	3.0	3.6
Geothermal	0.0	0.0
Solar/Wind/Other	0.0	0.0
Electricity	15.2	18.3
Heat	0.1	0.1
Total industry consumption	**30.3**	
Coal	1.3	4.3
Oil	13.8	45.5
Gas	7.7	25.4
Biomass & Wastes	1.0	3.3
Geothermal	-	-
Solar/Wind/Other	-	-
Electricity	6.6	21.8
Heat	0.1	0.3
Transport consumption	**32.7**	
Total other sectors consumption	**20.2**	
Coal	0.1	0.5
Oil	7.3	36.1
Gas	2.4	11.9
Biomass & Wastes	2.0	9.9
Geothermal	0.0	0.0
Solar/Wind/Other	0.0	0.0
Electricity	8.4	41.6
Heat	-	-

TPES has grown at an average annual rate of 3% over the past decade, considerably more than the IEA average of about 1.4%. Domestic energy production increased rapidly in the 1970s and 1980s, reaching 38% of TPES in 1990. It has decreased to 26% of TPES in 1999. Spain has some oil and gas resources but they are almost completely depleted.

Total final energy consumption increases with an average annual rate of 3.4% since 1990. The share of each fuel in TFC remained basically stable during the 1990s, except for natural gas, whose share in 1990 was lower and for coal, which was higher.

Transport has the biggest share in final energy consumption, followed by industry, and the residential, services and agricultural sectors. Final energy consumption by the transport sector grew by 43% in 1990-1999, with an average annual growth rate of 4.1%. Final energy consumption by the industrial sector grew by 24% in 1990-1999 (average annual growth rate of 2.5%). During the rapid increase in industrial production in the late 1990s, the introduction of more energy-efficient production technologies and a slight structural change in industrial output has kept the growth of energy consumption in the sector moderate. Final energy consumption in the other sectors (residential, services and agricultural) has grown by 43% between 1990 and 1999.
Average annual growth in electricity consumption was about 3% in the mid-1990s but climbed to 6-7% in 1998-2000. Electricity consumption increased by 63% in the services sector, 38% in the residential sector and 13% in the industrial sector during 1990-1998. At the end of 1998, total net maximum capacity was 50,000 MW, of which public utilities owned 91% and autoproducers 9% (hydro 16,600 MW (of which about one-third was pumped storage), coal 11,000 MW, oil 9,400 MW, nuclear 7,300 MW, natural gas 4,800 MW and renewables 960 MW). In 1999, coal was the main fuel used for electricity production, with a share of 36.6%. The second most important source was nuclear power (28.5%), followed by oil (11.8%), hydro (11.1%), natural gas (9.2%) and non-hydro renewables, including waste (2.7%). The share of nuclear power has decreased during the last ten years because no new units have been commissioned since 1988. The share of coal grew slightly from the late 1980s to the early 1990s but decreased thereafter. Over the past five years, oil and renewables have increased their shares somewhat,while the introduction of natural gas in electricity generation has been rapid.
At the beginning of 2001, industry had submitted applications for over 26 GW of new combined cycle gas turbine (CCGT) capacity and some of the units are already under construction.

Policy for renewables and CHP

Until 2001, energy policy was set out periodically in a series of National Energy Plans (*Plan Energético Nacional*, PEN). The PEN91, for the period 1991-2000, came into force in 1992. The PEN91 has been mostly superseded by the Electric Power Act (1997) and Hydrocarbons Act (1998). Until May 2000, energy administration was the responsibility of the Ministry of Industry and Energy. This ministry was then abolished, and energy matters were transferred the Ministry of Economy. The central government has general jurisdiction over energy issues, especially those that concern the entire country, such as tariffs and taxes, and issues that concern more than two autonomous regions. The responsibility of the regions is limited to issues exclusively within their area. The regions play an important role in specific policy areas, such as promoting the use of renewables. Furthermore, they implement many of the energy policies defined by the central government. Energy taxes are set by the government, but municipalities can set local taxes on electricity and gas.

Two national projects have been identified in Spain aiding biomass CHP:

- **Biomass Producers Financial Incentives**

Contact organization: Ministry of Economy
Short description: Under this legal framework, cogenerators and renewable energy producers (legally referred to as the Special Regime producers) had the right to connect their installations to grid, sell the excess output to a utility and obtain certain fiscal benefits for investing in this technology.

- **Fiscal Incentives**

Contact organization: Ministry of Treasure
Short description

Type A.- Fiscal deduction for investments on material assets designated to the protection of the environment from the Law 43/1995, the 27th of December, from the Societies Tax.
Type B.- Fiscal deduction for investments on material assets designated to the useful of renewable energies from the Law 24/2001, the 27th of December, from the Societies Tax.

CHP and biomass-CHP

Thanks to the financial incentives provided under the special system, co-generation increased rapidly in the 1990s. Whereas the total installed co-generation capacity was 370 MW of electricity at the end of 1990, it reached almost 5,000 MW in 2000. About 4,100 MW of capacity was installed in 1991-1999. The peak year for commissioning new CHP plants was 1998 when 120 new plants started operation. Since then, their number has declined and some older plants have been closed because fuel prices have increased and electricity buyback tariffs have decreased. Natural gas is the most commonly used fuel, covering 72% of total CHP generation, followed by oil (25%) and other fuels (3%). In terms of technology, the majority of the installations are based on the reciprocating engine (76%), but some plants based on gas turbines (21%) and steam turbines (3%) have been commissioned.
In 1999, the total amount of electricity produced by CHP plants was 28 TWh (almost 14% of total electricity generation), and the amount of heat that was produced to be sold totaled 3,100 TJ. Almost all co-generation facilities are run by autoproducers, typically industries. The size of the installations is generally small: 16% of the plants have a capacity of under 1 MWe, 53% have 1-5 MWe capacity, and 17% have 5-10 MWe capacity. The typical industries to invest in CHP production are ceramics and tiles, food processing, textile, chemical, and pulp and paper industries. No large-scale public CHP plants have been built yet.
Since 1994, IDAE has signed voluntary agreements (VAs) to improve energy efficiency with ten industrial associations representing nine sectors (pulp and paper, ceramics, glass, etc). These sectors represent 56% of the total final consumption of energy by industry. They create a framework for activities and projects aimed at energy saving, installation of co-generation systems and promoting the use of natural gas and biomass. Co-generation capacity financed through IDAE's third-party financing was 300 MWe, or 8.8% of total capacity installed in 1991-1999. However, high fuel prices in 2000 discouraged the installations of new co-generation capacity in 1999-2000.
Nonetheless, there is still room for improvement, for example in the total efficiency of CHP installations.
The 1992 Energy Saving and Efficiency Plan (PAEE) set a target to increase the use of renewables by 1.1 Mtoe30 between 1991 and 2000. It set a target to increase the contribution of non-hydro renewables in power generation from 0.3% in 1990 to 1.4% in 2000. Various measures have been taken to achieve these targets. Pta 70.1 billion of public funds were allocated for subsidies and soft loans for renewables in 1991-1999. Every year a decree determines how much of the eligible costs can be subsidised. The subsidies (premiums) have varied from 10% (*e.g.* for mini-hydro plants outside the Spanish peninsula) to 30% (for wind energy) of total generation costs. During 1991-1999, the power generation capacity of renewables increased by 2,930 MW and renewables replaced other fuels for heating by 0.3 Mtoe during the same period. A new plan, the Plan for the Promotion of Renewable Energy in Spain (*Plan de Fomento de las Energías Renovables en España*, PFER), was introduced by the Electric Power Act (Law 54/1997) in 1999.
Waste from forestry, wood processing industries, agriculture and agricultural industries (altogether 2.65 Mtoe) and energy crops (3.35 Mtoe) are expected to be the most important sources of biomass. About 0.9 Mtoe of biomass would be used for thermal applications. The target for new electricity generation from biomass is set at 1,708 MW of new capacity generating 12 TWh per year in 2010.

One industrial CHP unit was identified:

- **Valencia, Spain**

  Switzerland's turbogenerator packaging company Turbomach has delivered a 10.6 MW cogeneration plant to a food company located in the Autonomous Community of Valencia, Spain, an extension to the existing plant that will cover the company's current steam and electricity requirements, as well as the factory's future power needs.

  The package comprises a 10.6 MW industrial turbogenerator, a heat recovery boiler for the production of 45 tonnes/hour of steam and a new natural gas installation.

One pilot action was identified in Spain on CHP:

- **Prosmaco Spanish pilot action**

  Econoler financed and realized a project where a cogeneration unit (1Mwe, 1.26MWth) fuelled by natural gas produces 3.96 GWh_e/a (of which 3.44 are sold to the grid) and 3.72 GWh_{th}/a in a sawmill.

On biomass-CHP a THERMIE project is ongoing:

- **25MW straw fired fluidized bed, high efficiency district heating power plant in Pamplona**