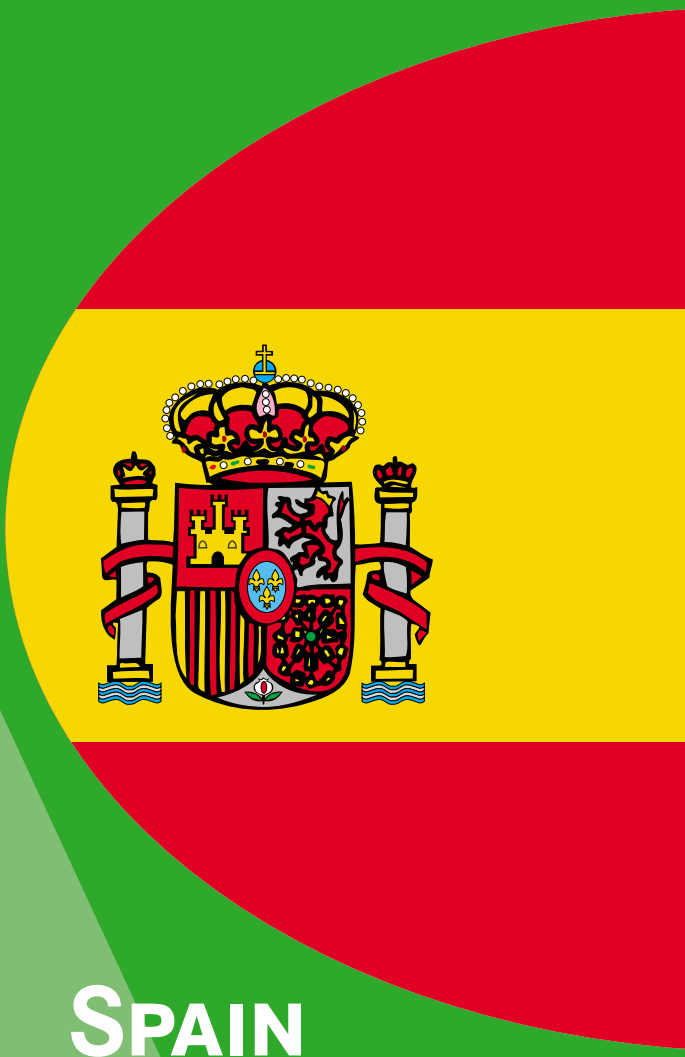
INTERNATIONAL ENERGY AGENCY

Energy Policies of IEA Countries



SPAIN 2001 REVIEW

OECD

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INTERNATIONAL ENERGY AGENCY
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The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-five* of the OECD's thirty Member countries. The basic aims of the IEA are:

- To maintain and improve systems for coping with oil supply disruptions;
- To promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- To operate a permanent information system on the international oil market;
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- To assist in the integration of environmental and energy policies.

** IEA Member countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission also takes part in the work of the IEA.*

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Pursuant to Article 1 of the Convention signed in Paris on 14th December 1960, and which came into force on 30th September 1961, the Organisation for Economic Co-operation and Development (OECD) shall promote policies designed:

- To achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;
- To contribute to sound economic expansion in Member as well as non-member countries in the process of economic development; and
- To contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.

The original Member countries of the OECD are Austria, Belgium, Canada, Denmark, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The following countries became Members subsequently through accession at the dates indicated hereafter: Japan (28th April 1964), Finland (28th January 1969), Australia (7th June 1971), New Zealand (29th May 1973), Mexico (18th May 1994), the Czech Republic (21st December 1995), Hungary (7th May 1996), Poland (22nd November 1996), the Republic of Korea (12th December 1996) and Slovakia (28th September 2000). The Commission of the European Communities takes part in the work of the OECD (Article 13 of the OECD Convention).

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SUMMARY AND RECOMMENDATIONS

SUMMARY

The Spanish energy sector changed fundamentally during the 1990s. Energy demand grew rapidly, together with the economy. Because Spain has limited energy resources, which cover only 25% of total primary energy supply (TPES), security of supply is an important aspect of Spanish energy policy. The government has made the diversification of fuels and their supply sources a priority. The electricity, gas and oil markets have been liberalised. The main challenges facing Spain in the coming decade will be to ensure that the energy supply can satisfy growing demand, to curb CO_2 emissions to meet the country's Kyoto target and to introduce full liberalisation and true competition in the electricity, gas and oil markets.

Sharply growing energy consumption complicates the government's efforts to address environmental issues. Spain's greenhouse gas emission objective under the European Union "burden-sharing" agreement is set at 15% above 1990. But Spain's CO_2 emissions were 21% higher in 1998 than in 1990.

At present, there is neither a national plan nor a package of effective policies and tools for achieving the Kyoto target. Prompt action is needed to develop an effective national policy. In the industrial sector, for example, the feasibility of emissions trading should be studied. Industry has shown interest in greenhouse gas emissions trading and other Kyoto "flexible mechanisms". But the government has not taken a position on them. Since some forms of energy are cheaper in Spain than the European Union (EU) average, a new tax on CO_2 emissions in the transport and residential/commercial sectors should not be excluded. The current government policy is, however, against introducing a carbon tax or modifying energy taxes to reflect environmental costs.

The government sees real potential in energy efficiency improvements, a belief that underpinned the Energy Saving and Efficiency Plan for 1991-2000. While some progress was made in energy efficiency, the country's energy intensity increased slightly over the same period, and the government has not yet prepared a follow-up plan. Additional strong measures are needed to slow the growth of energy consumption.

Noteworthy progress has been achieved in the liberalisation of electricity, gas and oil markets. It is encouraging that the government has decided to liberalise fully the electricity and gas markets by 2003, at a faster pace than required by the European directives. In the electricity sector, the transmission system and market operations have been separated out from the vertically-integrated utilities following the establishment of a Market Operator and a Transmission System Operator (TSO). A TSO has been established also in the gas sector but arrangements for separating it from the vertically-integrated incumbent have not yet been completed. In the oil sector, the oil transport and storage company CLH and other small operators grant third party access to their facilities. But the separation of CLH from other oil market

interests has not been completed. With powerful companies present in all the energy markets, there is still work to be done to ensure that effective competition will happen. Many details still need to be set if the electricity and gas markets are to be fully liberalised by 2003. The National Energy Commission, an advisory body, deals with some of the regulatory issues in the electricity, gas and oil sectors, but the main regulator remains the Ministry of Economy.

Tariff-setting for the captive market is a problem, as is the effort to ensure that the tariffs for the different consumer groups fully reflect cost. The government appears, in fact, to be using the tariff-setting process to transfer to captive consumers the efficiency gains from market liberalisation. On the other hand, captive consumers clearly bear a greater share of energy policy costs than eligible consumers. Some elements in tariff-setting, which are at the discretion of the government, are stranded cost payments, the costs of transition to competition or CTCs, and incentives under the "special system" (see Chapter 6).

The introduction of natural gas in Spain has been successfully managed, and the government is making continuous efforts to diversify the supply sources of natural gas, including increasing connections to EU grids. In both electricity and gas, however, interconnection to neighbouring countries remains complicated. In order to improve security of supply, gas imports from a single country and by a single agent are limited to 60% of the total. This policy objective may be valid, but the measure needs to be scrutinised to ensure that it has no adverse impact on competition.

More work remains to be done on the liberalisation of the gas market. Current tariffs do not fully reflect costs, and the cost of connection to the grid is too high. Even though new companies have emerged, the incumbent still dominates the market and retains advantages, including secured access to relatively cheap gas from Algeria through long-term contracts. A quarter of the supplies from Algeria, which pass through the Maghreb-Europe pipeline must, by law, be sold into the liberalised part of the market.

Natural gas is subject to lower taxes than are oil products and, without explicit justification by reference to defined externalities, this distorts the market. Lower taxes on gas were earlier seen as incentives to invest in new infrastructure. Now the gas infrastructure covers wide areas of the country, reaching four million consumers, and there is less need to provide such incentives. Another tax distortion is the differential between gasoline and diesel taxes. This discrepancy is hard to justify since there are no environmental or other externalities that favour the use of automotive diesel over gasoline.

There has been steady progress in restructuring domestic coal mines. While subsidies are still paid to domestic coal producers, direct state aid for coal production is decreasing by 4% every year. In 2000, the subsidies approved by the EU totalled Pta 186 billion. The government should be encouraged to continue restructuring the industry to reduce subsidies further.

The government has strongly promoted combined heat and power generation (CHP) and renewable energy sources. In its plan to promote renewable energy, it has set the ambitious target of meeting 12% of TPES by renewables by 2010 as

compared to about 6% today. But concrete policy measures have yet to be defined. Renewables can contribute considerably to the diversification of energy. They may also be important in reaching environmental objectives. It is important, however, to find cost-effective means for promoting the use of renewables. There is an ongoing debate in Spain on the amount of subsidy to be paid for power generation from renewable energy installations. With regard to CHP, subsidies should be phased out, and the installation of efficient CHP units should be encouraged. The subsidies for co-generation are also currently under discussion. A decision has been taken to phase out subsidies for units larger than 10 MW_e by 2007.

Nuclear power is an important energy resource. It covers about 30% of total electricity generation and 13% of the country's TPES, thus making an important contribution to the diversification of energy supply. Spain should be commended for the excellent safety record and efficient operation of its nuclear plants. There is a moratorium on completing five partially-built nuclear units. The 1997 Electric Power Act confirms that the reactors will never be put into operation, but Spain has not ruled out nuclear power as an option for future capacity needs. With rapidly rising energy consumption and CO_2 emissions, and the enormous challenge of meeting the Kyoto target, the nuclear option remains very important. To keep this option viable, appropriate nuclear waste management is essential. Progress on, and timely implementation of, the current Spanish nuclear waste plan is necessary.

Science and technology policies and priorities are defined in the National Plan for Scientific Research, Development and Technological Innovation for the period 2000-2003. It is the task of the new Ministry of Science and Technology to manage, evaluate and follow up on national policy in science and technology, including energy. The strategic objectives for R&D in the energy field are defined by the National Energy Programme (PROFIT-Energia) within the National Plan. The programme has been prepared with the co-operation of the former Ministry of Energy and Industry (now the Ministry of Economy) and the major actors in the energy R&D sector. For energy research and development to be effective, close communication among governmental organisations and other stakeholders is essential. Currently, no instrument exists to evaluate the performance of energy research projects. There are areas in energy where continuous and long-term R&D is necessary, such as developing new technologies for renewables. In the energy field, international co-operation can bring significant benefits.

RECOMMENDATIONS

The following are the actions recommended for the Spanish government:

General Energy Policy

- ☐ Continue to review supply-demand projections, especially in light of the sharp growth of demand and progress in liberalisation.

- ☐ Enhance co-ordination of energy-related policies among different ministries and regional authorities in order to improve the coherence of energy policies. Consistency should be sought in the measures taken by the autonomous regions.
- ☐ Ensure that the National Energy Commission can collect all necessary information to carry out its regulatory task independently.
- ☐ Consider how to increase the number of energy market players to stimulate competition further.
- ☐ Ensure that the conditions set for foreign ownership of energy companies do not limit effective competition.
- ☐ Review tax policies to prevent possible market distortion and send the right signals to consumers. For example, address oil market distortions by increasing taxes on diesel fuel to reduce the price differential between gasoline and diesel.

Energy and the Environment

- ☐ Speed up the development of the national Kyoto implementation plan; the plan should identify priority measures based on their potential contribution towards meeting the target in cost-effective ways.
- ☐ Consider using the flexible instruments under the Kyoto Protocol and encourage private initiatives to do so; study the feasibility of using economic instruments, such as introducing a CO_2 tax and restructuring the energy taxes, to reach the Kyoto target and to address external costs, particularly environmental costs.
- ☐ Monitor emissions reduction policies closely.
- ☐ Encourage autonomous regions to formulate their policies for CO_2 emissions reductions in line with national policies.
- ☐ Promote the use of alternative transport fuels for energy efficiency and environmental benefits.

Energy Efficiency

- ☐ Establish a new, coherent and comprehensive energy efficiency programme to help slow growth in energy demand in all sectors; ensure that the measures are cost-effective and consistent with their objectives, and that the programme sets priorities, on both the supply and demand sides.
- ☐ Regularly verify compliance with building codes, in both new and retrofitted buildings.
- ☐ Monitor systematically the performance of measures taken.

Electricity, Co-generation and Nuclear Power

- ☐ Encourage efforts to build new interconnections with neighbouring countries and increase the capacity of existing ones.
- ☐ Ensure that alliances between the gas and electricity companies are fully in line with market liberalisation and do not prevent new entries.
- ☐ Ensure efficiency and transparency in electricity tariff-setting for the captive markets; efficiency gains in generation and network operation should be reflected in end-user prices.
- ☐ Make sure that capacity payments and subsidies under the special system function effectively to enhance efficiency.
- ☐ Review subsidies for co-generation with a view to phasing them out fully.
- ☐ Assist in defining technical details for opening the market for small consumers and help them prepare for full market liberalisation in 2003.
- ☐ Assess the impact that retiring nuclear reactors would have on energy security, diversity of energy supply, the economy and the environment.
- ☐ Assess the extension of the operating lives of existing nuclear reactors.
- ☐ Ensure that progress is made in defining options and formulating a plan for the final disposal of high-level radioactive waste; ensure timely implementation of the programme for siting and building a centralised interim storage facility for high-level radioactive waste that is needed by 2010.

Natural Gas

- ☐ Monitor the growth of the gas sector and investigate the possible effects of a major gas supply disruption, using cost-benefit analysis and taking into account the consequences to interruptible consumers and gas-fired power plants; set up an emergency plan.
- ☐ Encourage the construction of new liquefied natural gas terminals and gas network interconnections with neighbouring countries, and augment the capacity of existing interconnections and terminals.
- ☐ Complete promptly the regulatory framework for third party access to gas networks, liquefied natural gas terminals and storage facilities.
- ☐ Ensure that the enforcement of the 60% cap on natural gas imports from a single country does not become an obstacle for new entrants.
- ☐ Assist in defining the technical details for opening the market for small consumers and help them prepare for full market liberalisation in 2003.
- ☐ Ensure transparency and efficiency in gas tariff-setting for captive markets during the transition period; efficiency gains should be reflected in end-user prices.

Oil

☐ Set a clear time frame for implementing legislation for increasing competition.

☐ Consider steps to facilitate new entries in the distribution of liquefied petroleum gas.

☐ Continue monitoring compliance with oil product standards to avoid tax fraud and quality problems.

Coal

☐ Continue restructuring the coal industry, cut subsidies, eliminate other distortions and progressively decrease the industry's size, while limiting welfare and regional effects by industrial restructuring in the affected regions.

Renewables

☐ Elaborate and implement co-ordinated initiatives and measures, including adequate public funding as proposed by the Plan for the Promotion of Renewable Energy in Spain.

☐ Co-ordinate efforts of the different actors in the sector, while respecting the role of the autonomous regions and local governments in the implementation of the Plan for the Promotion of Renewable Energy in Spain.

☐ Study the benefits of developing a nation-wide green certificate system, as part of a least-cost strategy to achieve the Kyoto objectives.

Energy Research and Development

☐ Ensure co-ordination among the Ministry of Science and Technology, the General Department for Energy and Mining Policy, and research organisations.

☐ Continue adequate support for the development and demonstration of clean coal technologies, and for research on final management of high-level radioactive waste and on renewable and alternative energy sources.

☐ Develop tools to assess and evaluate the performance of R&D activities.

☐ Increase participation in IEA Implementing Agreements, particularly in the energy end-use programmes, and continue involvement with the research activities of the European Union.

2

CONDUCT OF THE REVIEW

REVIEW TEAM

The International Energy Agency (IEA) 2001 in-depth review of the energy policies of Spain was undertaken by a team of energy policy specialists drawn from the Member countries of the IEA. The team visited Spain from 29 January to 2 February 2001 for discussions with the Energy Administration and energy industries.

Members of the team were:

Mr Hidenobu Sobashima (team leader)
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Head, Country Studies Division
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Desk Officer – Spain, Country Studies Division
International Energy Agency

Lea Gynther managed the review and drafted the report. Monica Petit and Bertrand Sadin prepared the figures.

The team consulted with the following organisations:

- Association of Petroleum Distributors (AOP)
- Consumer Association of Spain (UCE)
- Ministry of Economy, General Department of Energy and Mining Policy
- Electricity Association (UNESA)
- Enagas
- Endesa
- Gaz Natural
- Iberdrola
- Institute for the Diversification and Saving of Energy (IDAE)
- Institute for the Restructuring of Coal Mining and Alternative Development of Mining Regions
- National Energy Commission (CNE)
- OMEL (Electricity Market Operator)
- Red Electrica (Transmission System Operator)

The assistance and co-operation of all participants in the review are gratefully acknowledged.

REVIEW CRITERIA

The *Shared Goals* of the IEA, which were adopted by IEA Ministers at their 4 June 1993 meeting held in Paris, provide the evaluation criteria for in-depth reviews conducted by the Agency. The *Shared Goals* are set out in Annex B.

3

GENERAL ENERGY POLICY

OVERVIEW

Spain comprises 17 autonomous regions, each with a local parliament. In 1998, the population was 39.4 million and in 2000 the population growth rate was estimated at 0.11%. Spain is the second largest country in Europe, with a total area of 505,000 km^2. The country 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, thanks to a sharp decline in interest rates prior to joining the European Monetary Union, sound fiscal policy and wide-ranging structural reforms. Average annual GDP growth was 3.4% per year from 1995 to 1999. Since 1998, inflation has averaged 2.25%, one of the lowest rates in the history of Spain. Unemployment remains high; it was 15% of the labour force at the end of 1999, but has steadily decreased recently. Per capita income has grown sharply in the past decade, and reached US$ 18,100 in 1999, using current purchasing power parities; yet this was still 19% under the OECD average.

ENERGY POLICY OBJECTIVES

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 main energy policy goals in this plan were security of supply, enhancement of domestic energy sources, diversification of supply, minimisation of costs, energy savings and efficiency, adaptation to EU rules and the incorporation of environmental considerations in energy policies. The PEN91 has been mostly superseded by the Electric Power Act (1997) and Hydrocarbons Act (1998). With the aim of using market forces more effectively, the government decided not to develop new energy plans for all energy sectors, but only an indicative plan for renewables (see Chapter 10).

The objectives of Spain's current energy policy are:

- Ensuring the competitiveness of energy production and industries.
- Reducing the cost of energy for final consumers.
- Providing adequate quality.
- Addressing environmental concerns associated with the transformation and use of energy by improving energy efficiency, reducing greenhouse gas emissions and promoting clean energies and new technologies.

Figure 1
Map of Spain

INSTITUTIONAL FRAMEWORK

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 to the Office of the State Secretary of the Economy, Energy and Small and Medium-sized Enterprises located in the Ministry of Economy. Within this office is the General Department of Energy and Mining Policy which consists of five sub-directorates, for hydrocarbons, electricity, nuclear energy, energy planning, and mining. The General Department of Energy and Mining Policy has the following responsibilities:

- Setting rules relating to energy and mining matters.
- Making proposals on the regulation of the tariff structure, prices of energy products and taxation.
- Making proposals for conserving and saving energy, promoting renewable energy and developing new technologies relating to energy and mining.
- Proposing and enforcing measures to ensure energy supply.

Within this office, there is also the Institute for the Restructuring of Coal Mining and Alternative Development of Mining Regions. It is responsible for the restructuring of the coal industry and for promoting economic activities in the mining regions to create alternative employment opportunities.

The Strategic Reserves Corporation (CORES), which is also located in the State Secretary's office, is responsible for ensuring the security of oil and the supply of oil products in accordance with Spain's international commitments. The two basic principles governing its operation are the fair distribution of costs among all agents in the sector, and transparency in setting costs. All operators authorised to distribute oil and oil products are obliged to store oil as part of Spain's commitments to IEA and EU stock requirements and all participate in CORES.

The Nuclear Safety Council (CSN) is responsible for monitoring safety of the construction and operation of nuclear power facilities. It reports directly to the parliament every year and it is independent of the government.

In 1997, the Electric Power Act established the National Electric Regulatory Commission (CNSE) which replaced the National Electricity System Commission (CSEN) set up in 1995. The Hydrocarbons Act of 1998 then created the National Energy Commission (CNE) to take over the regulatory duties of the CNSE, which had been extended to cover the natural gas and oil sectors, over and above the electricity sector.

The CNE is composed of a board of nine commissioners, including a chairman and vice-chairman. It works closely with the Electricity Consultative Board and the Hydrocarbons Consultative Board. The total number of CNE staff, including the

Board of Commissioners, was 116 at the end of 2000. The annual budget of about Pta 1.5 billion[1] is financed through electricity distribution charges.

The commissioners, appointed by the Minister of Economy, serve for a fixed six-year term. The mandates are irrevocable and the government cannot shorten the terms except under clearly defined circumstances, such as proven corruption. The candidates are discussed in the parliament before being appointed. The commissioners are not allowed to work in the energy sector for two years after they have left the commission. The Electricity Consultative Board and Hydrocarbons Consultative Board are advisory bodies composed of representatives of the central government, regional governments, market operators, consumers and other social and environmental groups. The commission is required to consult with the consultative boards on legislation and tariff-related issues, but it is not required to follow the advice given.

The central government has general jurisdiction over energy issues, especially those that concern the entire country, such as tariffs and taxes. The government is also responsible for 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 (see Table 1). Furthermore, they implement many of the energy policies defined by the central government.

Table 1
Division of Responsibilities for Energy Policy between the Government and the Autonomous Regions

Government	*Autonomous regions*
■ basic energy legislation; ■ power plants over 50 MW; ■ tariffs; ■ energy taxation; ■ energy transmission planning; ■ energy R&D; ■ the nuclear fuel cycle and related R&D programmes, as well as research in the field of nuclear fusion; ■ all issues under the responsibility of autonomous regions that affect more than one region.	■ permits and licences for co-generation and the use of renewable energy facilities under 50 MW; ■ environmental issues related to energy production and use; ■ environmental taxation.

Source: Energy Administration/Ministry of Economy.

1. On average in 2000, one Spanish peseta (Pta) = US$ 0.0055 or €0.060.

PRIMARY ENERGY SUPPLY

In 1999, total primary energy supply (TPES) in Spain was 118.5 Mtoe. TPES has grown at an average annual rate of 3% over the past decade, which is considerably more than the IEA average of about 1.4% (see Figure 2). Domestic energy production increased rapidly in the 1970s and 1980s, reaching 34 Mtoe (38% of TPES) in 1990 (see Figure 3). It has decreased to 30.7 Mtoe (26% of TPES) in 1999. The major contributor to energy production is nuclear power, followed by coal, hydro and other renewable energy sources. Spain has some oil and gas resources but they are almost completely depleted.

FINAL ENERGY CONSUMPTION

Total final energy consumption (TFC) was 83.2 Mtoe in 1999, which represents average annual increases of 3.4% since 1990, when it was 61.4 Mtoe. In 1999, final energy consumption in the transport sector was 32.7 Mtoe (39%); in industry, 30.3 Mtoe (36%); in the residential sector, 11.9 Mtoe (14%); in the services sector, 5.9 Mtoe (7%); and in agriculture it was 2.2 Mtoe (3%).

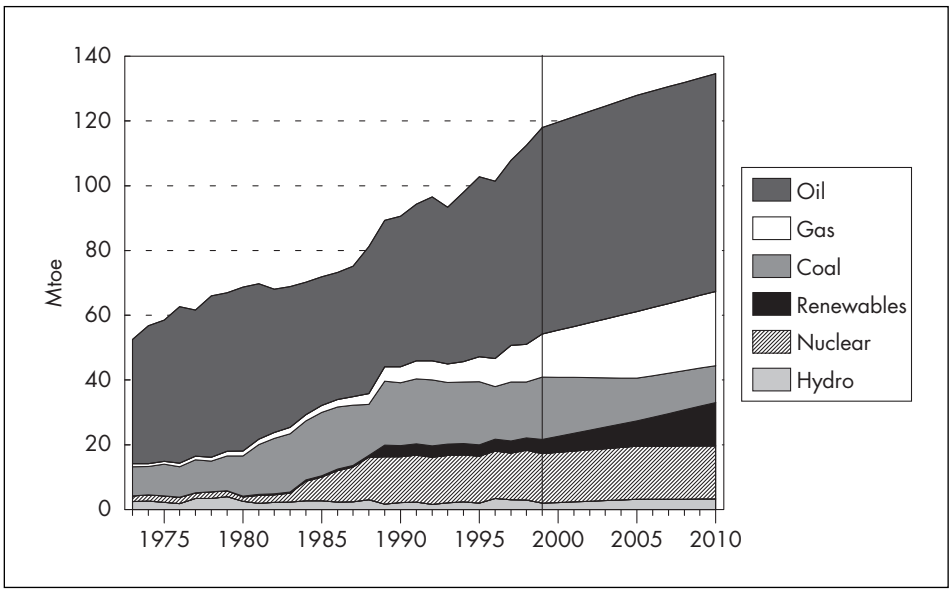
In 1999, oil accounted for 64.2% of TFC; electricity, 18.3%; natural gas, 12.1%; combustible renewables and wastes, 3.7% and coal 1.6%. The share of each fuel in TFC remained basically stable during the 1990s, except for natural gas, whose share in 1990 was lower (7.5%) and for coal, which was higher (5.3%).

ENERGY FORECASTS

In 1999, the study *Energy in Spain: 1995–2020*[2] presented two scenarios, the Trend Scenario and the Basic Saving Scenario, to estimate energy consumption and associated CO_2 emissions until 2010. The Trend Scenario does not assume any major changes in policies. The main variables are population and economic growth and changes in energy prices. This scenario assumes that changes in the energy sector occur independently, without significant modifications in energy efficiency or environmental policies. The Basic Saving Scenario foresees intensified energy efficiency and environmental policies together with an increase in fuel prices. The TPES in 2010 is projected to be 149 Mtoe in the Trend Scenario and 135 Mtoe in the Basic Saving Scenario, compared to 118.5 Mtoe in 1999. These estimates correspond to average growth rates of 2.1% and 1.2% respectively, which are much lower than the actual average growth rate of 3% in the 1990s.

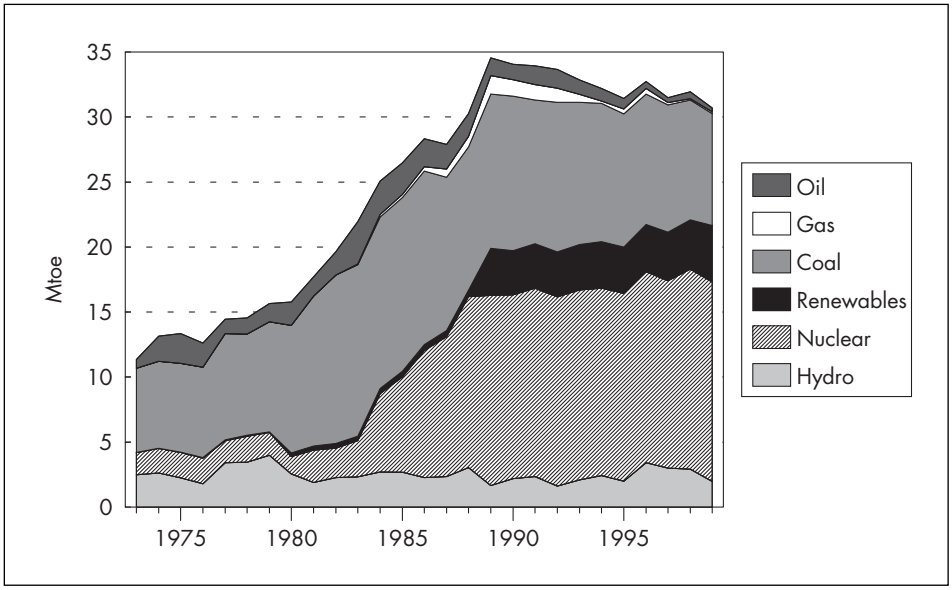
2. Study by the Institute for the Diversification and Saving of Energy (IDAE).

Figure 2
Total Primary Energy Supply, 1973-2010



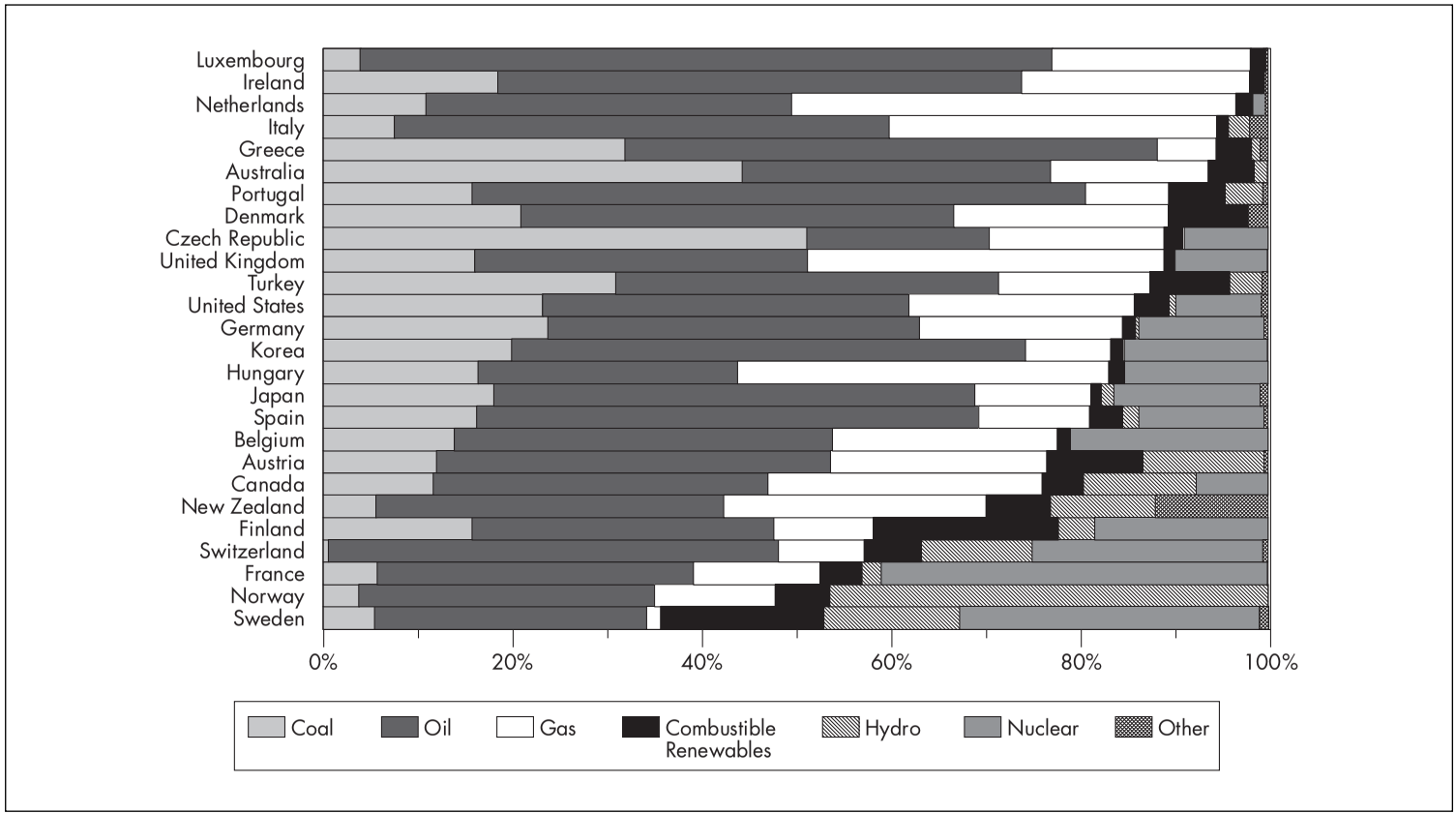
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Figure 3
Energy Production by Fuel, 1973-1999



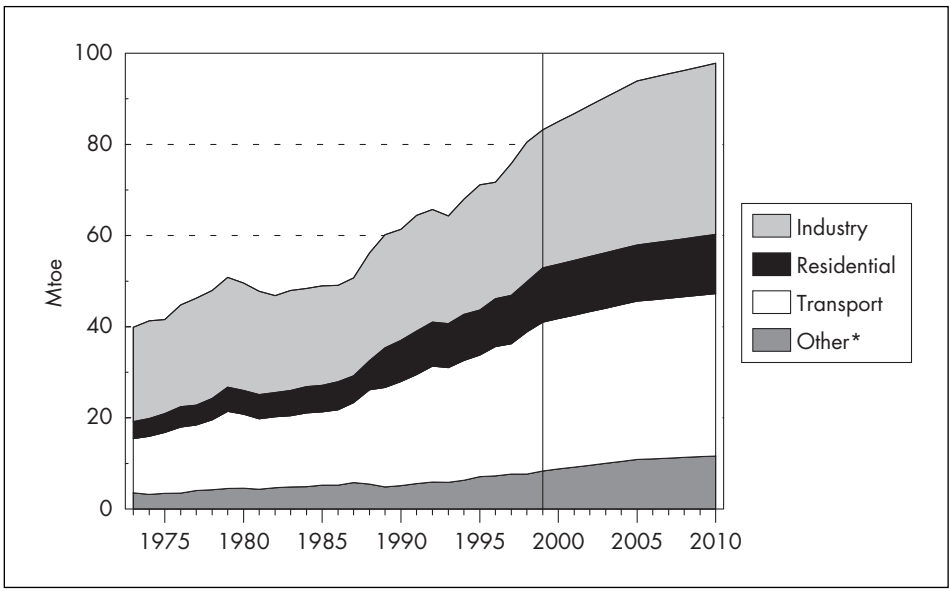
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Figure 4
Total Primary Energy Supply in IEA Countries, 2000



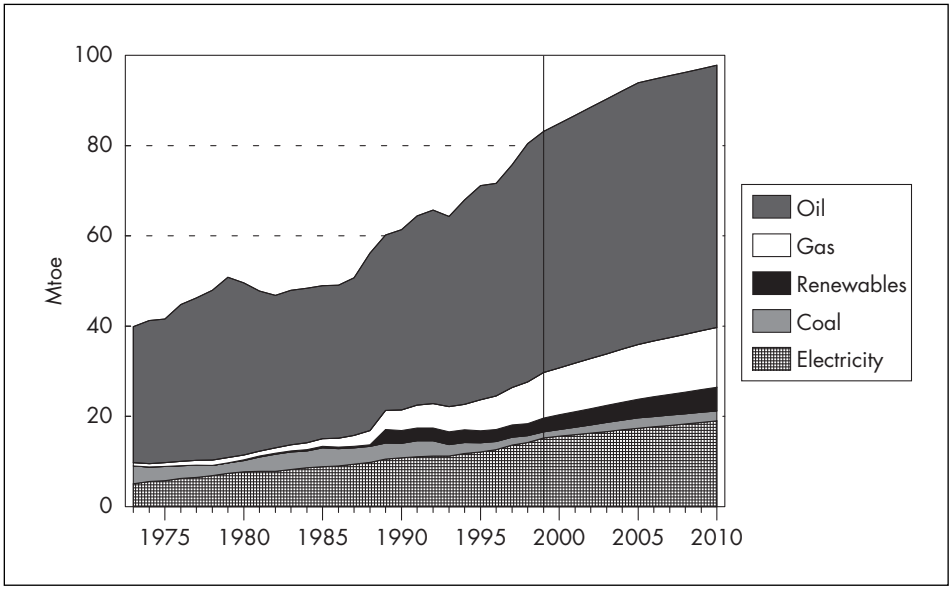
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001.

Figure 5
Total Final Consumption by Sector, 1973-2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Figure 6
Total Final Consumption by Fuel, 1973-2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

ENERGY TAXES AND PRICES

Energy taxes are set by the central government, but municipalities can set local taxes on electricity and gas. All consumers pay a 1.5% municipal tax for electricity. Residential and other small consumers also pay a municipal tax of 1.5% on natural gas. As the municipal taxes are considered to be a cost element, they are quoted as part of the pre-tax prices and not as separate taxes. The general VAT rate is 16%, with the exception of LPG for which the tax was reduced to 7% in October 1999 to limit inflation.

The government sets electricity tariffs and price ceilings for natural gas for captive consumers and price ceilings for some LPG supplies. Large electricity consumers have the option of staying in the regulated market. Small electricity and gas consumers will also be granted this option starting in 2003. However, to enhance competition, the government has decided to remove this option for large consumers in 2007.

Table 2
Energy Taxes in Spain in 1999

Sector/Fuel	*Excise tax* *Pesetas/unit*	*VAT* *%*
Households/electricity	0.94/kWh[1]	16
Households/natural gas	0[1]	16
Households/light fuel oil	13,097/1,000 litres	16
Households/coal	..	16
Households/gasoline, leaded	67.35/litre	16
Households/gasoline, unleaded	61.84/litre	16
Households/diesel	44.90/litre	16
Liquefied petroleum gas in a 12.5 kg cylinder	1,227/kg	16
Industry/electricity	0.42/kWh	0
Industry/natural gas	0	0
Industry/light fuel oil	13,097/1,000 litres	0
Industry/heavy fuel oil (not dependent on sulphur content)	2,235/tonne	0
Industry/coal	..	0
Industry and commercial/diesel	44.9/litre	0

.. not available.

[1] Does not include municipal taxes which are applied to households.

Sources: *Energy Prices and Taxes*, IEA/OECD Paris, 2001, and Energy Administration/Ministry of Economy.

CRITIQUE

During the 1990s, the energy sector in Spain underwent significant change. Energy demand grew rapidly. At the same time, the electricity, gas and oil markets were rapidly liberalised. The diversification of supply sources, initiated in the 1980s, has made progress. The main challenges for the coming decade will be to ensure an energy supply sufficient to satisfy growing energy demand, to curb CO_2 emissions to meet the Kyoto target, and to introduce full liberalisation in the electricity and gas markets.

Energy demand is expected[3] to continue to grow, but at half the rate of the past decade. Spain has had only moderate success in demand-side management. Reducing energy demand will be difficult; additional and powerful measures will be necessary. The government should review demand projections regularly, assess the performance of existing policies, and adjust them to meet national energy policy objectives.

The institutional framework for dealing with energy matters is somewhat complex. Three separate ministries are involved: the Ministry of Economy, the Ministry of the Environment and the Ministry of Science and Technology, but most of the responsibilities concerning energy belong to the General Department of Energy and Mining Policy of the Ministry of Economy (hereafter called the Energy Administration). In addition, several institutions have been established to handle specific energy issues and regional authorities have significant responsibilities for dealing with energy matters of local interest. Co-ordination among the different institutions is essential for the formulation of effective policies and for timely implementation. The government should ensure that the policies adopted by the autonomous regions are consistent with national policies.

About 80% of electricity generation and distribution is in the hands of two companies (Endesa and Iberdrola), and the Gas Natural Group is the dominant player in the gas market, making the energy markets highly concentrated. Legislation for market liberalisation has created a market environment which allows for new entrants. Nevertheless, true competition is developing very slowly. It is encouraging that the government respected a recommendation by the National Energy Commission to impose very strict conditions on a proposed merger of Endesa and Iberdrola. The merger was called off. The government is strongly encouraged to continue the practice of heeding the advice of the CNE. However, the CNE has experienced difficulty in collecting information from the markets, and this problem should receive attention. By law, the CNE can collect information from market players through questionnaires called "circulars"; in practice, using "circulars" has proved difficult and time-consuming.

Most restrictions on foreign ownership in the Spanish energy industry have been removed. The only remaining regulations apply to foreign publicly-owned energy companies whose shares and voting rights in Spanish companies are limited to 3%. This limitation has been set to ensure reciprocity, that is, to protect the

3. Based on country submission, 2000.

national privatised utilities from being acquired by foreign companies that have not yet been privatised. The case of foreign companies with minority state-ownership is unclear.

Taxes on oil products and natural gas are the same for all consumers, but small consumers still pay higher taxes on electricity than does industry. Moreover, the taxes on natural gas are lower than those for oil products. Current tax policies distort the market. At a time when the gas market was underdeveloped, taxes on natural gas were kept low to provide incentives to invest in new infrastructure. Now that the gas infrastructure covers wide areas of the country, reaching four million consumers, there is less need for such incentives. There is also a tax differential between gasoline and diesel, which is hard to justify, as there are no environmental or other externalities which justify the use of automotive diesel over gasoline. Because of the tax break for diesel, 60% of new cars have diesel engines and the consumption of diesel is increasing, whereas that of gasoline has stabilised. The government should also note that lower taxes on heating oil, compared to diesel, can lead to tax fraud when heating oil is mixed with diesel; regular quality checks are therefore necessary (see Chapter 4.)

RECOMMENDATIONS

The Governement of Spain should:

- ☐ Continue to review supply-demand projections, especially in light of the sharp growth of demand and progress in liberalisation.
- ☐ Enhance co-ordination of energy-related policies among different ministries and regional authorities in order to improve the coherence of energy policies. Consistency should be sought in the measures taken by the autonomous regions.
- ☐ Ensure that the National Energy Commission can collect all necessary information to carry out its regulatory task independently.
- ☐ Consider how to increase the number of energy market players to stimulate competition further.
- ☐ Ensure that the conditions set for foreign ownership of energy companies do not limit effective competition.
- ☐ Review tax policies to prevent possible market distortion and send the right signals to consumers. For example, address oil market distortions by increasing taxes on diesel fuel to reduce the price differential between gasoline and diesel.

4

ENERGY AND THE ENVIRONMENT

CLIMATE CHANGE

Emission Targets and Trends

In order to achieve the 8% reduction in greenhouse gas (GHG) emissions to which the EU is committed under the Burden-Sharing Agreement[4] of the Kyoto Protocol, Spain must ensure that its GHG emissions do not exceed the 1990 level (306 Mt of CO_2 equivalent) by more than 15% during 2008-2012.

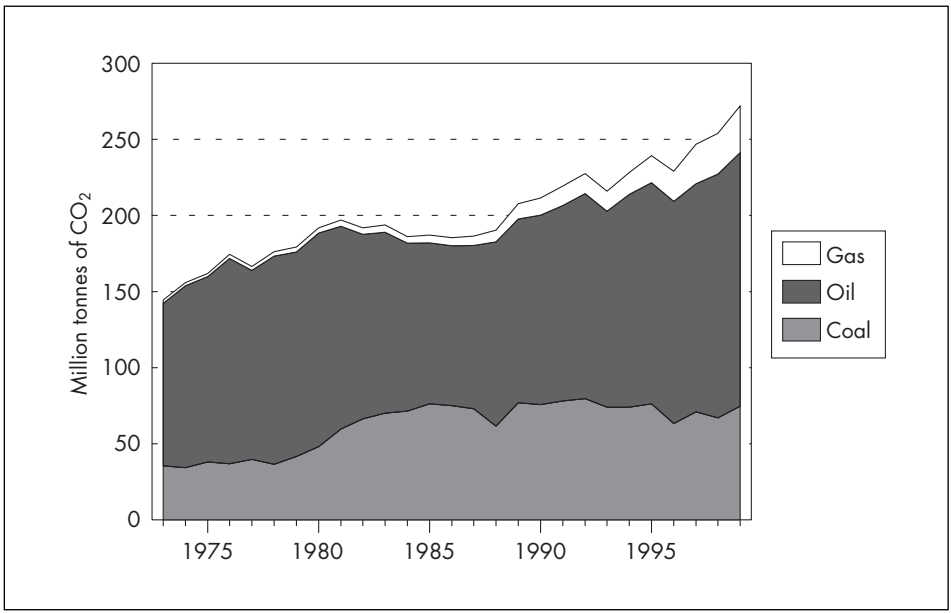
Spain's GHG emissions have grown with its economy. According to IEA statistics, Spain's energy-related CO_2 emissions have grown by 28.6% from 1990 to 1999. According to the United Nations Framework Convention on Climate Change (UNFCCC) statistics, total GHG emissions in Spain were 369 Mt in 1998, which is already 20.9% above the 1990 level, and total CO_2 emissions were 20.8% above the 1990 level. Meeting the Kyoto target will require that total GHG emissions be reduced by 17 Mt from the 1998 level.

Energy conversion and use were responsible for about 70% of total GHG emissions and about 90% of CO_2 emissions during 1990-1999. The transport sector has been the main contributor to the increase in CO_2 emissions; emissions from all the other sectors have remained almost stable during the last 20 years. Oil is the most important fuel contributing to CO_2 emissions, followed by coal. The emissions from gas combustion have been growing steadily. However, in the industrial sector and the residential and services sectors, the use of gas to replace coal and oil has slowed down the growth of CO_2 emissions. Emissions intensity, as measured by energy-related CO_2 emissions per unit of GDP, decreased in the 1980s but has remained stable through the 1990s when both CO_2 emissions and GDP were growing.

In 2000, a study called "Projection for CO_2 Emissions from Energy: Scenarios 2010" (*Prospectiva Energética y CO_2: Escenarios 2010*) was published by the Institute for the Diversification and Saving of Energy (IDAE) and the Ministry of Science and Technology. It was primarily based on the long-term energy projections model for 1995-2020, with emission estimates being based on the energy forecasts from the study *Energy in Spain: 1995-2000* (see Chapter 3). By 2010, emissions are estimated to exceed the 1990 level by 48% in the Trend Scenario, and by 28% in the Basic Saving Scenario (the base scenario).

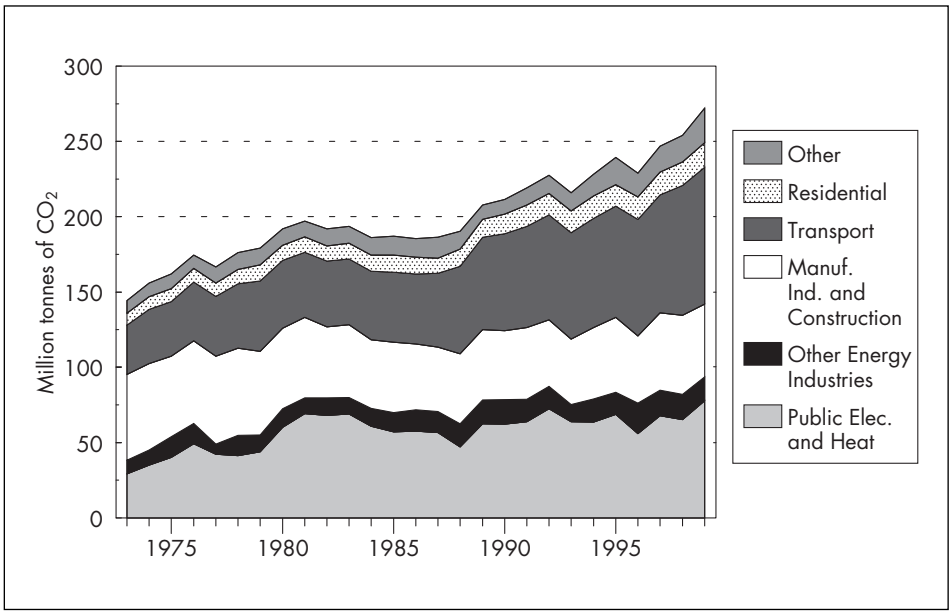
4. The Burden-Sharing Agreement covers CO_2, CH_4, N_2O, PFCs, HFCs and SF_6.

Figure 7
CO_2 Emissions by Fuel, 1973-1999



Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2001.

Figure 8
CO_2 Emissions by Sector, 1973-1999

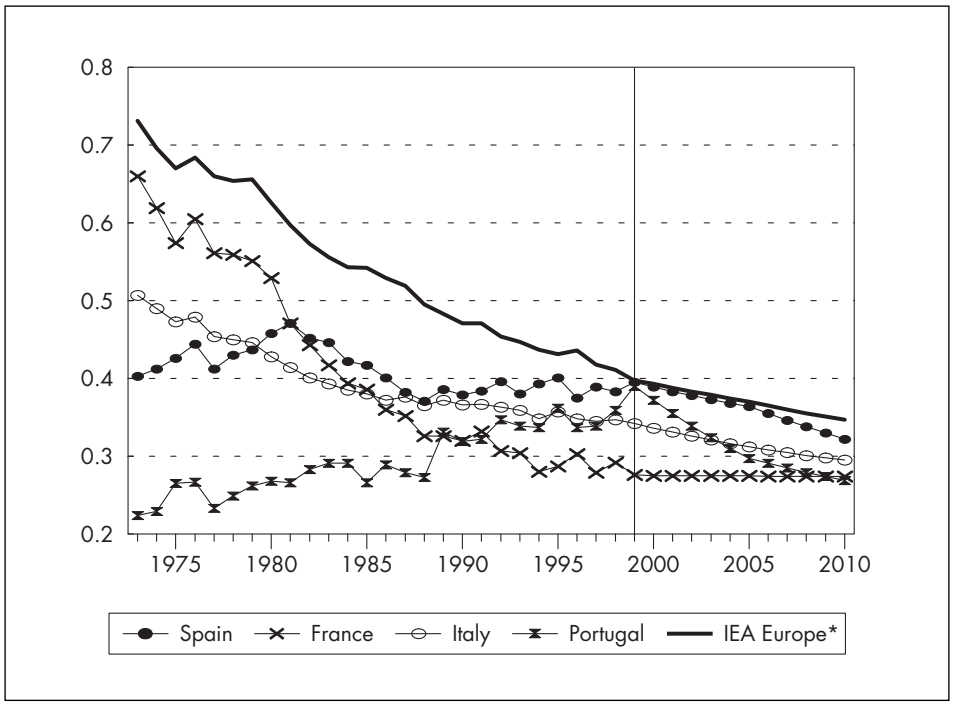


Source: *CO_2 Emissions from Fuel Combustion*, IEA/OECD Paris, 2001.

Figure 9

Energy-Related CO_2 Emissions per GDP(PPP) in Spain and in Other Selected IEA Countries, 1973-2010

(kilogrammes CO_2/US$ using 1995 prices and purchasing power parities)



* excluding Norway from 1999 onwards.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001; *National Accounts of OECD Countries*, OECD Paris, 2001; and country submissions.

Institutional Framework

The central government formulates the policies for mitigating climate change. However, the regional governments have the authority to adapt policies to their own geographic area as long as they do not distort the intent of the national policies. The regional governments also play an important role in the implementation of policies in their region, such as licensing installations for producing energy from renewables and CHP, and promoting energy efficiency and transport planning.

The National Climate Commission was created in 1992 when Spain launched its climate change abatement strategy. The commission ceased to exist in May 1996 when the Ministry of the Environment was created to co-ordinate environmental policies and propose environmental legislation. The National Climate Council (CNC) was created in February 1998 to formulate a Spanish climate change strategy

and to co-ordinate work between the central and regional governments and among different government agencies. The Minister of the Environment chairs the Council, and the members represent the different ministries that play a role in the implementation of emissions reduction measures. The representative of the Energy Administration is the State Secretary of the Economy, Energy and Small and Medium-sized Enterprises. The council is composed of four working parties: industry and energy, transport, agriculture and forests, and institutional relations.

A new Royal Decree (376/2001) established the Spanish Climate Change Prevention Office (*Oficina Española del Cambio Climático, CCPO*) in April 2001. It will be located in the Ministry of the Environment. The composition and structure of the CCPO have not yet been defined. Its tasks are the following:

- Act as the Secretariat of the National Climate Council for technical and management tasks.
- Follow up on UNFCCC decisions and promote Spanish policies and measures to meet the commitments under the UNFCCC and the Kyoto Protocol.
- Act as the focal point of the Ministry of the Environment in matters related to climate change.
- Represent the Ministry of the Environment in international forums.
- Advise different departments of the Spanish government on climate change matters.
- Collaborate with and provide advice to autonomous regions.
- Develop a relationship with non-governmental organisations and other stakeholders to involve them, for example, in planning new initiatives.

Policies and Measures

Past policies applied to the reduction of CO_2 emissions in the energy sector have relied heavily on the Energy Saving and Efficiency Plan (*Plan de Ahorro y Eficiencia Energética,* PAEE), established by the PEN91 in 1992. The plan set the objective that energy-related CO_2 emissions should not increase by more than 25% between 1990 and 2000. It projected that if the additional measures it introduced were not implemented, emissions would grow by 45% over this period. The plan was divided into four programmes: fuel substitution (replacement of other fossil fuels by natural gas), renewables, co-generation and energy saving. Each programme introduced a set of measures. The most commonly used measures were fiscal. Premiums were paid to co-generators and to those using renewables for power generation; taxes on natural gas were set at a lower rate than for oil; and energy

efficiency projects were given subsidies and soft loans. The programmes were sufficiently effective to limit the growth of CO_2 emissions to 28.6% between 1990 and 1999.

The Ministry of the Environment, in co-operation with the Ministry of Economy, is currently preparing the national Kyoto implementation plan. However, no clear time frame for the completion of the plan has been set. The question of target-setting by sector, by region, or possibly a combination of these, is still under consideration. However, the policy papers "Policies and Measures for the Fight Against Climate Change: A First Step" and the "Plan for the Promotion of Renewable Energy in Spain" have been completed.

"Policies and Measures for the Fight Against Climate Change: A First Step" was published by the CNC in 1998 to propose policies and measures for various sectors. The report estimates GHG emissions for 2010 under the assumption that only existing, or already planned, policies and measures are taken. These policies include replacement of coal and oil by natural gas in industry, increasing the use of co-generation and renewables, and more intense efforts to develop energy efficiency measures in all sectors. With these measures in place, total GHG emissions from all sectors were estimated to exceed the 1990 level by 20.9% in 2010, which is above the Kyoto target level. To help reduce this gap, the report includes a list of 77 technologies that could be used to limit emissions in all sectors, with a preliminary analysis of their cost-effectiveness. The changes proposed for the energy sector were: increasing the number of combined cycle power plants; improving the performance and extending the life of nuclear power plants; applying the EU IPPC Directive[5]; and a greater use of renewables. The changes proposed for the industrial sector include modernisation of processes, promotion of energy efficiency, changing the fuel mix, and co-generation. Currently it is not clear which will be the priority measures applied to improve energy efficiency, but the government will elaborate a new energy efficiency plan in the near future. Both renewables and co-generation will be promoted by premiums under the "special system" (see Chapters 6 and 10). According to an IEA inventory[6] there are seven measures to mitigate climate change in Spain – four implemented and three planned – which is less than half of the average number of such policies being used in OECD countries.

The "Plan for the Promotion of Renewable Energy in Spain", published in 1999 (see Chapter 10), is important in providing a basis for formulating national strategies

5. The IPPC Directive 96/61/EC (Integrated Pollution Prevention and Control Directive) of 1996 sets common rules on environmental permitting for industrial installations of facilities and equipment. Almost all installations, except for only the smallest units, are required to obtain an environmental permit from the environmental authority. "Integrated" means that the permits must take into account all aspects of environmental performance of the plant: emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, risk management, *etc*. As from October 1999, the directive applies to all new installations, and eight years later it will apply to all existing installations that intend to carry out changes that may have significant negative effects on people or the environment.
6. *Dealing with Climate Change. Policies and Measures in IEA Member Countries*. IEA/OECD Paris, 2000.

for reducing CO_2 emissions. If renewable energy sources are increased as targeted in the plan and replace power and heat production from coal, CO_2 emissions would be reduced by 41.5 Mt, and by 19.5 Mt if they replace combined cycle gas turbines. In forecasts included in the plan, the total primary energy supply is estimated to be 135 Mtoe in 2010, and the related CO_2 emissions from energy transformation and use are expected to reach 289 Mt.

OTHER ENVIRONMENTAL ISSUES

The government has prioritised improving and managing air quality to comply with the relevant EU directives. The EU directive on large combustion plants (88/609/EEC), which sets emission standards for SO_2 and NO_x for new plants and national emission ceilings for existing plants, has been transposed to national legislation. According to the directive, SO_2 emissions should be reduced from the 1980 level by 24% by 1998, and by 37% by 2003. Similarly, NO_x emissions should be reduced by 24% by 1998. PEN91 had set a slightly stricter target for SO_2 emissions from the energy sector than the EU directive. According to PEN91, SO_2 emissions from existing large combustion plants should be reduced by 23% between 1980 and 1990, and by 42% between 1980 and 2000. Based on the emission levels in 1999, it seems that the stricter target for SO_2 was met, and NO_x emissions were reduced by 41% between 1980 and 1996.

CRITIQUE

In 1999, CO_2 emissions from energy transformation and use were 28.6% above the 1990 level. This contributes to the prevailing situation where total GHG emissions are higher than the 15% objective adopted by Spain for the 2008-2012 commitment period of the Kyoto Protocol. Energy consumption increased significantly in many sectors, particularly in the transport sector and residential and services sectors, induced by high economic growth. Energy efficiency improvement in power generation has been more than offset by the sharp increase in electricity consumption, which may have been stimulated by low energy prices in the last decade.

Several studies have been done and targets have been set to promote the use of renewables. These studies admit that the GHG emissions reduction targets have become very challenging, and the existing and currently planned measures for energy saving and renewables are insufficient. Spain is currently preparing the national Kyoto implementation plan, but it is unclear when the plan will be finalised and implemented. To make the challenge of meeting the set targets less difficult, the national plan should be completed as soon as possible. A set of powerful policies and measures are needed to meet the Kyoto commitments.

Past policies applied to CO_2 reduction (co-generation, renewable energy, fuel substitution by natural gas and energy efficiency) were insufficient, although they managed to reduce emissions compared to projections based on scenarios without

these measures. The target set for energy-related CO_2 emissions was not to exceed the 1990 level by more than 25% in 2000; in practice, emissions were 28.6% over the 1990 level in 1999. Though the measures had a promising impact on emissions, no comprehensive analysis of the cost-effectiveness of the measures has been done. It is essential that the cost performance, as well as the emissions reduction potential, of different current and future measures be identified. Those proven effective by the analysis should be included in the national plan to meet the Kyoto target.

A recent study, "Projection for CO_2 Emissions from Energy: Scenarios 2010", evaluated the impact of current policies on the development of CO_2 emissions from energy transformation and use. The study assumed that between 1998 and 2010 the share of renewables in TPES will increase from 6.3% to 12.0% and the share of natural gas from 13.3% to 22.9%. Also, energy efficiency will be enhanced by intensified demand-side management measures and by increasing the use of CHP. In the scenario, CO_2 emissions from energy transformation and use are estimated to exceed the 1990 level by 36.5%. According to the study, given the relative importance of energy transformation and use, the measures introduced so far are not enough to meet the emissions reduction target.

Flexible instruments, such as those envisioned under the Kyoto Protocol as well as other instruments, could bring further reductions. There are several possibilities. The energy companies have already started investigating the possibilities of the emissions trading mechanisms under the Kyoto Protocol, and have manifested a willingness to adopt such approaches[7]. The possibilities for the industrial sector to use emissions trading and other Kyoto mechanisms should be carefully considered. The prevailing energy taxes have been set only for fiscal purposes and do not reflect the externalities of fuels, especially the environmental externalities. The current Spanish fiscal policy for energy and environmental issues is not to financially "punish" technologies that emit more, and instead give financial incentives to cleaner technologies. The implementation of the incentives system, however, does not ensure that the "polluter pays principle" (or the "user pays principle") is respected.

The incentives system is financed through a charge on the price of electricity. Yet end-users do not pay in proportion to their consumption because most of the financing for the incentives is collected from captive consumers. When incentives are used, these need to be carefully balanced to ensure competition among cleaner technologies to enhance efficiency. One option would be to introduce a green certificate system (see Chapter 10). Direct taxation of emissions could pursue both objectives: fair burden-sharing of the cost from externalities and enhanced efficiency in production. Therefore, as part of the mix of measures to be studied, Spain might want to consider adjusting fuel taxes to reflect environmental objectives and introducing a CO_2 tax. One approach could be to allow power generators and other large industrial users of energy to enter cap-and-trade

7. Spanish electricity companies have participated in the first and second CO_2 emissions and electricity trading simulations organised by Eurelectric in 1999 and 2000.

regimes. In the liberalised energy markets, companies may not have sufficient resources to comply with CO_2 objectives by domestic means. Then, a tax could be applied to smaller energy users, such as in the transport, residential and commercial sectors.

For achieving the national Kyoto target, it is essential to ensure the effectiveness of each policy measure that has already been taken or will be taken in the future. Effective monitoring of the progress and analysing the cost-effectiveness of the measures are necessary. These are particularly important in a country where the climate change mitigation policies are formulated by the national government but implementation is likely to be, at least partially, in the hands of the regions. The energy efficiency indicators that have already been developed by IDAE could become a standardised tool to help in monitoring. In addition, updates should be done frequently on the detailed modelling that has been used to estimate future trends under current policies.

As the autonomous regions and the municipalities have an important role in the implementation of many measures, these downstream actions should be in line with national policies. Today, energy planning is not carried out by the government but left to the responsibility of the energy industry. Therefore, it is vital that national and regional governments stay in close communication with the industrial sector to find and implement cost-effective and practical measures.

An institutional framework is necessary to develop and track policy actions in climate change and co-ordinate work between the national and regional governments and non-governmental organisations. Over time, attention will need to be paid to the institutional and policy effectiveness of the Climate Change Prevention Office to ensure that appropriate policies are being implemented.

Spain has been successful in reducing SO_2 and NO_x emissions from energy production. Although total coal consumption has remained steady in the 1990s, SO_2 emissions were reduced by replacing domestic coal, which has a high sulphur content, with imported coal. NO_x emissions could be reduced even further if technologies with lower NO_x emissions, such as fluidised bed technologies for coal combustion, were used. Spain participates in international research on clean coal technologies and is likely to use new technologies with a good emissions reduction potential, such as coal gasification.

Vehicles fuelled by natural gas or LPG produce fewer emissions of SO_2, NO_x and small particles than gasoline or diesel-fuelled vehicles. They also produce fewer CO_2 emissions than gasoline-fuelled vehicles, but may emit more CO_2 than diesel-fuelled vehicles. In some cities, municipal bus companies have already introduced natural gas-fuelled buses in their bus fleet. In Spain, the introduction of gas-fuelled vehicles has only just begun, and the potential for increased use should be investigated. An alternative for natural gas could be LPG, which is a mature technology. The government should ensure that there are no barriers, regulatory or other, for increased use of vehicles fuelled by natural gas.

RECOMMENDATIONS

The Government of Spain should:

- ☐ Speed up the development of the national Kyoto implementation plan; the plan should identify priority measures based on their potential contribution towards meeting the target in cost-effective ways.

- ☐ Consider using the flexible instruments under the Kyoto Protocol and encourage private initiatives to do so; study the feasibility of using economic instruments, such as introducing a CO_2 tax and restructuring the energy taxes, to reach the Kyoto target and to address external costs, particularly environmental costs.

- ☐ Monitor emissions reduction policies closely.

- ☐ Encourage autonomous regions to formulate their policies for CO_2 emissions reductions in line with national policies.

- ☐ Promote the use of alternative transport fuels for energy efficiency and environmental benefits.

5

ENERGY EFFICIENCY

FINAL CONSUMPTION AND ENERGY INTENSITY

Total final energy consumption was 83.2 Mtoe in 1999. Transport had the biggest share (39%), followed by industry (36%), and the residential, services and agricultural sectors (24%).

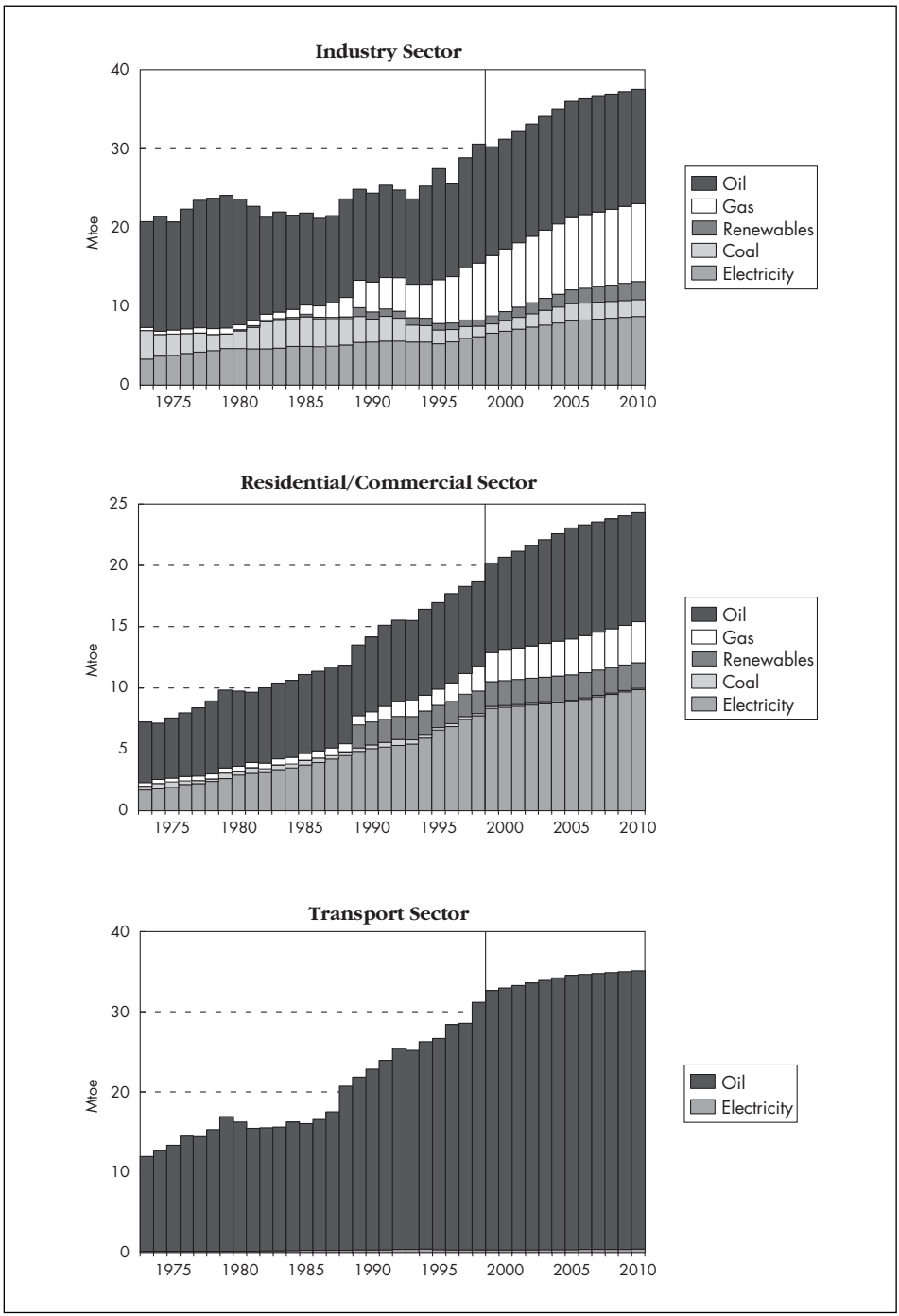
Final energy consumption by the transport sector grew by 43% in 1990-1999, with an average annual growth rate of 4.1%. The reasons for this growth are a larger car fleet, increased average length of trips, more use of cars in urban areas, and bigger average size of vehicles. The total number of vehicles (private cars, lorries, motorcycles) was 33% higher in 2000 than in 1996. Over the last decade, the volume of goods transported by road in national transport grew by 40.2%, and in international transport by 61.4%. The passenger transport volume has also grown rapidly. However, modal change from road to railway is expected to help reduce the volume of goods transported by road in the future. Improvements in the energy efficiency of engines have been partially offset by new equipment, such as air conditioning. The number of vehicles with diesel engines has been growing faster than the number of vehicles with gasoline engines.

Final energy consumption by the industrial sector grew by 24% in 1990-1999. This corresponds to an average annual growth rate of 2.5%, as compared to an economic growth rate of 2.2%. During the rapid increase in industrial production in the late 1990s, the introduction of more energy-efficient production technologies has kept the growth of energy consumption in the industrial sector moderate. Furthermore, there has been a slight structural change in industrial output, a shift from a basic metals industry towards less energy-intensive industries. The chemical and petrochemical industries (31% of industrial consumption) and the non-metallic mineral industries (19%) are still the major industrial consumers.

Final energy consumption in the other sectors, including the residential, services and agricultural sectors, has grown by 43% between 1990 and 1999 -- as much as in the transport sector. Essentially driven by the rise in household income levels, increased energy consumption in the residential sector has mainly resulted from rapid increase in the use of electric appliances, central heating and air-conditioning. The major factors contributing to greater energy consumption in the service sector have been the growing use of electronic equipment and air-conditioning in offices, and the overall growth of the sector, with its increased number of new buildings and bigger workforce. The number of employees in the service sector has grown from 53.1% of the labour force in 1988 to 61.5% in 1998.

Figure 10

Final Consumption by Sector and by Fuel, 1973-2010



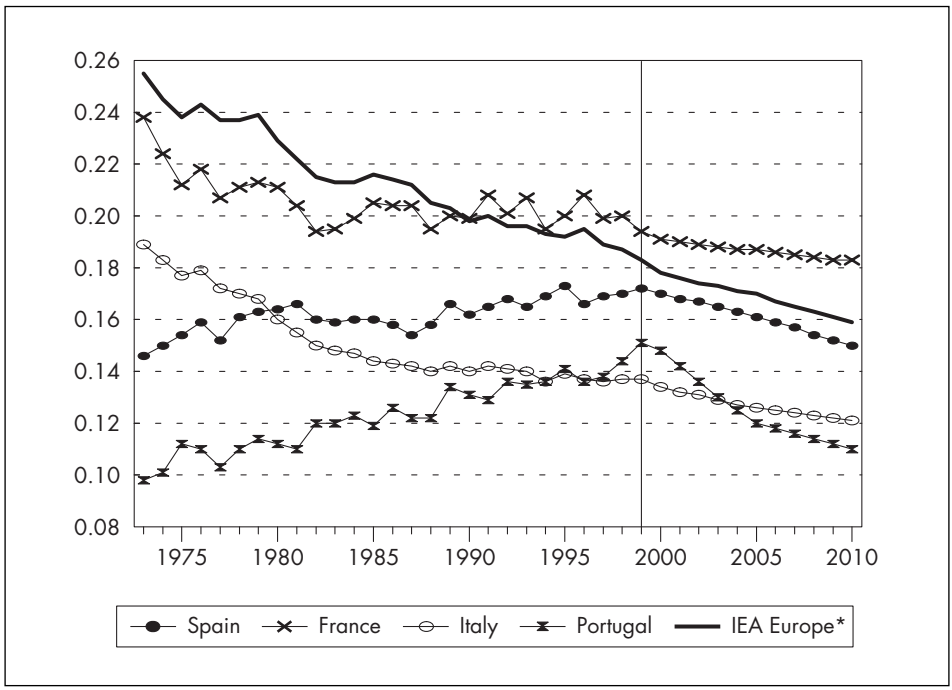
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

The total primary energy supply (TPES) grew by 3% per year from 1990 to 1999. With a marked acceleration at the end of the decade (5-6% per year in 1997-1999), Spain's energy intensity (TPES per unit of GDP) has been slowly rising over the past ten years. The difference in the energy intensity of Spain and the average of IEA Europe has been decreasing and was marginal in 1999. Spain's energy intensity is expected[8] to decrease in the future thanks to energy efficiency policies and structural changes. For example, the energy-intensive steel industry is slowly declining, and consumption in the residential and transport sectors will eventually slow down as the demand for new appliances and cars weakens because the market has become saturated.

Figure 11

Energy Intensity in Spain and in Other Selected IEA Countries, 1973-2010

TPES (Toe)/GDP (thousand US$ at 1995 prices and purchasing power parities)



* excluding Norway from 2000 onwards.

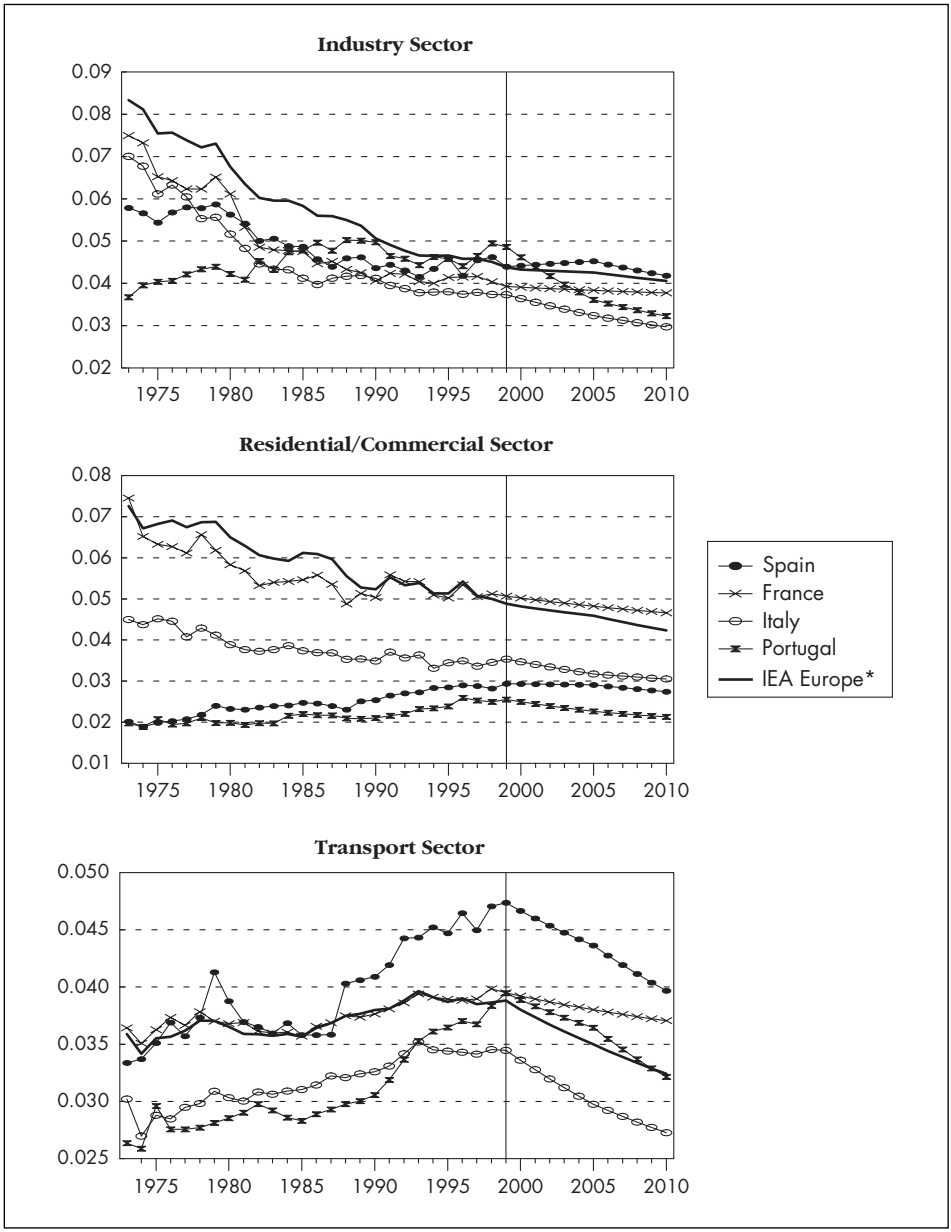
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001; *National Accounts of OECD Countries*, OECD Paris, 2001; and country submissions.

8. The forecast is based on country submission 2000.

Figure 12

Energy Intensity by Sector in Spain and in Other Selected IEA Countries, 1973-2010

Final consumption (Toe)/GDP (thousand US$ at 1995 prices and purchasing power parities)



* excluding Norway from 1999 onwards.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001; *National Accounts of OECD Countries*, OECD Paris, 2001; and country submissions.

INSTITUTIONAL FRAMEWORK

The central government formulates the national energy efficiency policies. However, the autonomous regions can introduce their own policies within their area provided that they are not in contradiction with the national policies. The Institute for the Diversification and Saving of Energy (*Instituto para la Diversificacion y Ahorro de la Energía*, IDAE) plays a consultative role in the policy formulation processes. Implementation of the policies is then carried out by IDAE and the autonomous regions. Both the central government and the autonomous regions provide financial support for projects to improve energy efficiency. Some of the funds are administered by IDAE.

In addition to resources provided by the state and regional budgets, funding from the European Union (*e.g.* global cohesion funds, SAVE for energy efficiency and ENERGY-VFP to promote innovative energy technologies) has been used to support energy efficiency efforts. In 1999, a charge representing 0.25% of the end-user price of electricity was introduced to finance demand-side management.

IDAE is responsible for promoting energy efficiency, the rational use of energy, energy diversification and renewable energy in Spain. It reports to the newly created Ministry of Science and Technology through the Office of the Secretary of State for Scientific and Technological Policy, but operates as a "public business entity". Both the central government and the regions are represented in the Committee for Energy Saving and Diversification (CADER) which has been established to co-ordinate IDAE's activities.

The main activities of IDAE are project financing and implementation, information dissemination and technical assistance to energy users. More specifically, its tasks are to:

- Prepare studies and make proposals which can be used as a basis for formulating policies to promote energy efficiency and renewable energy.

- Manage and monitor subsidies from different sources for energy conservation, saving, diversification and development, such as encouraging the use of renewable energy.

- Advise enterprises, inform consumers and organise professional training and conferences.

- Provide financial and technical assistance for the installation of energy-efficient equipment through third-party financing and other contractual forms.

- Initiate co-operation agreements with the state administration, city administrations and various institutions to promote the development of new technologies.

POLICY FRAMEWORK

As of the beginning of 2001, the central government had neither defined targets nor prepared a plan for energy saving and energy efficiency improvements in the coming decade. In a joint effort of the Ministry of Economy and the Ministry of Science and Technology a plan is under preparation for demand-side management, but the schedule for completing the plan has not yet been set.

Past policies for improving energy efficiency in the 1990s were defined in the Energy Saving and Efficiency Plan (*Plan de Ahorro y Eficiencia Energética*, PAEE), established by the PEN91 in 1992. The PAEE set quantitative targets for energy conservation in each sector (see Table 3). The plan also included an estimate of how much private investment would be needed and how public funds should be allocated so that the targets could be reached. During the first few years, IDAE both managed and monitored the programme; later, the autonomous regions took over the responsibility of its management but IDAE continued the monitoring.

Table 3
Targets and Results of the PAEE Energy Saving Programme[1]

Sector	*Target 2000* Ktoe	*Cumulated energy saving in 1991-1999* Ktoe	*Actual public spending* Billion Pta	*Actual private spending* Billion Pta
Industry	2,261	2,185	44.8	173.7
Transport	1,645	148	2.9	8.9
Energy use in buildings	927	331	8.5	41.1
Total	**4,833**	**2,663**	**56.2**	**223.8**

[1] Includes an estimate of non-monitored spending, a 25% increment to the registered investments.
Source: IDAE.

The target for the industrial sector was almost achieved, but those for the transport sector and energy use in buildings were not. The overall achievement rate was 55% by the end of 1999.

No systematic analysis of the reasons for not meeting the targets has been made but several reasons can be identified. First, investments were lower than estimated. Actual investment in the public sector was Pta 56.6 billion as compared to the original estimate of Pta 96 billion, and in the private sector it was Pta 224 billion as compared to the original estimate of Pta 344 billion. Second, the low prices of fuels in the 1990s could have made energy efficiency less attractive, discouraging investment for energy efficiency. Third, the relatively low GDP per capita (19% lower than the OECD average in 1999) may also have had an impact on the possibilities of households to make the initial investment needed for more efficient heating, electric equipment and insulation.

A demand-side management programme was launched by Royal Decree in 1995. The objective of the programme was to lower peak demand for electricity by replacing inefficient electrical equipment with efficient equipment. It was co-managed by the central government and the autonomous regions. Projects for the practical application of the programme were managed by the electricity utilities on a voluntary basis. For example, consumers were given subsidies for purchasing energy-efficient bulbs and the utilities were compensated for their management costs. The programme's total budget for 1995-2000 was Pta 30.7 billion. While it was not continued after 2000, its revival may be considered when the government prepares a new energy efficiency plan.

Following several Ministerial Orders in 1995-1998, new energy efficiency programmes were established in the industrial sector. Action carried out until 1999 in both the industrial and residential/service sectors has saved 293 GWh of electricity, representing a saving of 80 MW in electric power capacity. The most successful programmes have been:

- REVEM-PYME: promotion of electronic speed regulators for electric motors in factories and workshops in small and medium-sized enterprises (SMEs), and replacement of inefficient electric motors by more efficient ones.

- ACTANO: in the residential sector, replacement of direct electric water heaters by boilers which heat water during the night (off-peak hours).

- PYMELUZ: promotion of efficient lighting in SMEs.

- DOMOLUZ: promotion of low consumption compact electronic lights in the residential sector.

- DOSALUZ: promotion of efficient lighting equipment in educational and health facilities.

- ADMONLUZ: promotion of efficient lighting in public buildings.

MEASURES

Even though PAEE has been phased out, many of the measures that were implemented under the plan are still in force. The efficiency of these measures is being monitored by sectoral energy efficiency indicators developed by IDAE within the framework of an EnR[9] project.

9. The European Energy Network (EnR) is an association which brings together 15 European organisations responsible for the planning and management of national R&D, demonstration and dissemination programmes in the field of rational use of energy and renewable energy. EnR was founded in 1991.

Industrial Sector

Since 1994, IDAE has signed voluntary agreements (VAs) to improve energy efficiency with ten industrial associations representing nine sectors. The sectors that have signed voluntary agreements are pulp and paper, structural ceramics, glass containers, tanning, cement, food, chemicals, automobile auxiliary equipment and textiles. These sectors represent 56% of the total final consumption of energy by industry. Depending on the sector, the agreements cover one to several years. 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. It is estimated that the agreements have saved 641 ktoe of energy (equivalent to 4.5% of the final energy consumption by the sectors that have signed the agreements) and contributed to the installation of co-generation capacity totalling 285 MW_e.

Whereas the total installed co-generation capacity was 369 MW_e at the end of 1990, it reached almost 5,000 MW_e at the end of 2000. About 4,100 MW of capacity was installed in 1991-1999, which is 2.2 times the target set by PAEE. Co-generation capacity financed through IDAE's third-party financing was 300 MW_e, or 8.8% of total capacity installed in 1991-1999. In addition to support by IDAE, the so-called "special system" has provided subsidies to co-generators. However, high fuel prices in 2000 discouraged the installations of new co-generation capacity in 1999-2000 (see Chapter 6).

IDAE has provided third-party financing for 80 industrial energy efficiency projects during the last ten years. IDAE invests in energy efficiency improvement in industry and recovers its investment through energy savings. At the end of the period covered by the financial agreement, the industrial facility becomes the owner of the energy-saving installations that have been built. The projects do not require investments from industry and are carried out at IDAE's risk.

The IDAE-FEDER programme for SMEs was established in 1998 to disseminate information to small industrial energy users and to facilitate their access to government and EU support programmes aiming to help industry become more energy-efficient. The budget for the IDAE-FEDER programme is Pta 11.3 billion for 1998-2001. At the end of 1999, 121 projects that had been proposed by SMEs were accepted by the programme and another 20 were at the negotiation stage. The programme does not only assist SMEs in finding funding but also provides training through courses and seminars that IDAE organises for SMEs in different sectors.

Transport Sector

The PREVER Programme (formerly RENOVE) was introduced in 1997 to achieve environmental improvements and better road safety by inciting car users to replace old cars with new ones. The programme is applicable to automobiles over ten years of age and light industrial vehicles over seven years of age. The car registration tax of a new vehicle is reduced by Pta 80,000 when there is the guarantee that an old vehicle will be scrapped.

The cities of Granada, Vittoria, San Sebastian, Oviedo and Barcelona have introduced transport plans for urban traffic management to promote public transport. Madrid, Salamanca, Bilbao and Valladolid already use – or are planning to use – buses fuelled by natural gas for public transportation. There are projects under way to improve rail transport, including high-speed commuter trains in large cities such as Madrid and Barcelona, to facilitate and encourage the use of public transport.

Training programmes for energy-efficient driving have received support from the Spanish Confederation of Freight Transporters, the Driving Schools' Association and the Government Traffic Department. IDAE has published several brochures on problems regarding fuel consumption in transport and city travel, and has assisted cities in information campaigns.

Reduced VAT on the fares for public transport can promote its use. Some means of public transportation benefit from a reduced VAT rate of 7%, namely all rail and bus transport, as well as travel between the mainland and Balearic Islands by air or sea. The full 16% VAT rate is applied to all other national passenger transport by air and sea. The annual vehicle taxes, levied by the municipalities, were originally introduced solely for fiscal reasons; however, since they are progressive and based on vehicle weight and engine size, they can be considered also to enhance energy efficiency. Because of the relatively low level of the annual vehicle taxes, about Pta 12,000 at most, their impact on energy efficiency improvement may be modest.

Residential and Services Sector

IDAE is currently working on the development of instruments to allow Spain to adopt the so-called "SAVE Directive" of the EU (93/76/EEC) regarding energy certification[10] of buildings. After IDAE has worked out the details of this certification for use in Spain and a new law to make it mandatory has been passed, the directive will be implemented and enforced by the autonomous regions. Certification will be based on the use of passive solar energy, thermal insulation materials, and low consumption electric lamps. It will also be based on an evaluation of CO_2 emissions and assessment of building materials according to regions. IDAE is currently developing two computer tools to support the energy certification process, namely Energy Rating of Homes (*Calificación Energética de Viviendas*, CEV) and Energy Rating of Buildings (*Calificación Energética de Edificios*, CALENER).

Today's standards for energy savings in buildings were established by Royal Decree in 1979, which set mandatory minimum requirements for thermal insulation. New and stricter mandatory standards, in compliance with the SAVE Directive, will be introduced in 2002. Their enforcement will be the responsibility of the autonomous regions, based on the evaluation of building projects at the planning phase and on random checks of new buildings.

10. According to the directive, energy certification of a building is a description of a building's energy characteristics intended to inform the consumer on its energy efficiency.

The ACTANO, DOMOLUZ, DOSALUZ, and ADMONLUZ programmes aim to improve energy efficiency through the use of better heating systems and more energy-efficient lighting. Following the regulations of the SAVE Directive, periodical boiler checks became mandatory in 1998. According to IDAE, heating systems in the existing building stock are often very old and operate with low efficiency.

The EU directive on the energy efficiency labelling of domestic electric appliances[11] and its later amendments have been adopted by Spanish legislation through the Royal Decree 124/1994.

IDAE has provided third-party financing also for public sector buildings. By this mechanism, co-generation equipment has been installed in hospitals in Guadalajara, Valencia and Marqués de Valdecilla (Santander).

While IDAE uses energy efficiency indicators to monitor the energy efficiency in buildings, no systematic cost-efficiency analysis has been carried out for each energy efficiency measure currently in use.

CRITIQUE

Total final energy consumption grew rapidly in the 1990s. Energy intensity has grown slowly though steadily during the last ten years, almost reaching the average level of IEA Europe. Unless additional and effective policies and measures are introduced, it is not likely that Spain will be able to reduce energy intensity in all sectors in the future.

Spain introduced an energy efficiency and diversification plan, the PAEE, in 1992 for the period of 1991-2000. The plan included clearly defined objectives for increasing energy efficiency, with an indication of resources that will be needed and how responsibilities should be allocated. Outcomes were carefully monitored. Energy savings in the industrial sector were close to the target, but not much energy savings were achieved in the other sectors. The investments that were actually made in both the public and private sectors were less than the amount estimated as necessary to achieve the targets.

Some of the programmes initiated under the PAEE were continued after PAEE expired. However, without a new plan, the effective continuation of these programmes may be at risk. While the government intends to introduce a new plan, it has not yet announced when. Taking into account the growth in energy demand in all sectors, a new coherent and comprehensive energy efficiency programme is needed urgently. The plan should define quantitative targets both on the supply and demand sides. PAEE was more successful in supply-side measures than in demand-side measures. Nonetheless, there is still room for improvement, for example in the total efficiency of CHP installations. Demand-side management should be strengthened, especially in the

11. EU Directive 92/75/EEC of 22 September 1992 (and the later amendments) on the indication, by labelling and standard product information, of the consumption of energy and other resources by household appliances.

residential/services and transport sectors, given the growing demand and limited success in these sectors so far. The successful programmes in the industrial sector should be continued. Moreover, the plan should not only identify measures, but also rank them according to their cost-effectiveness. Systematic cost-effectiveness analysis of the measures used in the past was not done. Developing effective means to monitor the performance and assess the effectiveness of policy measures would help the government to adjust and improve its policies.

There are several possible new measures to improve energy efficiency. The introduction of mandatory energy certificates, which is under consideration by the government, would bring significant results. Energy performance standards for residential and commercial buildings could also be introduced. In the transport sector, new regulatory initiatives could be taken, such as voluntary agreements with regions/municipalities and transport companies, energy efficiency labelling of new cars, and better speed limits with stricter enforcement. Covenants, or long-term agreements with industry, the autonomous regions and municipalities which have already been initiated by IDAE, could be strengthened. The information campaign for industry could be extended to architects and engineers to ensure that any changes in regulation are taken into consideration at the early stage of planning and that the most effective means are used for their implementation.

The European directives on energy efficiency of appliances and boilers have been transposed into Spanish law, and an energy certification system for buildings will come into force shortly. New building codes will be introduced in a few years. In order for these measures to be effectively enforced, the energy efficiency of buildings should be examined both at the planning stage and after the buildings have been completed. As the enforcement of energy efficiency legislation and regulation is usually the responsibility of the autonomous regions, collaboration between them and the central government is essential.

RECOMMENDATIONS

The Governement of Spain should:

- ☐ Establish a new, coherent and comprehensive energy-efficiency programme to help slow growth in energy demand in all sectors; ensure that the measures are cost-effective and consistent with their objectives, and that the programme sets priorities, on both the supply and demand sides.

- ☐ Regularly verify compliance with building codes, in both new and retrofitted buildings.

- ☐ Monitor systematically the performance of measures taken.

6

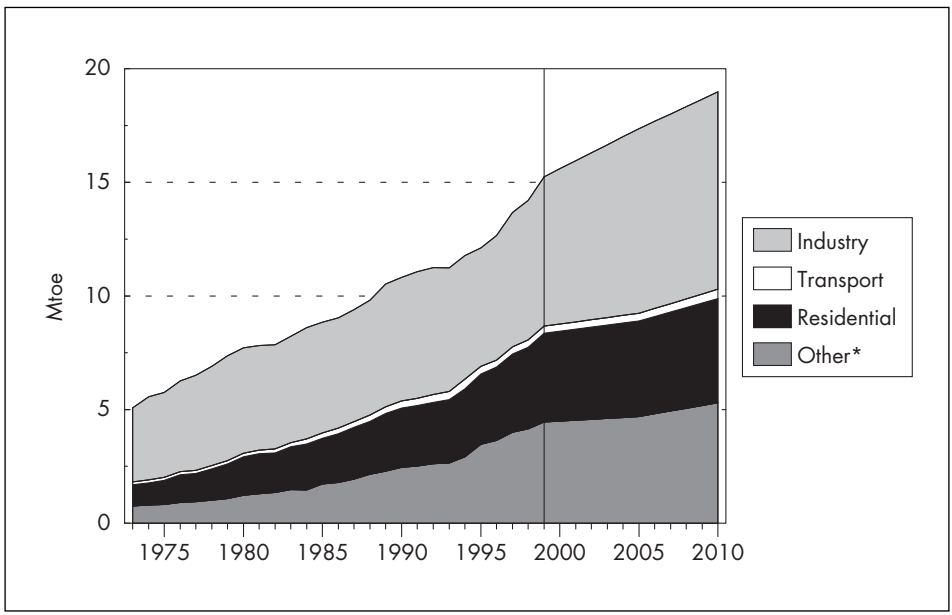
ELECTRICITY, CO-GENERATION AND NUCLEAR POWER

DEMAND AND SUPPLY

Electricity consumption grew steadily in the 1990s, except for 1992-1993. 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. Electricity consumption was 195 TWh in 1999. About 95% of all electricity is consumed in the peninsula and 5% in the islands.

At the end of 1998, total net maximum capacity was 50,000 MW, of which public utilities owned 91% and autoproducers 9%. The breakdown of installed capacity was: 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

Figure 13
Electricity Consumption by Sector, 1973-2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

renewables 960 MW. The reserve margin was 50% in 1998 -- compared to 20-25% in most countries -- indicating over-capacity. However, consumption has increased rapidly and power utilities have made only modest investments in new capacity. In addition, hydro capacity is very sensitive to weather conditions from year to year and season to season. As a result, excess capacity has diminished. Capacity in the southern part of the country is not adequate to meet demand. For example, owing to a series of simultaneous events – poor hydro conditions, failure at several power plants and a failure in a transmission line used for interconnection with the central region – the Andalucia region experienced power shortages during one day in August 2000. This led to interrupting electricity supplies to interruptible consumers and cancelling planned exports to Morocco. Red Electrica, the Transmission System Operator, has recognised the need to establish more capacity in the area and to improve the interconnections to other regions.

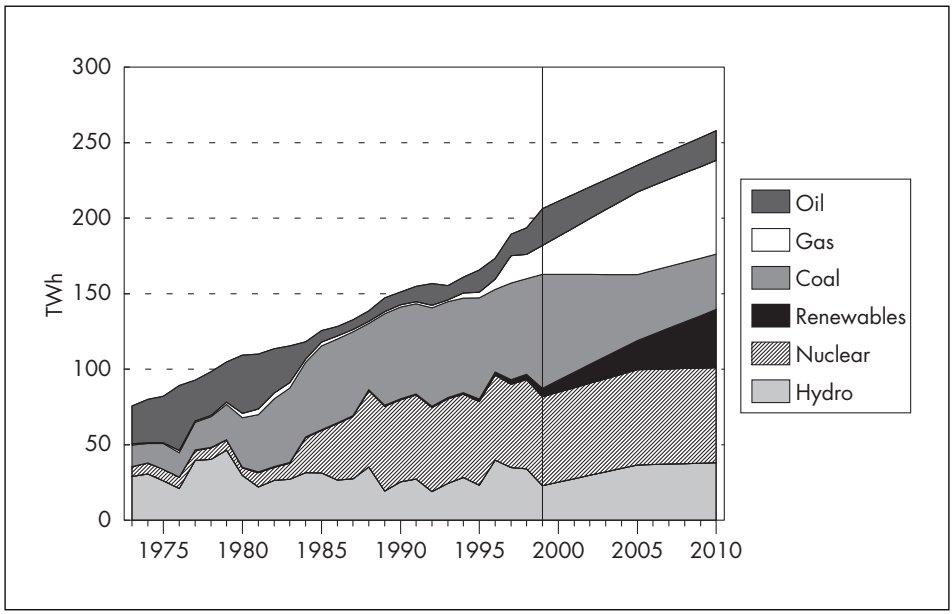
In 1999, coal was the main fuel used for electricity production, with a share of 36.6%. The second most important source was nuclear power (28.5%), followed by oil (11.8%), hydro (11.1%), natural gas (9.2%) and non-hydro renewables, including waste (2.7%). In the 1990s, electricity supplies derived from hydroelectric power have varied year by year, with a minimum of 19 TWh in 1992 to a maximum of 40 TWh in 1996. 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.

The generation mix in the future is expected[12] to be significantly different from what it is today. By 2010, the share of nuclear is expected to be 24.4%, natural gas 24.1%, hydropower 14.7%, renewables (other than hydro) and waste 14.9%, coal 14.2%, and oil 7.6%. Renewables and natural gas are the fuels which would increase their shares in the fuel mix the most, while coal, nuclear and oil would decrease their shares. 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. The technical potential of wind power has been estimated at 15 GW, and Spain intends to have 5.6 GW of wind power capacity by 2006. Many wind power plants have already been installed, and their number is growing rapidly.

The total volume of electricity traded amounted to 18.1 TWh in 1999. The volume of imported electricity is increasing, amounting to 5.6% of total electricity consumed in Spain in 1999. Electricity exports increased in the early 1990s, but stabilised in the second half of the decade. Spain imports electricity from France and Portugal, and exports electricity to Andorra, France, Morocco and Portugal. Spain has only a few links with neighbouring countries. The 400 kV lines are

12. The forecasts of future electricity production and consumption were prepared by Red Electrica (Transmission System Operator), commented by the National Energy Commission and approved by the government.

Figure 14
Electricity Generation by Fuel, 1973-2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

connected with the networks of France at two points, with Morocco at one point and with Portugal at three points, and the 220 kV lines are connected with France at two points and with Portugal at three points. Spain has been trying to increase interconnections with France, but this has not yet happened mainly because of environmental and other constraints. However, Red Electrica has plans to upgrade the current lines between Spain and France and to build a new connection, the Aragón-Cazaril. There are also plans to install new 400 kV interconnections to Portugal and Morocco.

Table 4
Import and Export of Electricity, TWh

	1990	*1995*	*1996*	*1997*	*1998*	*1999*
Import	3.21	7.63	6.75	4.60	8.96	11.9
Export	3.63	3.15	5.69	7.67	5.56	6.2
Net import	**- 0.42**	**4.48**	**1.06**	**-3.07**	**3.40**	**5.7**

Sources: *Electricity Information 2000* and *Oil, Gas, Coal & Electricity Quarterly Statistics*, IEA/OECD Paris, 2000.

PRICING AND TARIFFS

In the liberalised segments of the electricity market, the prices are set by the market and the government does not set price ceilings, but eligible consumers can choose to stay under regulated tariffs. Tariffs for the captive markets are set by the government and are uniform across the country, including the islands.

In 1999, the average electricity price for households was Pta 22.4 per kWh, and for industry it was Pta 8.70 per kWh. In 1999, the price for households was about 39% above the average for OECD Europe[13], and for industry it was 9.5% below the average for OECD Europe. Compared to 2000, the regulated tariffs set for 2001 have decreased by 4% for residential consumers and by 2.2% for industrial consumers. The ratio of residential prices to industrial prices was 2.6, which is significantly higher than the average ratio for OECD Europe, which was 1.7 in 1999[14].

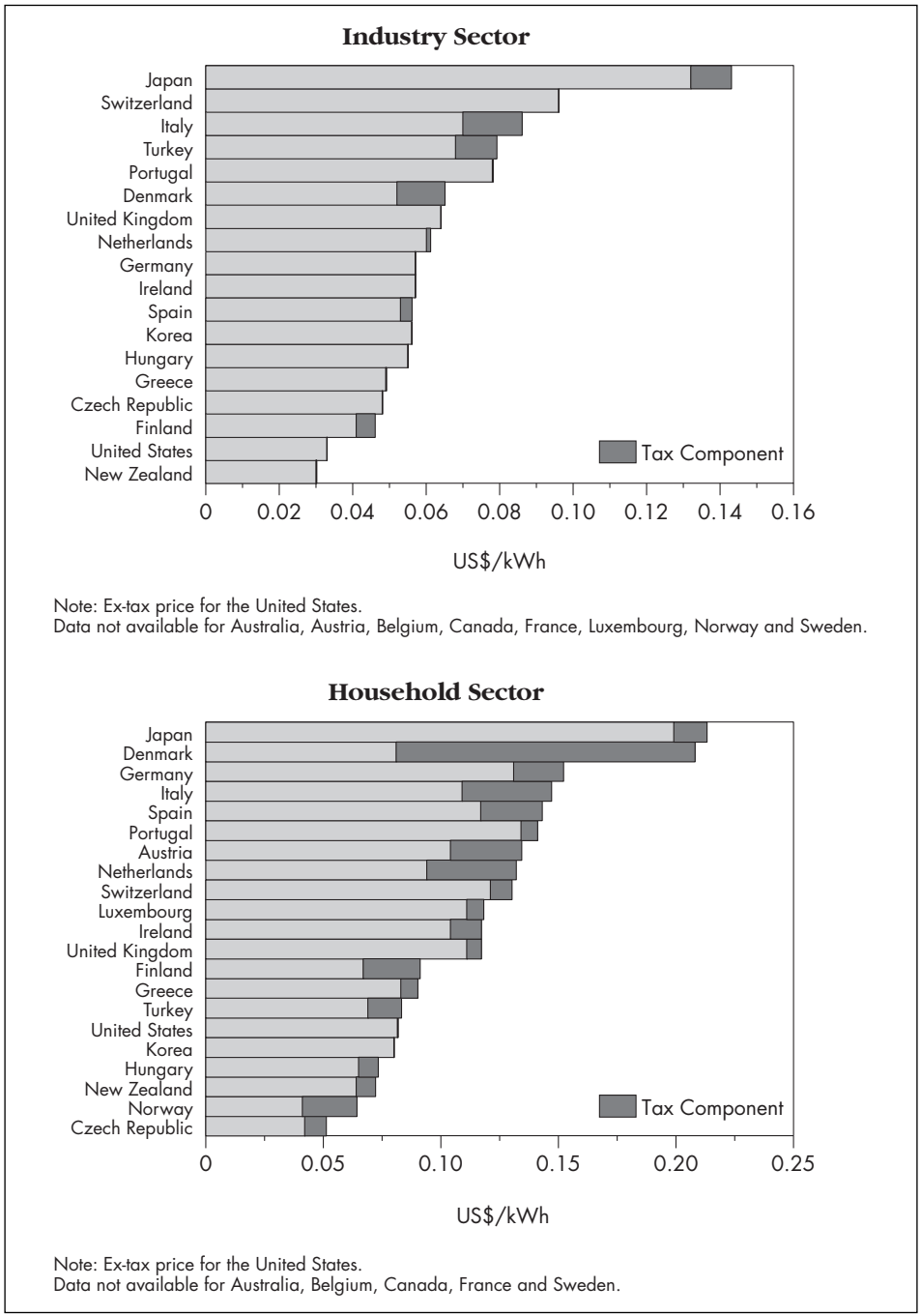
Costs related to energy policy add significantly to the cost of electricity in Spain (see Table 5). These include capacity payments (see Introduction of Competition below), incentives to generators under the special system, costs related to the nuclear moratorium[15], stranded costs[16], incentives for power producers to use domestic coal, and subsidies to compensate for higher generation costs in the extra-peninsular system. Energy policy-related costs constitute about 16% of the total Spanish electricity bill before value-added tax is included. These costs are mainly borne by captive consumers, representing 23% of their electricity bill.

All generation facilities can be classified as operating either under the so-called "ordinary system" or under the "special system". The special system was introduced to promote market penetration of co-generation and renewables. The generators who qualify for the special system receive premiums to make them more competitive with generators using traditional technologies and energy sources. Special system generators typically run installations for co-generation and for electricity generation from renewables. The Electric Power Act of 1997 introduced stricter qualifying criteria for the special system and some of the older installations lost their premium. The premiums (€712 million in 2001) are

13. Data not available for Austria, Belgium, France, Germany, Luxembourg, Norway and Sweden.
14. All prices are given after excise taxes and VAT.
15. In 1984, Spain placed a moratorium on the completion of five partially built nuclear reactors. The costs to the developers are covered through the energy bill.
16. Stranded costs are unamortised costs of prior investments that are scheduled for recovery through regulated monopoly rates but would not be recovered under competition. In Spain, stranded costs are called "costs of transition to competition (CTCs)". In 1996, the government reached a decision to permit the payment of CTCs for a period of ten years. The European Commission is currently reviewing the practice to determine if CTCs should be considered as fair compensation or state aid. A decision is expected in 2001.

Figure 15

Electricity Prices for Industry and Household Sectors in IEA Countries, 1999



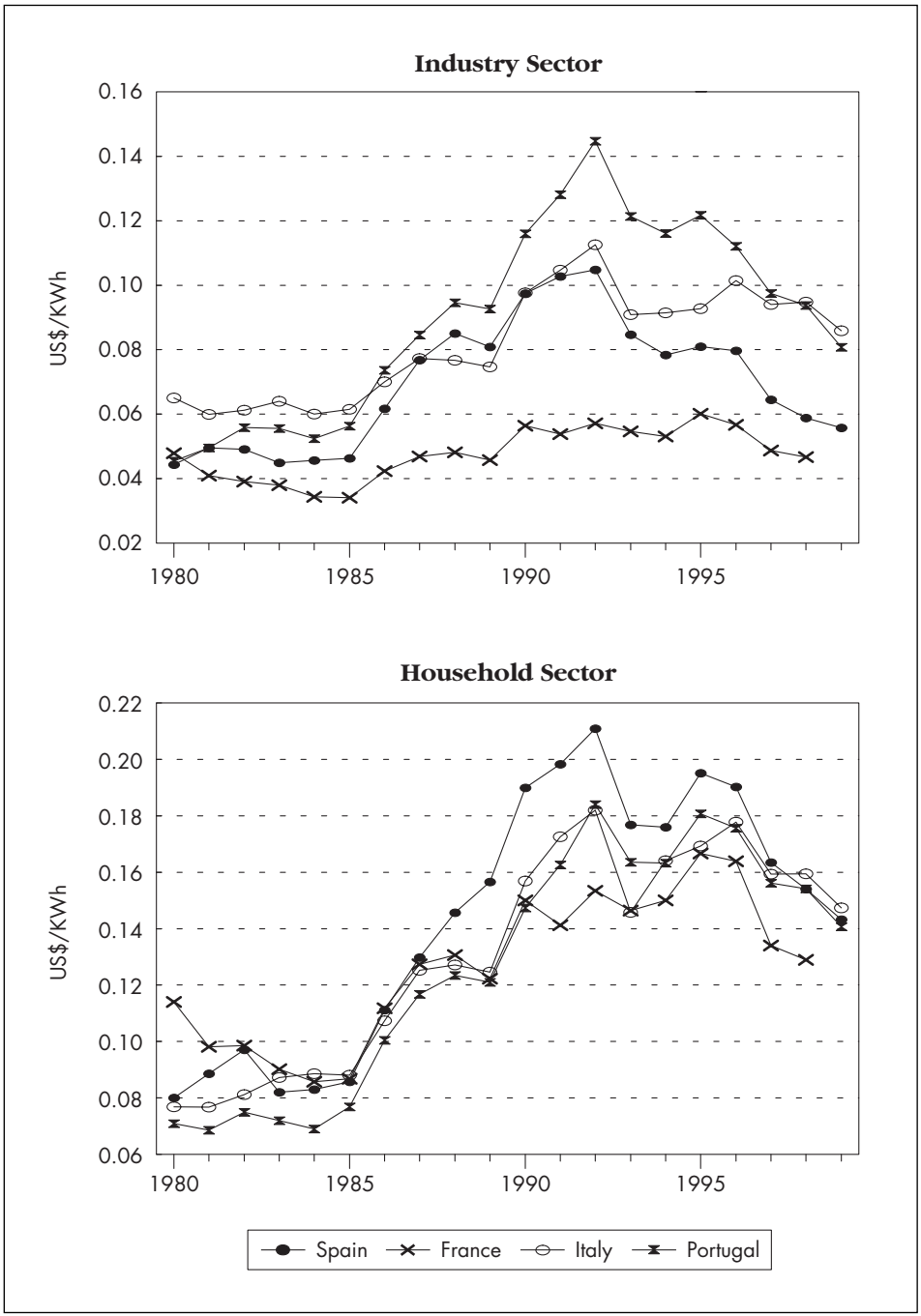
Note: Ex-tax price for the United States.
Data not available for Australia, Austria, Belgium, Canada, France, Luxembourg, Norway and Sweden.

Note: Ex-tax price for the United States.
Data not available for Australia, Belgium, Canada, France and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Figure 16

Electricity Prices in Spain and in Other Selected IEA Countries, 1980-1999



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Table 5
Components of Electricity Prices in 2000

Items	*Costs (Pta billion)*	*Share %*
Production and related costs	**1,341**	**62**
Production under ordinary system and imports	867	40
Production under special system	302	14
Capacity payments	138	6.5
Auxiliary services	35	1.5
Transmission	**97**	**4.5**
Distribution	**441**	**20.5**
Retailing	**42**	**2**
"Permanent costs"	**142**	**6.5**
System Operator, Market Operator, CNE	4.5	0.2
Stranded costs (CTCs)	74	3.5
Incentives to indigenous coal	42	2
Subsidies to extra-peninsular system	22	1
Diversification and security of supply	**97**	**4.5**
Nuclear moratorium	76	3.5
Nuclear fuel cycle	17	1
Other	3	0.15
Total	**2,161**	**100**

Source: National Energy Commission.

financed through a charge included in electricity prices for all consumer groups; for 2001, the charge represents 5.4% of the average electricity price for captive consumers.

The share of electricity generated under the special system increased from 2% in 1990 to 13% in 1999. In 2000, some co-generation plants were closed because of increasing gas prices and decreasing electricity prices, but the overall share of production under the special system continued to increase[17]. In some cases it became more economical for industrial co-generators to buy electricity from the liberalised electricity markets. In 1999, 24 TWh were produced under the special system, with co-generation producing 68.8%, hydro 15.4%, and other renewables 15.8%.

17. In November 2000, the share of accumulated production under the special system, out of total accumulated production in 2000, was 14.2% in the peninsula system.

If any production unit has been running long enough to produce electricity equivalent to the amount produced during five years on full load, it receives special treatment in the electricity pool called "guaranteed power". Electricity generated by these units gets priority in the matching of supply and demand in the pool. They also get higher remuneration than the marginal price. The total amount of these premiums, or capacity payments, was Pta 1.3 per kWh in 1998, but was reduced to Pta 0.80 per kWh in July 2000. The objective is to improve the reliability of supply by encouraging current facilities to stay in the production system and new capacity to enter it by providing a stable market environment. This creates an incentive for baseload plants, but there is no incentive for peak load plants. When capacity payments were introduced in 1996, the government announced that they would be removed after a transitory period, possibly in 2001, but they appear to remain as "permanent costs". In 1998, all consumers contributed to financing capacity payments; in 1999 the system changed, and consumers buying electricity from the liberalised markets now pay a charge of Pta 0.3 per kWh whereas those still under regulated tariffs pay more.

INDUSTRY STRUCTURE

Electricity generation is dominated by four large public utilities. Their shares of total power production in 1998 were Endesa Group 48%, Iberdrola 26%, Unión Fenosa 11%, and Hidrocantábrico 4%; independent power producers represent 11%. Endesa was created in 1944 as a state-owned enterprise but was privatised in 1998. The Spanish government retains one special preferential share, the so-called "golden share", and has the power of veto in matters of national energy policy. Iberdrola is the result of the merger in 1992 of two large electric utilities, Hidroelectrica Española and Iberduero. Iberdrola is a private company, and the government does not hold a golden share. Both Unión Fenosa and Hidrocantábrico are private companies that have been generating and distributing electricity for more than 80 years.

Red Electrica owns most of the national high-voltage networks[18] and is the Transmission System Operator (TSO). When the electric utilities established Red Electrica in 1985, it was a state-owned company. The ownership structure changed at the end of 1997, with the State retaining about 50% of the shares. Today, the State is further reducing its ownership share even though it still owns 25%; the four power utilities own 10% each, and 35% of the shares are free floating. The Electric Power Act of 1997 requires that the direct and indirect shareholding of any individual or institution may not exceed 10% (except for the

18. The Spanish transmission network consists of 400 kV, 220 kV and 132 kV lines and cables. The length of the transmission network is 30,997 km, consisting of 30,914 km of overhead lines and 83 km of submarine and underground cables. Red Electrica owns 98% of all 400 kV lines, 79% of 400/220 kV substations, 27% of 220 kV lines and 13% of 220/132 kV substations.

State until the end of 2003) and the aggregated shareholding of the electricity companies may not exceed 40%.

As the TSO, Red Electrica is responsible for the technical management of the electricity system. Its task is to guarantee the continuity and security of the electricity supply and the proper co-ordination of the electricity production and transportation systems. As a part of this mandate, it oversees electricity imports and exports between the Spanish and foreign networks. It is also responsible for the development and expansion of the high-voltage transmission grid, but the plans for network development are subject to government approval. Moreover, the TSO gives access to the transmission network. It can only refuse access if necessary transmission capacity is not available, and any refusal has to be duly justified. Spain applies the regulated third party access formula for both domestic and international operations. The law acknowledges that transmission tariffs should be fair, transparent and non-discriminatory. The transmission fee is set by the Energy Administration and it is uniform across the country. Access tariffs have also been set for consumers who wish to purchase electricity from foreign suppliers, which is possible if they consume at least 50 GWh of electricity annually.

Electricity distribution in the Spanish peninsula is mainly the responsibility of the four big electricity generators. At the beginning of 2000, Iberdrola distributed electricity to 41% of the customers, Endesa to 39%, Unión Fenosa to 14%, and Hidrocantábrico to 5%. In addition, there are small electricity distributors in the Balearic and Canary Islands which account for 1% of the total market share.

Endesa and Iberdrola Merger Plan

Endesa and Iberdrola announced a plan to merge in October 2000. They cancelled their plan in February 2001 after the government set conditions to the merger based on a recommendation of the National Energy Commission (CNE). To maintain and enhance competition in the market, the commission recommended that the generation assets of the new company be limited to about 21 GW and that the market share in distribution be limited to 41%, corresponding to the current market share of Iberdrola. This would have meant divesting 17 GW of generation assets – compared to the current combined 38 GW of assets -- and divesting 8.3 million clients. The initial proposal of the companies was to sell 16 GW of generation assets and limit their combined market share in distribution to 62%, compared to the current 80%.

The generators offer electricity daily to the electricity pool (see box) which is run by the Market Operator. Following the introduction of the 1997 Spanish Electric Power Act, the government established a new company, OMEL (*Compañia Operadora del Mercado Español de Electricidad*, *S.A.*) to act as the Market Operator and operate the electricity pool. Its main functions are to match sale and purchase bids and to determine prices, disseminate information on market operation, and inform the regulation authority of any violation of the market rules by market players. The law obliges the TSO and the Market Operator to perform their functions in co-ordination and according to the principles of transparency, objectiveness and independence. At the end of 1999, the main shareholders of OMEL were investment banks and energy sector market players, including the four large power companies that each held 5.71% of the shares. This ownership structure is in line with the requirements of the Electricity Power Act which limits the direct and indirect shareholding for all owners to 10% and sets an aggregated limit for power companies at 40%.

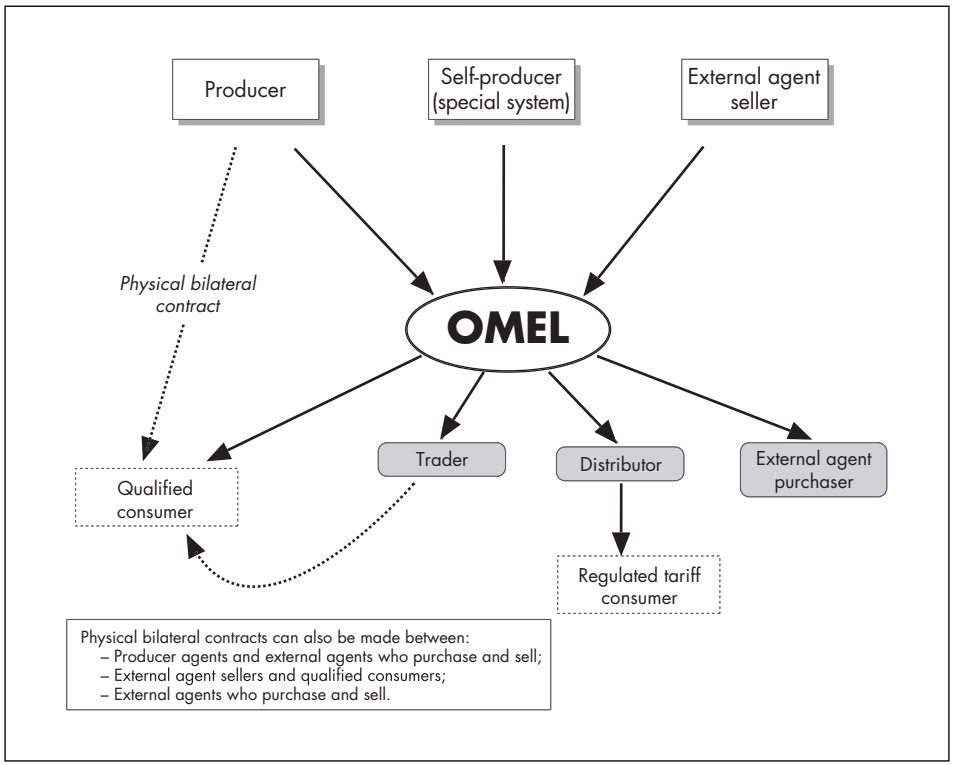
Electricity Pool

The electricity pool is a market mechanism based on a legal framework which sets out the commercial agreements that govern the sale of power in the market. The pool itself does not buy or sell electricity. Generators and buyers trading in the pool must record their data in the Administrative Registers and confirm their adherence to the Production Market Rules by signing the corresponding Contract of Adherence with the Market Operator. The market rules are prepared by the Market Operator and approved by the Ministry of Economy.

In January 2001, the number of licensed sellers was 5 producers, 7 external agents and 12 retailers, and the number of licensed purchasers was 8 distributors, 7 external agents (foreign operators), 12 retailers and 2 qualified consumers. The number of operators using the pool has tripled in the three years after the pool was established in 1998. The daily market volume traded in the pool is 500 GWh. In 1999, the amount of electricity traded was 179.5 TWh, *i.e.* about 90% of the power produced. The remaining 10% of electricity was not sold to the market but used by the producers themselves. The weighted average final hourly price was Pta 5.85 per kWh.

The pool consists of different markets and processes, of different methods for matching sales and purchases. About 91% of electricity is traded through the daily market. In the daily market, electric power transactions are handled for the following day. The suppliers and buyers submit bids consisting of two components: the amount of electricity to be traded and the proposed selling or purchasing price. OMEL matches these bids and the resulting marginal price is equal to the last sale bid production block needed to meet demand. All generators, including those who offer electricity under the marginal price, will receive the same remuneration based on the marginal price. The user interface for the bidding is provided on the Internet.

Figure 17
Electricity Market Organisation



Source: OMEL.

INTRODUCTION OF COMPETITION

The law of 27 November 1997, the Spanish Electric Power Act (54/1997), transposed the EU directive of 1996 on internal electricity markets into Spanish legislation. The law defined the conditions and schedule of market liberalisation, reorganised network management and market operation, established the regulator and removed the public service obligation from electricity suppliers. The law also limits centralised government planning to the development of transmission facilities.

The Electric Power Act and the Royal Decree of 23 June 2000 on Urgent Measures for Increasing Competition in Goods and Service Markets (6/2000) define the schedule for giving consumers the right to choose their suppliers (see Table 6). The schedule exceeds the requirements of the EU directive by allowing faster market opening and by extending the eligibility to choose the supplier to all consumers from the beginning of 2003. Currently, 54% of the consumers are eligible.

Table 6
Electricity Market Liberalisation Schedule

Date	*Eligibility*[1]	*Market opening*
1 January 1998	Consumption > 15 GWh/year	26.5%
1 January 1999	Consumption > 5 GWh/year	34%
		(Directive requires 26% in Feb. 1999)
1 April 1999	Consumption > 3 GWh/year	37%
1 July 1999	Consumption > 2 GWh/year	40%
1 October 1999	Consumption > 1 GWh/year	42%
1 July 2000	All supplies 1 kV voltage level	54%
		(Directive requires 30% in Feb. 2000)
1 January 2003	All consumers	100%
		(Directive requires 35% in Feb. 2003)

[1] Under current legislation, eligibility is defined for purchases from the domestic markets. Only consumers with at least 50 GWh annual consumption are allowed to buy from foreign suppliers.

Source: National Energy Commission.

Electricity users who are not yet free to choose their supplier can buy electricity only from distribution companies. The government set the objective to reduce the tariffs for consumers in the captive markets. Eligible consumers can buy electricity from the electricity pool, directly from suppliers, or from a retailing company, which is a new type of marketing company defined by law. Unlike distribution companies, retailing companies do not have exclusive rights for supply in any given area.

Consumers who are free to choose their supplier nonetheless have the possibility of staying under regulated tariffs. Most chose to do so when the regulated tariff was lower than the market price at the beginning of market opening in 1998. As the prices in the liberalised markets began to fall, only 35% of the consumers who could buy from the liberalised markets chose to remain under the regulated tariffs in 2000, and their number is further decreasing. In terms of volume, only 1% of all electricity was sold through the liberalised market in 1998, although 26.5% of it had been liberalised. In 1999, the volume sold through liberalised markets increased to 15.9%, and in 2000 it reached 27.6%. In 2007, regulated tariffs for high-voltage electricity consumers will be abolished and all consumers connected to the high-voltage networks will have to buy their electricity from the liberalised markets. The details for extending market liberalisation to small consumers, such as metering and billing arrangements, have not yet been defined. Also, the government plans to give small consumers the option of remaining under regulated tariffs as long as there is not enough competition to keep market prices at a reasonable level.

Legislation has given consumers the right to choose suppliers and it has liberalised the power generation market. Prior administrative authorisation is

required for building generating facilities, but approval for the installations can only be denied on environmental and land-use grounds, or if the generator cannot provide proper technical and economic guarantees, or if the power generator already has a significant market share. Producers whose installed capacity exceeds 40% of total capacity in Spain may not acquire more capacity for five years; and those whose share is between 20% and 40% of total capacity may not add new capacity for three years from 2000. In practice, the first limit applies to the Endesa Group and the second to Iberdrola. The producers nonetheless are allowed to construct new capacity to replace either closed or dismantled facilities.

The Law 6/2000 also obliges generators that are operating under the special system, and which have more than 50 MW of installed capacity, to sell their surplus electricity in the wholesale market. Co-generators with more than 5 MW of capacity can sell their surplus electricity to the wholesale market on a voluntary basis. Furthermore, the Law 6/2000 makes it easier for new operators to participate in the electricity system by introducing new contractual arrangements for retailing companies, including the possibility to buy electricity on credit.

CO-GENERATION

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. 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 buy-back 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 totalled 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 MW_e, 53% have 1-5 MW_e capacity, and 17% have 5-10 MW_e 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 co-generation plants have been built yet.

Co-generation plants are eligible for premiums if they qualify under the special system. CHP plants must meet certain conditions for efficiency in electricity production but not in total fuel use. The requirements on efficiency depend on the

size of the installation, the producer's own energy consumption, the amount of electricity supplied to the network, and the fuel and technology used. The premium provided under the special system depends also on the installed capacity. In 2000, small co-generators (<10 MW_e) received a premium of €24 per MWh for a maximum of 70% of their total annual production, and larger co-generators (between 10 and 25 MW_e) received on average €18 per MWh for a maximum of 50% of their total annual production. The premium represents 43–67% of the market price, which was €36-42 per MWh in 2000. The special system will be revised in 2007, and co-generators with electricity capacity of over 10 MW will no longer get the premium. Co-generators have two possibilities to sell their surplus electricity, either through the pool, or directly to retailing or distribution companies.

The targets and forecasts for CHP production have been met and exceeded. The energy target set by PEN91 for co-generation, at 14.3 TWh by the end of 2000, has been exceeded. The increase of CHP capacity has slightly exceeded the technical maximum potential estimated by IDAE in 1998. What the future holds for CHP is not certain. The government has not set new targets for CHP production since the PEN91 ended in 2000. Also, according to an estimate made by IDAE, the market for CHP will be saturated in a few years and installed capacity will reach about 6,500 MW_e in 2010. However, the growth rate of CHP capacity has exceeded estimates made for 1999-2000.

IDAE has closely monitored the progress of the CHP market and has identified some constraints to the competitiveness of co-generation. First, it considers the fuel prices for co-generators, essentially the price of natural gas, to be too high compared to the price of fuels used in conventional power plants. Second, the efficiency requirements for co-generation should be stricter than they are today. Third, the buy-back tariff should take into account the environmental externalities and transmission network costs that are avoided in co-generation: electricity generated by co-generators is usually consumed close to the production site and so does not burden the transmission system.

NUCLEAR POWER

Spain has nine nuclear reactors operating at seven sites (see Table 7). Seven units are pressurised water reactors (PWR) and two are boiling water reactors (BWR). One unit, Vandellos I, is being decommissioned. The nine nuclear power plants have a total gross generating capacity of about 7,800 MW_e. The nuclear capacity represents 15% of the total installed electricity generating capacity in Spain. In 1999, nuclear plants produced 59 TWh, supplying 28.5% of the country's electricity requirements. Although the electricity produced by nuclear reactors has increased by about 7% since 1995, its share in total electricity production has diminished by about 4%. This reduction is the result of increased electricity consumption and the penetration of natural gas in electricity production observed over the past years.

Table 7
Operating Nuclear Power Reactors in Spain

Plant	*Year of commissioning*	*Capacity (MW gross)*	*Type*	*Shareholder*
José Cabrera (Zorita)	1968	160	PWR[1]	Unión Fenosa 100%
Sta Maria de Garoña	1971	466	BWR[1]	Iberdrola 50% and Endesa Group 50%
Almaraz-I	1981	974	PWR	Iberdrola 52.7%, Sevillana Electricidad 36%, Unión Fenosa 11.3%
Ascó-I	1983	1,028	PWR	Endesa Group 40%
Almaraz-II	1983	983	PWR	Iberdrola 52.7%, Endesa 36%, Unión Fenosa 11.3%
Cofrentes	1984	1,025	BWR	Iberdrola 100%
Ascó-II	1985	1,015	PWR	Endesa Group 85%, Iberdrola 15%
Vandellós-II	1987	1,082	PWR	Endesa Group 72%, Iberdrola 28%
Trillo	1988	1,066	PWR	Iberdrola 48%, Hidroelectrica del Cantábrico 15.5%, Nuclenor 2%

[1] PWR = Pressurised Water Reactor. BWR = Boiling Water Reactor.

Sources: Ministry of Science and Technology; Ministry of Economy, Spain.

In 1984 Spain placed a moratorium on five nuclear units then under construction. The 1994 law on electricity confirmed the moratorium on these power plants without ruling out nuclear power as an option for future capacity needs. The associated costs to the nuclear developers, Pta 729 billion, are being financed by a percentage included in the electricity tariff until March 2020.

Spain has gained about 400 MW of additional gross nuclear capacity since 1994 by capacity upgrades implemented in existing nuclear units. In 1998, upgrades were performed in Cofrentes, Garoña and Ascó-I, totalling about 52 MW; and in 1999, the upgrades in Vandellós-II and Ascó-II totalled some 111 MW.

Spanish nuclear reactors continue to perform very efficiently, as demonstrated by a sustained trend of very high load and availability. Availability was 88.5% in 1999 and 90.0% in 1998, among the highest in OECD countries. Other performance indicators confirm the continuation of a positive trend in nuclear reactor operation characterised by high reliability, an excellent safety record and cost improvements.

Empresa Nacional de Uranio (ENUSA) is the Spanish company in charge of activities related to the front-end of the nuclear fuel cycle. Some of the uranium used in Spanish nuclear reactors was produced by ENUSA in the Quercus plant located in Saelices el Chico. Uranium production for 1999 was about 300 tonnes of U_3O_8. However, uranium production at that site ended in 2000 as a consequence of low uranium prices in the world market. The other step in the front-end of the nuclear fuel cycle carried out in Spain is the fabrication of nuclear fuel. In 1999, 586 fuel elements were fabricated in the Juzbado plant, 336 for PWRs and 250 for BWRs.

In Spain, the operating licences of nuclear power plants can be extended for up to 10 years following a rigorous safety review. Vandellós-II, Almaraz and Garoña have been granted 10-year extensions. Other plants whose licences have been extended beyond their initial 30-year operation period include Trillo for five years and José Cabrera (Zorita) for three years. Assuming a 40-year life span for these facilities, two reactors will be retired around 2010 and the other seven after 2020.

One of the latest trends in operating nuclear reactors in Spain is consolidation and management integration. Operating partnerships have been created between different nuclear power plants and their management has been integrated in order to increase efficiency and reduce costs while maintaining very high safety standards. The Ascó/Vandellós-II group and the Almaraz/Trillo group are examples of this trend. Better performance and consolidation of plant ownership into large and financially strong corporations has led to increasing confidence in nuclear power plants and their management.

The Nuclear Safety Council (*Consejo de Seguridad Nuclear*, CSN) is the sole institution in Spain responsible for regulating and controlling nuclear safety, including protection from radiation. It proposes regulation, which must be approved by the government, and reports on its activities to parliament every year. The CSN is an independent agency with power to suspend operation and propose procedures to impose sanctions, cancel permits and authorisations. It also issues the reports that the Ministry of Economy needs to grant and extend licences for the operation of nuclear plants and other facilities handling radioactive material. Safety indicators for Spanish nuclear reactors continue to show a positive trend. The CSN 1999 report to the parliament concluded that no major incident involving nuclear safety occurred during that year.

The National Radioactive Waste Corporation (*Empresa Nacional de Residuos Radioactivos*, ENRESA) is the company responsible for the back-end activities of the nuclear fuel cycle. These activities include spent fuel and radioactive waste management, and dismantling and decommissioning nuclear and radioactive installations. In addition, ENRESA manages the fund for financing the back-end activities of the nuclear fuel cycle and related research and development programmes.

Nuclear waste management activities and plans in Spain are currently defined by the Fifth General Radioactive Waste Plan, issued in 1999. The plan contains all the necessary actions and technical solutions applicable in the different areas of

radioactive waste management. It calls for: delaying the decision on the final disposal of spent fuel and high-level radioactive waste to after 2010; construction of a centralised interim storage facility for high-level waste by 2010; and continued dependence on the El Cabril facility as the basic site for managing low- and intermediate-level waste.

Based on the strategy established by the Waste Plan, research and development will continue on geological disposal to increase the technological expertise for site characterisation and barrier performance evaluation. The strategy also calls for promoting research and development of new technologies for final disposal, in particular partition and transmutation.

CRITIQUE

Electricity consumption has grown rapidly in the late 1990s and Red Electrica expects the trend to continue during the coming decade. The supply is already diversified but further diversification is taking place as the share of natural gas and renewable sources is increasing. Although investment in additional capacity was modest in the past when there was excess capacity, industry has announced significant investment plans for new plants, which appear sufficient to meet the anticipated growth of electricity demand.

Much progress in market liberalisation has been observed in the Spanish electricity sector since the last in-depth review of Spain was conducted by the IEA in 1996. Spain has taken a number of steps in a clearly defined manner and in a short time to facilitate fast market opening. Spain is liberalising the electricity market much faster than required by the EU directive and is aiming for full liberalisation at the beginning of 2003. The initial market opening in January 1998 covered 26.5% of the consumers, and this coverage has been gradually expanded to reach 54% of the consumers in July 2000. Spain has completed the necessary legislation and established new institutions, such as an independent regulator and an electricity pool, to create an environment that facilitates competition. However, some constraints for effective competition remain. Most of these are reflections of former energy policies applied in oligopolistic markets.

Electricity generation is dominated by two large power utilities representing about 80% of total generation. In addition, there are two smaller generators and some autoproducers. Competition can be enhanced by new entrants into the Spanish market, by further liberalising the gas sector, by structural reforms of the two dominant firms, and by electricity imports.

Competition in electricity supply will most likely appear as a result of investments in new generation capacity made by new entrants because electricity consumption is growing fast and many units are approaching the end of their life. There are some signs of new entrants. Foreign and new domestic investors, such as Repsol and Gas Natural, have submitted applications for establishing new generation capacity. The

practice of providing capacity payments to existing power generators, however, does not favour new entrants. The introduction of competition in the gas sector may reduce gas prices and could benefit new entrants. The incumbents do not have gas-fired power plants yet and are not allowed to increase their production capacity for the next three to five years.

In some countries (*e.g.* Australia, New Zealand and the United Kingdom) the government broke up concentrated generation assets by divesting the generation assets of large publicly-owned utilities to create several independent generating companies. In the United Kingdom and the United States, privately-owned utilities have, in response to incentives, agreed to sell generating assets to address regulatory concerns about the concentration in the generation market. However, in Spain, the utilities have sought to increase concentration. Endesa and Iberdrola initiated a plan to merge in October 2000 to reinforce their competitive position and obtain other advantages. On the recommendations of the CNE, the government set limits for the market share that a company can have in electricity generation and distribution, which led to abandoning the merger. Even if this particular merger did not materialise, others may be proposed in the future. A clear policy for mergers should be formulated.

Imports can only have a limited competitive influence because there are only a few, already congested, interconnections with neighbouring countries. Substantially increasing the interconnection capacity between Spain and France depends on the border interconnections. To date this has not been possible because of local environmental opposition. Electricity prices in Portugal and Morocco are comparatively high, limiting the prospects of competition arising from these sources.

The responsibilities of the existing electricity distributors, who are also the electricity generators, will change as new retailing companies start business in the liberalised market. It has not yet been decided what the status of the existing distribution companies will be when all consumers become eligible in two years. The government plans to maintain a regulated tariff as an option for small consumers. As some of the distribution companies are likely to become retailers, their activities in sales and distribution network management should be clearly defined and unbundled. Efficiency gains should be sought in distribution, for example by introducing international benchmarking.

System and market operations are completely – and transmission to a large extent – separated from the vertically-integrated utilities. Further separation is needed between the domestic and international operations of Spanish energy companies since they have developed, and are still increasing, significant business opportunities in Latin America. Effective unbundling of domestic and international operations is a prerequisite for ensuring that the electricity suppliers do not subsidise international operations by domestic revenues or *vice versa*.

It is essential for fair and effective competition that the market be properly regulated and the market players have a clear understanding of the rules of the game. It is very important that the Spanish government regulates without arbitrary

intervention and with transparency. In this regard, it was very encouraging that the government respected the recommendations by the CNE on the proposed merger of Endesa and Iberdrola. The government is strongly encouraged to continue such good practices.

Electricity pricing in the captive markets leaves room for improvement although prices have been reduced over the last few years. Until now, price reductions have resulted from lower production costs owing to amortisation of power plants and from lower interest rates in the financial markets rather than from efficiency gains following the introduction of competition. Increasing competition can lead to greater efficiency in electricity generation and other functions, and these efficiency gains resulting from market liberalisation should also benefit captive consumers. Currently, captive consumers bear a greater portion of energy policy costs than eligible customers. These costs should be shared in a more equitable and transparent manner. Furthermore, the government should study how to allocate energy policy costs to different consumers when all consumers become eligible.

Compared to the average ratio of 1.7 in OECD Europe for 1999, electricity prices for residential consumers in Spain were 2.6 times higher than those for industry. This raises a concern of cross-subsidy from small to large consumers. A single price for electricity is applied for captive consumers throughout the country, and the price does not necessarily reflect real costs, such as differences related to geographical location and the time of use. The tariffs should be set to reflect real costs and increase economic efficiency.

The costs of transition to competition (CTCs) form part of the energy policy costs that are included in the tariffs for consumers. The introduction of CTCs has had a number of benefits, such as increasing the transparency of stranded costs, hedging against the volatility of market prices, and making it possible for utilities to have relatively stable profits and customers relatively stable prices during the transition period. However, the size of the payments made to utilities to compensate for CTCs has been controversial[19]. The European Commission is currently reviewing the practice to determine if CTCs are fair compensation or state aid; a decision is expected in 2001.

In less than two years, all consumers will be eligible, but technical details are yet to be defined. With large consumers, it can be assumed that the time-of-use meters will be introduced. With small consumers, the cost of metering may be too high and become a significant barrier to switching suppliers. Many countries have chosen to prepare a load profile for different consumer groups, and the tendering process is based on these profiles. The consumers are charged according to the average cost that their group represents to the system. On the other hand, if metering is applied on a large scale, the cost of meters may be reduced. The consumers need to have full information in order to be able to choose the best suppliers, and the government should act immediately to ensure that effective information campaigns are launched.

19. See National Electric Regulatory Commission (1998): Report on Securitisation of Stranded Costs, IE 005/98, September 28, pp. 13-14.

In the last decade, the number of CHP units increased continuously and the electricity they supplied to the national network grew from under 2% in 1990 to 14% in 1999. The co-generation targets that were set by the government in PEN91 were exceeded. Today, most co-generation units in Spain are not competitive without the premium paid under the special system. The gas price increase in 1999 and the falling electricity prices have made industries hesitant to invest in co-generation. Some have even closed down their CHP facilities. On the other hand, efficient co-generators have remained competitive. There are no requirements for total fuel efficiency, efficiency of heat production or for the power-to-heat ratio[20]. As some parts of the country have a climate with cold winters and hot summers, IDAE should be encouraged to continue its studies on the potential and cost-effectiveness of using CHP for cooling. This would improve the total efficiency of installations where there is not adequate constant heat load.

Policy measures to promote efficient CHP should be carefully designed since efficient CHP should be competitive in nature and not need support. More attention should be paid to preparing an appropriate market environment, including the adjustment of buy-back tariffs and providing more certainty for the future. Currently, the back-up tariff may be discouragingly high because co-generators have to commit themselves to fixed charges for a whole year even though they may seldom need backup. It is also important that CHP generators can find cheaper gas, which should be possible once the planned liberalisation in the gas market has been completed as scheduled. On the other hand, subsidies to CHP, either direct or indirect, should be phased out. Spain is planning to do so for the larger CHP units in 2007 but will continue to give a premium to smaller generators.

Nuclear power is an important indigenous energy resource, covering about 30% of total electricity generation and 13% of TPES in the country. Spain should be commended for the excellent safety record and efficient operation of its nuclear plants. Sixteen years ago Spain imposed a moratorium on five nuclear units that were under construction at that time. The moratorium does not rule out nuclear power as an option for future capacity needs. Energy consumption is growing fast, and meeting and maintaining the Kyoto target is a real challenge, even with continued electricity production by existing nuclear plants. Given the long-term horizon of investments for large-scale power generation projects, Spain should immediately initiate quantitative analyses that compare the various technological options available for future generation and include environmental and economic aspects.

Despite the heavy investments that were needed in the past to develop the nuclear power industry, Spain recognises the economic attractiveness of fully depreciated nuclear units. One of the objectives of energy policy is developing appropriate and effective life extension programmes for existing nuclear power plants.

20. The power-to-heat ratio is used to describe the balance between the outputs of a co-generation plant. Generally, in well-designed plants it should be between about 0.2 to 1.0, depending on the technology and application. If the ratio is too high, the heat load is not sufficient for the plant to be competitive with separate production of heat and power.

Appropriate nuclear waste management is essential to keep the nuclear option viable, and progress and timely implementation of a plan for the final disposal of high-level radioactive waste is necessary. According to the Fifth General Radioactive Waste Plan, issued in 1999, the decision on the final disposal of spent fuel and high-level radioactive waste will only be taken after 2010. Nonetheless, it is recommended that a centralised interim storage facility for high-level waste be constructed by 2010.

RECOMMENDATIONS

The Government of Spain should:

- ☐ Encourage efforts to build new interconnections with neighbouring countries and increase the capacity of existing ones.
- ☐ Ensure that alliances between the gas and electricity companies are fully in line with market liberalisation and do not prevent new entries.
- ☐ Ensure efficiency and transparency in electricity tariff-setting for the captive markets; efficiency gains in generation and network operation should be reflected in end-user prices.
- ☐ Make that capacity payments and subsidies under the special system function effectively to enhance efficiency.
- ☐ Review subsidies for co-generation with a view to phasing them out fully.
- ☐ Assist in defining technical details for opening the market for small consumers and help them prepare for full market liberalisation in 2003.
- ☐ Assess the impact that retiring nuclear reactors would have on energy security, diversity of energy supply, the economy and the environment.
- ☐ Assess the extension of the operating lives of existing nuclear reactors.
- ☐ Ensure that progress is made in defining options and formulating a plan for the final disposal of high-level radioactive waste; ensure timely implementation of the programme for siting and building a centralised interim storage facility for high-level radioactive waste that is needed by 2010.

7

NATURAL GAS

DEMAND AND SUPPLY

Demand

Between 1990 and 1999, the proportion of natural gas grew from 5.0 Mtoe (5.5%) of the total primary energy supply to 13.3 Mtoe (11.2%), *i.e.* by 167%, and the number of consumers increased from 1.9 million to 3.8 million. The Gas Natural Group expects gas supplies to almost triple during the next ten years because gas use in power production is likely to increase significantly.

The growth in volume in the 1990s was mainly due to the increased use of natural gas for co-generation by autoproducers. The share of natural gas in electricity production grew from 1% in 1990 to 9.2% in 1999. The demand for natural gas for power generation is expected to at least triple between 1999 and 2010. Currently operating power producers and new entrants have submitted applications for authorisation to install 29 GW of new combined cycle gas turbine capacity.

The gas supply to industry doubled between 1990 and 1999, and the demand for natural gas in the industrial sector is expected[21] to grow by 28% from 1999 to 2010. Gas represents 25.4% of total final energy consumption by industry and this share is expected to increase slightly during the next ten years.

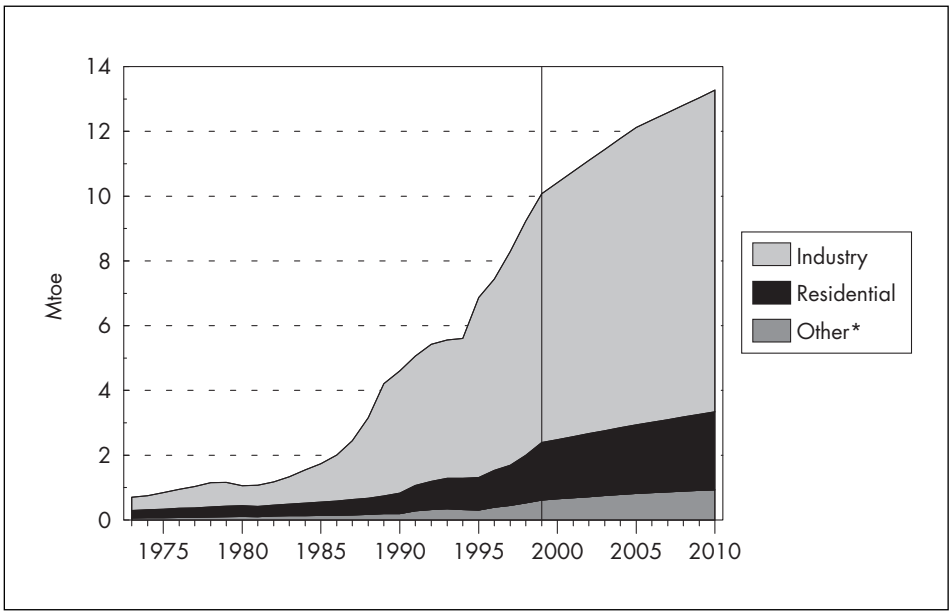
In the 1990s, natural gas has increased its importance as a source of heating in the residential and service sectors. Consumption of natural gas in these sectors tripled from 1990 to 1999, representing 11.8% of their final energy consumption and 18% of total gas demand in 1999. By 2010 gas is expected to account for 13.6% of the final energy consumption of these sectors.

Supply Sources

Natural gas supplies have grown rapidly during the last 20 years. They totalled 1.6 billion m^3 in 1980 and more than tripled to reach 5.4 billion m^3 by 1990, and then almost tripled again during the 1990s to reach 14.8 billion m^3 in 1999. That year the supply sources were Algeria (66%), Norway (15%), Libya (6%), Qatar (5%), Trinidad and Tobago (5%), United Arab Emirates (2%), indigenous sources (1%) and

21. All forecasts are based on country submission 2000.

Figure 18
Natural Gas Consumption by Sector, 1973-2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

Nigeria (0.5%). Imports from Nigeria and Trinidad and Tobago started only in 1999 and are expected to grow significantly, therefore increasing the diversity of supply. By 2000, the share of natural gas imports from Nigeria had already reached 10.9% of the total, whereas Algeria's share was reduced to 60%.

Norway has supplied natural gas to Spain through a pipeline since 1993, and Algeria has used the Maghreb-Europe pipeline since 1996. However, almost half of the Algerian supplies and all of the other supplies are imported as liquefied natural gas (LNG). Imports through the existing pipelines could be increased, but importing gas as LNG is likely to remain important. Regasification plants are located in Barcelona, Huelva and Cartagena; a fourth one will start operating in Bilbao in 2003, and a fifth one in Murgados (La Coruña) possibly in 2005. The total storage capacity of the three existing plants is 560,000 m^3 of LNG. The emission capacity at 16 bar is 0.05 million m^3 of natural gas per hour, at 45 bar it is 0.6 million m^3 per hour, and at 72 bar it is 1.45 million m^3 per hour. There are plans to almost double the storage and emission capacities at the existing plants by the year 2005. When the new plants start operation and the capacity at the existing plants has been increased, current total capacity will be tripled.

Table 8
Regasification Plants
(*italics* indicate extended and new capacity)

Plant location	*Storage capacity* m^3 *of LNG*	*Emission capacity* *Pressure (bar)*	m^3*/hour*
	Existing plants		
Barcelona	2 x 40,000 +	45	600,000
	2 x 80,000	72	600,000
capacity increase by 2005	*+ 150,000*	*72*	*to 900,000*
Huelva	60,000 + 100,000	16	50,000
		72	400,000
capacity increase by 2005	*+ 150,000*	*72*	*to 900,000*
Cartagena	55,000 + 105,000	72	450,000
capacity increase by 2005	*+ 130,000*	*72*	*to 900,000*
	New plants		
Bilbao (2003)	*2 x 150,000*		*400,000*
Murgados/La Coruña (possibly 2005)	*2 x 150,000*		..

.. = not available.

Source: National Energy Commission.

Most of the natural gas supply contracts are take-or-pay contracts for 20-25 years, with the exception of supplies from the Persian Gulf which are set by two-year contracts. Gas Natural's contract for LNG supplies from Algeria will expire in 2004 and be subject to renegotiation. The contract covering the supplies imported through the Maghreb-Europe pipeline is valid until 2020.

Natural gas from indigenous sources has decreased both in terms of volume and market share during the last ten years. The only indigenous field, the south-eastern on-shore Marismas field, has almost been completely exploited. Exploration activities in Spain have nonetheless increased since 1999.

Gas Infrastructure

Although gas has been used in Spain for a long time, the large-scale development of gas infrastructure started when PEN91 set an objective to raise the share of gas in Spain's energy consumption to be in line with gas consumption in other European countries. The main motivation was increasing fuel diversification.

Today, gas transmission pipelines cover most parts of the country and only one major new transmission pipeline is currently under study for the east-west axis. In 1999, the high-pressure transmission network had 6,645 km of pipelines, the

medium-pressure network had 16,017 km, and the low-pressure network had 10,957 km, compared to 5,740 km, 3,690 km and 4,535 km respectively in 1990. The distribution network has been rapidly expanding and covers all the regions of the Spanish peninsula, but there is still a need for further expansion.

The major project in the 1990s was the Maghreb-Europe pipeline, which was commissioned in 1996. The capacity of the pipeline is about 10 billion m^3 per year, but it can be expanded to about 20 billion m^3 per year by means of looping and by adding compressor stations along the route. The Spanish part of the pipeline is owned and administered by Enagas, and the Algerian part by Sonatrach, the state-owned Algerian gas company.

The gas network in Spain is still in a heavy investment phase. Investments in the natural gas infrastructure amounted to Pta 83 billion in 1997, 102 billion in 1998 and 126 billion in 1999. The majority of investments are used for improving and expanding the transmission and distribution networks. The pipelines in the planning or construction stage are shown in Figure 19.

Spain's second biggest oil/LPG company, Cepsa, and Sonatrach of Algeria have agreed to set up a joint venture to carry out a feasibility study on a new Algeria-Spain gas pipeline. This would compete with the Maghreb-Spain pipeline. As mentioned above, the project is at the feasibility study stage and it is not clear at this point if the project will be realised.

The Maghreb-Europe pipeline was opened in 1996 and started to transit gas in 1997. The total transit volume to Portugal was 2.3 billion m^3 in 1999. The Tuy (Galicia) to Leiria pipeline in the north was completed in 1998.

Security of Supply

The Hydrocarbons Act of 1998 sets an indicative limit for maximum natural gas supplies from any single country at 60%, and the same limit is applied to supplies from each individual supplier. Because Spain was heavily dependent on supplies from one country, namely Algeria, this limit was set to enhance supply security. According to the legislation, the proportion of Algerian supplies out of the total cannot increase, but their volume may increase if the volume of natural gas obtained from other sources increases as well.

In Spain storage practices are considered important for maintaining the security of supply. The Hydrocarbons Act of 1998 defines the storage obligations of different operators:

- Transporters who deliver gas to the system must maintain stocks equivalent to 35 days of their sales to distributors supplying the captive markets.

- Traders must maintain stocks equivalent to 35 days of their sales.

Figure 19

Natural Gas Infrastructure

Source: *Natural Gas Information 2000*, IEA/OECD Paris, 2001.

- Qualified consumers who buy from unauthorised traders must maintain stocks corresponding to 35 days of consumption.

In addition to LNG tanks at the regasification plants, Spain has built underground storage facilities in depleted gas fields – the Serrablo storage facility in Huesca in 1991 and the Gaviota storage facility in Vizcaya in 1994 – which have working capacities of 0.5 billion m^3 and 0.8 billion m^3 respectively. Other storage sites are being actively sought, and studies have been carried out in the Tagus and Ebro River basins, the surroundings of Madrid, Montilla (Córdoba), Cantabria, Jumilla, the salt area in Alicante and in Reus (Tarragona).

To increase the flexibility in gas supply, interruptible contracts have been made with 20% of the consumers who are offered discount prices. In practice, there have been no interruptions in gas supplies through pipelines although LNG supplies have been delayed on a few occasions because of bad weather conditions.

PRICES

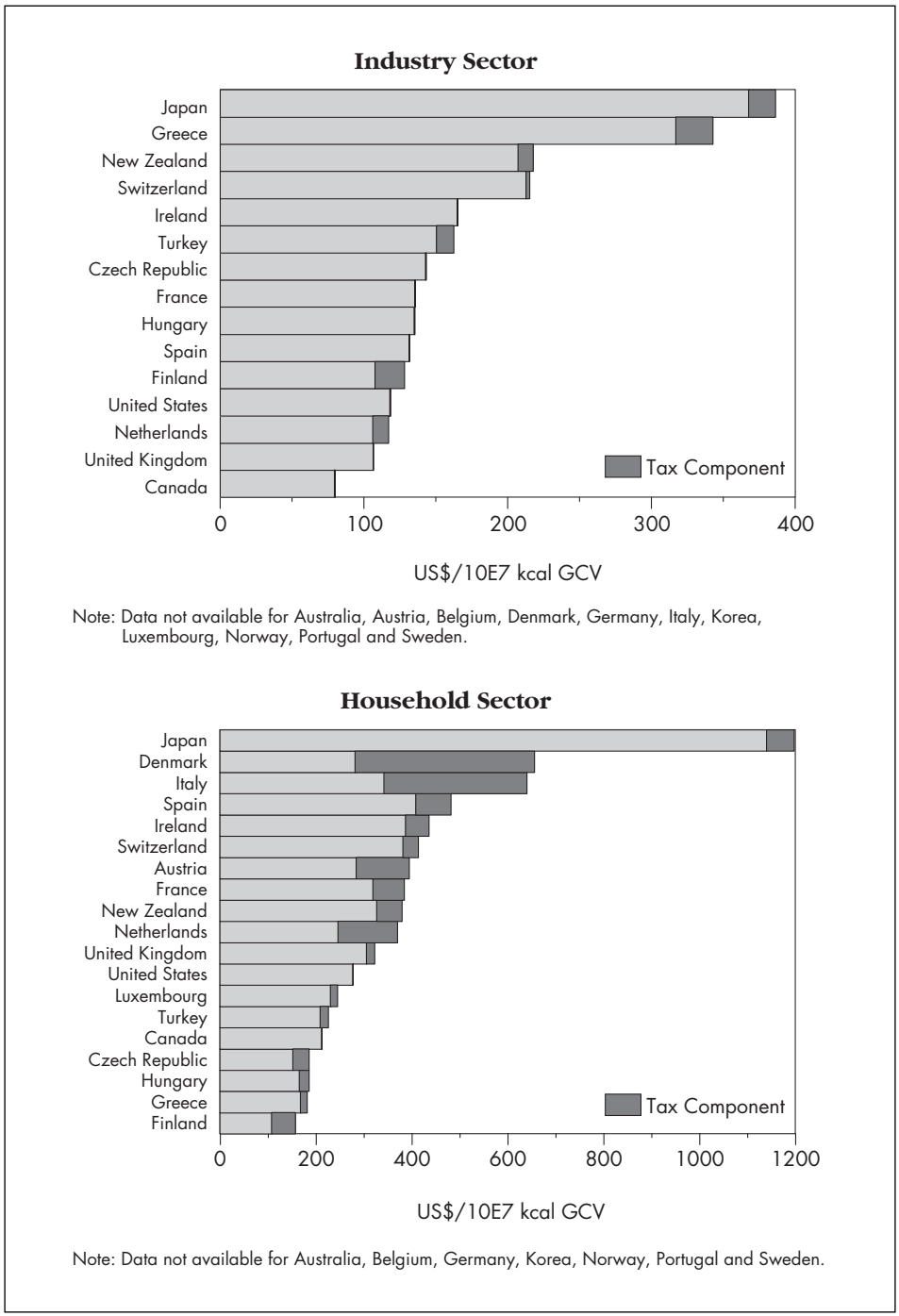
The government sets gas price ceilings for the captive markets, and these are uniform across the country. The maximum prices for residential consumers are set once every three months based on the changes in the cost of natural gas, and on transmission and distribution costs. For industrial consumers, they are set once a month based on the cost of competing energies. In the liberalised markets, the prices are set by the market and the government does not intervene. Prices of natural gas supplies to feedstock and power plants are not governed by price ceilings.

The natural gas prices for the industrial sector were mostly stable during the 1990s. However, in April 1999, these prices started to increase rapidly, and more than tripled by the end of 2000, at the same time as oil prices rose. During the same period, the prices for households and other small users, including small industrial consumers, did not increase as sharply (only by 30%). Also, the difference in tariffs for consumers with guaranteed supply and those with interruptible contracts became negligible.

Natural gas prices for residential and other small consumers have been consistently higher in Spain than the average for OECD Europe, but they have been comparable for industrial consumers and electricity generators (see Figures 20 and 21). For example, the gas price (after excise taxes but before VAT) for residential consumers was about 3.2 times higher than for industrial consumers in 1999. In the same year, this price ratio was 1.8 in Switzerland, 2.1 in Ireland, 2.4 in France, 2.7 in the Netherlands and 2.9 in the United Kingdom. However, the price difference in Spain has decreased since April 1999 reaching the ratio of 2.4 in the third quarter of 2000.

Figure 20

Natural Gas Prices for Industry and Households in IEA Countries, 1999



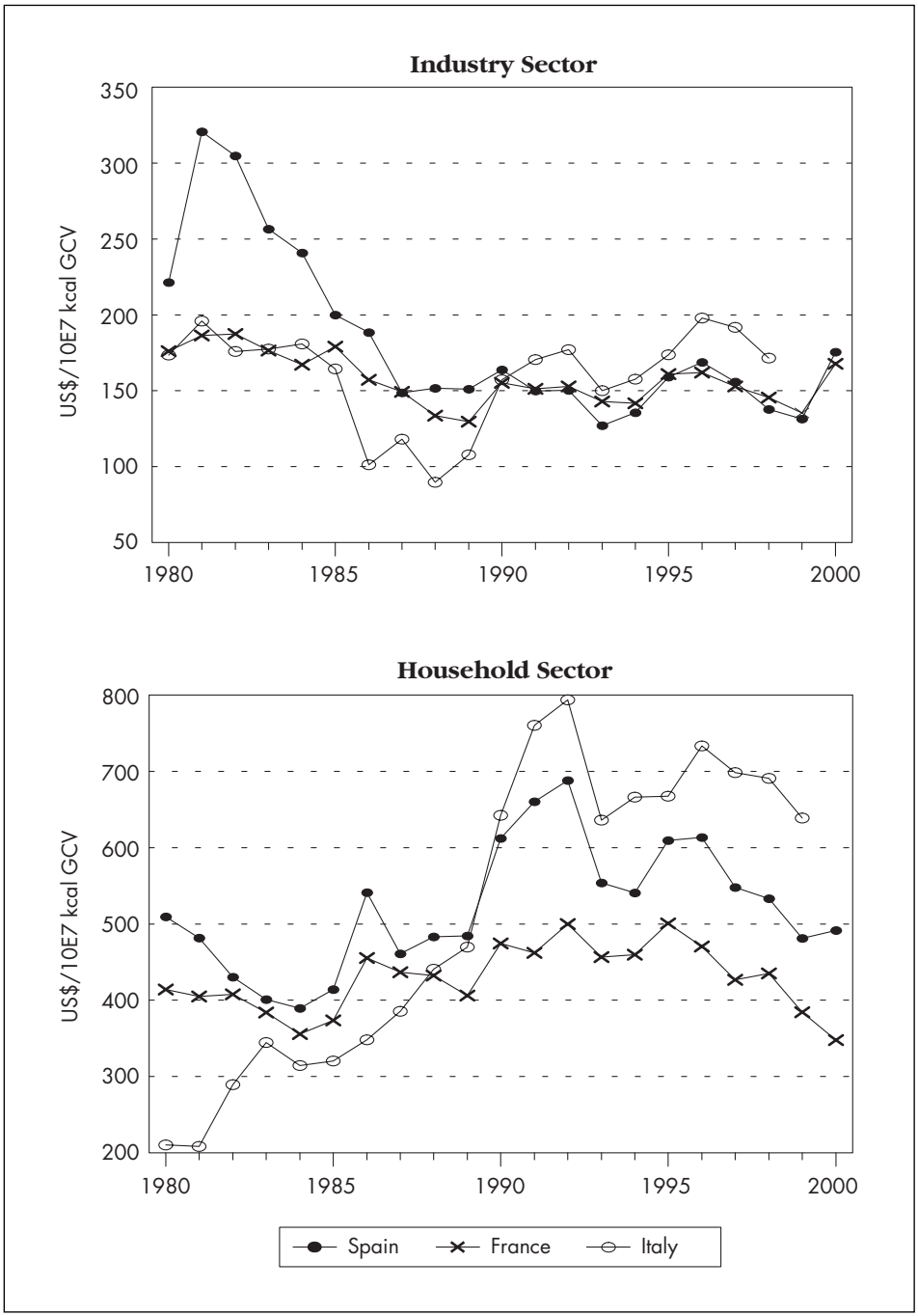
Note: Data not available for Australia, Austria, Belgium, Denmark, Germany, Italy, Korea, Luxembourg, Norway, Portugal and Sweden.

Note: Data not available for Australia, Belgium, Germany, Korea, Norway, Portugal and Sweden.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Figure 21

Natural Gas Prices in Spain and in Other Selected IEA Countries, 1980-2000



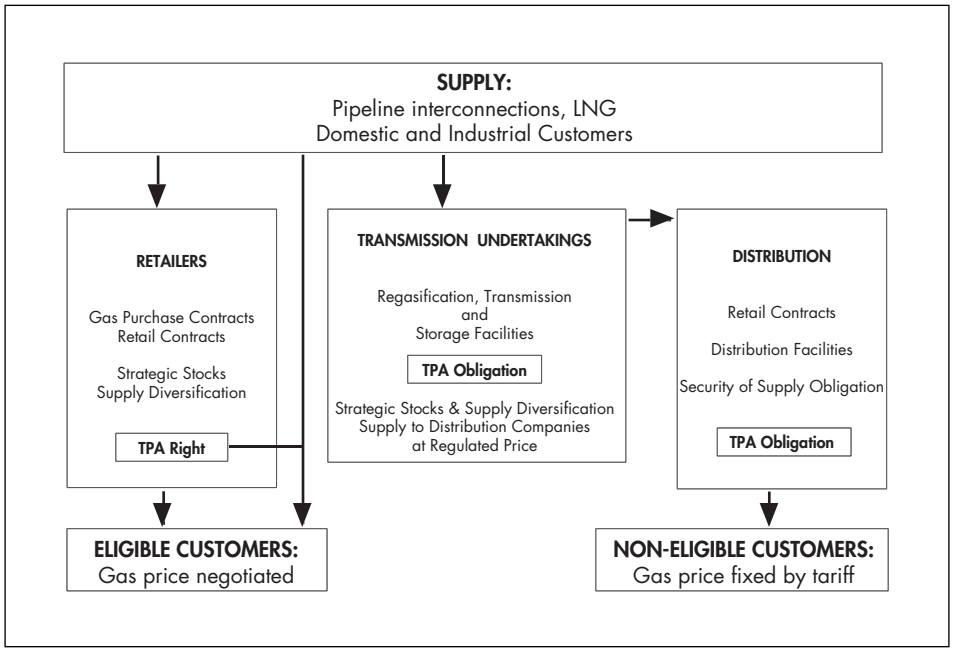
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

INDUSTRY STRUCTURE

Figure 22 presents the gas industry structure after new legislation was introduced in 1998 (see the following section on Introduction of Competition). Gas transmission, regasification, storage and distribution remain regulated activities, whereas production, import and trading are unregulated. The gas market operators are required to unbundle their regulated activities by account separation and to legally separate their regulated and unregulated activities.

The Gas Natural Group is the dominant player in the Spanish gas market. The group is vertically integrated and covers all areas of business from import to retail. It was created in 1991 when the two major gas companies at the time, Catalana de Gas and Madrid Gas, merged and acquired the piped gas distribution assets of Repsol. In 1994, the group acquired Enagas, a company which was then responsible for gas supplies and the management of the high-pressure gas network and storage. The core of the group is the distribution company Gas Natural, whose main shareholders are Repsol-YPF (45.3%) and la Caixa (26.1%). The remaining 28.6% of the shares are held by 20,000 shareholders. The State does not hold any shares, not even a "golden share".

Figure 22
Natural Gas Market Organisation



TPA: third party access.
Source: National Energy Commission.

Following market liberalisation, the share of natural gas supplies held by the Gas Natural Group decreased from 100% of total supplies to about 90% in 2000. The remaining 10% were covered by Cepsa Gas Comercializadora S.A. and Endesa Energia S.A. who imported gas for their own use, and by BP Amoco Gas España S.A. and Shell España S.A. who imported gas for distribution to their customers. Unión Fenosa has entered into a contract with the Egyptian General Petroleum Company for the delivery of 4 billion m^3 of LNG per year from Egypt to Spain as of 2004. This volume is equivalent to about one-fourth of Spain's current demand.

Since entering the Gas Natural Group, Enagas has continued its supply and transmission functions. Following the passing of the Hydrocarbons Act in 1998, the distribution assets of Enagas were transferred to Gas Natural and the transmission assets of Gas Natural were sold to Enagas. Enagas has been owned by Gas Natural since 1994, and its shares will be made available to new partners following Enagas's nomination as the Transmission System Operator (see Introduction of Competition below) in 1998. However, as of June 2001, there was only a draft ministerial order for changing the shareholding structure with no firm date set for bringing this about.

Another gas supplier licensed for gas transmission is the Sociedad de Gas de Euskadi (Naturgas by its commercial name), which operates only in the Basque Country in the northern part of the peninsula. Its shareowners are the Basque Energy Board (79.5%) and Enagas (20.5%). The total supplies of Gas de Euskadi were 0.02 Mtoe to about 120,000 consumers in 1999.

In Spain, the natural gas distribution activities are operated by 28 regional distribution companies; 14 of these belong to Gas Natural, which owns about 90% of the distribution networks. Following gas market liberalisation, the distribution companies will only operate the network, and sales of gas will be made by trading companies. In January 2001, there were 19 licensed traders, including some of the big power utilities.

INTRODUCTION OF COMPETITION

First steps towards market liberalisation were taken in 1996 when the Royal Decree 2033/1996 entered into force. It introduced negotiated third party access (TPA) to the gas networks and to the regasification plants. It also stipulated that customers with an annual consumption of at least 1.2 million m^3 per day were free to choose their suppliers. The Royal Decree 1914/1997 introduced regulated TPA, and reduced the threshold for becoming an eligible customer to consuming 25 million m^3 per year.

The Hydrocarbons Act (Law 34/1998) transposed the EU directive regarding the internal gas market into Spanish legislation. The law determined the implementation plan for natural gas market liberalisation with the introduction

of progressive liberalisation and elimination of the public service requirements for gas suppliers.

The Royal Decree of 23 June 2000 on Urgent Measures for Increasing Competition in Goods and Service Markets (6/2000) modified the Hydrocarbons Act. The objectives of the decree are to speed up market liberalisation, make the entry of new trading companies easier, improve the operation of the gas system and encourage competition. The decree:

- Limits the market share of any supplier to 70% from 2003.

- Introduces the Transmission System Operator (TSO), who is responsible for the technical management of the natural gas transmission and distribution networks and storage facilities; Enagas has been nominated as the TSO; the law limits the shareholding of any single owner of the TSO to 35%; (specifically the TSO takes care of system reliability control, system use and storage management, and makes proposals for network reinforcement; and the TSO has to keep separate accounts for transport, regasification and storage functions).

- Stipulates that 75% of gas coming from Algeria through the Maghreb-Europe gas pipeline is assigned to the TSO for sale to distributors who supply gas to captive consumers at regulated prices; that the remaining 25% is destined for the liberalised markets through trading companies; and that the allocation procedure between the traders must be transparent and non-discriminatory.

- Requires that the transmission network access fees and the tariffs for captive consumers reflect cost (the deadline for introducing new fees and tariffs was set for the beginning of 2001, but implementation has been delayed); until the new access fees are introduced, the current regulated fee is applied with an 8% discount.

- Moves forward (from 2008 to 2005) the end of Gas Natural's exclusive rights to build new distribution networks.

- Limits to 3% the shareholding participation of any other operators of the same market or sector.

- Gives the National Energy Commission the authority to propose settlements in case of complaints from market players regarding regulated activities.

The liberalisation schedule introduced in the Hydrocarbons Act was already faster than the minimum requirement of the EU directive. This schedule was further accelerated by Royal Decrees 6/1999 and 6/2000. The former decree sets the deadline for full market liberalisation at the beginning of 2008, and the latter moves the deadline forward to the beginning of 2003.

Table 9
Schedule for Natural Gas Market Liberalisation

Date	*Eligibility*	*Market opening*
1 January 1999	Annual consumption > 10 million m^3	61%
1 June 2000	Annual consumption > 3 million m^3 and all generation and co-generation plants	72% (Directive requires 30% in 2000)
1 January 2002	Annual consumption > 1 million m^3	79%
1 January 2003	All consumers	100% (Directive requires 38% in 2005 and 43% in 2010)

Source: Energy Administration, Ministry of Economy.

At the end of 2000, only 13.5% of the eligible consumers exercised their right to buy from the liberalised market. This is essentially explained by the limited number of suppliers. For 2001, the CNE estimates that this share will increase to 53%.

CRITIQUE

Natural gas was introduced on a large scale to the Spanish market in the 1990s, later than in many other European countries. In a short period, Spain has developed a large supply network as well as a legal framework, enhancing competition. In 1999, gas contributed 11.2% of total primary energy supply. Gas Natural estimates that gas demand will increase by a factor of three between 1999 and 2010.

As energy consumption grows sharply, security of supply has become an important policy objective for the country. In this respect, Spain has made considerable progress in the diversification of supply sources and the expansion of storage capacity. So far, there has been no disruption in supply. While energy consumption is still growing strongly, the pace may slow down as the markets mature. It is thus important for the government to monitor carefully the markets and forecast future consumption levels to help market players make appropriate investment decisions. The gas industry is already planning further action to ensure adequate supply. The capacity of the existing LNG terminals is being increased, new regasification plants have been planned, and the possibilities of increasing gas supplies through a new pipeline are being studied. A careful study should be made to assess the costs and benefits of alternatives to additional supply sources and the impacts of supply disruptions.

It is commendable that Spain is liberalising the gas market faster than required by the EU directive. Spain took its first action towards market liberalisation in 1996, and today 72% of the market has already been liberalised. Full liberalisation is scheduled for 2003.

It is encouraging to see that as many as 19 companies had received supply licences before January 2001. However, only five new licence holders started their supply activities in 2000. In April 2001 the number of licences had increased to 23. The requirement that the market share of any single supplier may not exceed 70% as of 2003 is likely to enhance competition. The effectiveness of this regulation is subject to the measures that the government will take to enforce it.

In 1998, the conditions of the Spanish gas market were such that the decision to adopt regulated TPA to replace negotiated TPA originally introduced in 1996 was a good one. The government discovered that negotiations were generally lengthy and particularly difficult when the parties were not on equal footing. Also, final consumers requested more stability. However, in regulated TPA, appropriate tariff-setting and timely revision are essential for successful market operation, and the government needs to ensure that the regulatory functions are carried out efficiently. Though legislation has been completed in this respect, all technical details have not been defined yet. New access fees to the network and the LNG terminals, based on cost, which were supposed to have been introduced at the beginning of 2001, still need to be set, creating some uncertainty for market players.

The stock obligation for gas suppliers, traders, and in some cases consumers, has been introduced to enhance the security of supply. This could also become an entry barrier unless the government ensures that available storage capacity is adequate for new entrants and that the market players have non-discriminatory access to storage facilities.

To increase the security of supply, the Hydrocarbons Act sets an indicative limit of gas supplies from any single country and for each supplier at 60%, with the exception of gas supplied to facilities with guaranteed alternative supplies of other fuels. According to the law, the Energy Administration should define the technical interpretation of the requirement. Algeria is currently the cheapest source for natural gas. The supplies from Algeria are based on long-term contracts and are subject to the 60% limit. For fair and effective competition, new market entrants should be ensured access to this economical gas source. When the LNG contract between Gas Natural and Algeria ends in 2004, the opening quota for imports from Algeria should be allocated in a fair and transparent manner. The government has recognised the problems that are caused to new entrants by the pipeline supply contract between Gas Natural and Algeria. New legislation introduced in 2000 therefore allocates 25% of the gas imported through the pipeline to the trading companies, *i.e.* to the liberalised markets, whereas the remainder goes to the distribution companies to be sold at regulated rates. This, together with access to Algerian LNG supplies after 2004, is likely to increase the competitiveness of the new entrants.

Current legislation requires effective unbundling of activities. Enagas was appointed as the Transmission System Operator and the shareholding of its former owner, Gas Natural, and any other owner, has been limited to 35%. Gas Natural still owns half of the distribution companies and has established a new trading company which is the largest in Spain. It is very important for the government to ensure that the incumbent will not undermine competition with its dominant influence. The

government should monitor the development of competition and should take further steps to enforce unbundling if competition is found to be insufficient.

In less than two years, competition will be extended to all consumers, including residential consumers. However, technical details have not yet been set. It is important for the government to set them immediately and provide customers with full information so that they can take advantage of the competitive markets.

Currently, the government sets price ceilings for captive consumers every three months. When prices are rising, these help avoid a sharp increase, but there is a risk of undermining investment and encouraging gas consumption, possibly leading to a disruption in supply, if the maximum price is set too low. On the other hand, in a situation where competition has not grown sufficiently, such ceiling prices may work as guiding prices and lead to actual prices that are higher than costs. The government needs to assess carefully the effects of price caps and rectify any problems that are found. Eliminating price caps is one option. The difference in prices for small and large consumers has been consistently much wider in Spain than in most other European countries, though this difference decreased in 1999, and now approaches European averages. Past pricing implies cross-subsidisation between large industrial customers and small consumers. The tariffs should be set in a transparent way that ensures that small consumers do not cross-subsidise large consumers. The government should ensure that any efficiency gains leading to a reduction in the cost of transmission and distribution following market changes benefit both the captive consumers and those buying from the market.

RECOMMENDATIONS

The Government of Spain should:

- ☐ Monitor the growth of the gas sector and investigate the possible effects of a major gas supply disruption, using cost-benefit analysis and taking into account the consequences to interruptible consumers and gas-fired power plants; set up an emergency plan.

- ☐ Encourage the construction of new liquefied natural gas terminals and gas network interconnections with neighbouring countries, and augment the capacity of existing interconnections and terminals.

- ☐ Complete promptly the regulatory framework for third party access to gas networks, LNG terminals and storage facilities.

- ☐ Ensure that the enforcement of the 60% cap on natural gas imports from a single country does not become an obstacle for new entrants.

- ☐ Assist in defining the technical details for opening the market for small consumers and help them prepare for full market liberalisation in 2003.

- ☐ Ensure transparency and efficiency in gas tariff-setting for captive markets during the transition period; efficiency gains should be reflected in end-user prices.

8

OIL

DEMAND, SUPPLY AND TRADE

The share of oil in total primary energy supply decreased significantly between 1973 and 1990, from 73.3% to 51.3%, but increased again in the 1990s, reaching 53.8% in 1999. Between 1990 and 1999, total oil consumption grew from 46.5 Mtoe to 63.8 Mtoe, that is by 37%. Final oil consumption grew by 7% in the transport sector and by 12% in the industrial sector, but decreased by 14% in the residential and commercial sectors between 1990 and 1998. Total demand is expected[22] to grow only slightly, by 5%, from 1999 to 2010. The major reason for expectations of slower growth in oil consumption is that the transport and industrial sectors are not likely to grow as much in the next decade as they did in the 1990s. Furthermore, the use of oil for power generation is expected to decrease slightly, although this may fluctuate considerably from year to year in response to hydropower production which depends on weather conditions.

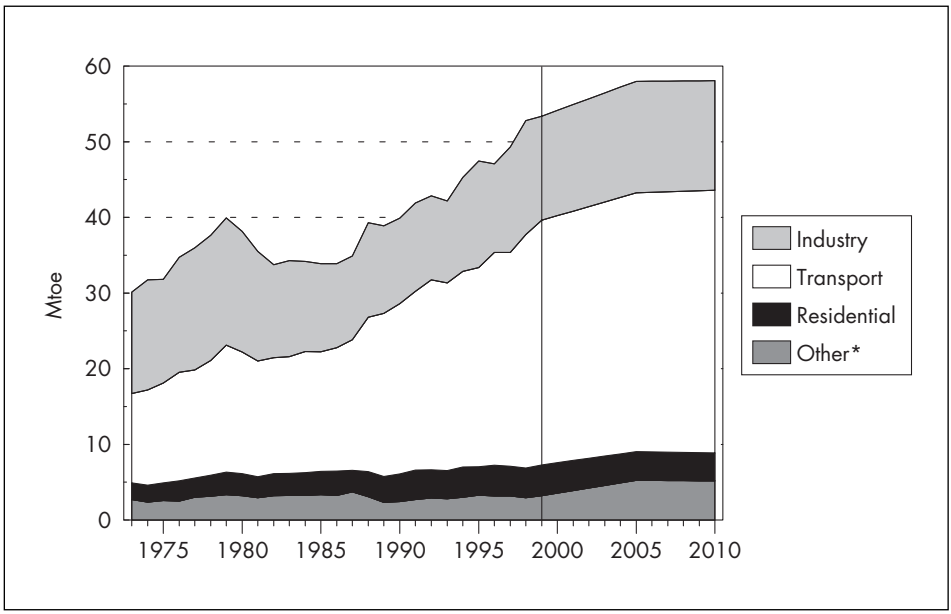
The volume of oil in total final energy consumption increased from 30.1 Mtoe in 1973 to 39.9 Mtoe in 1990. In the 1990s the growth rate nearly doubled, and the volume of oil grew to 53.4 Mtoe in 1999. Transport, the major oil consuming sector, accounted for 61% of final oil consumption in 1999. Energy and other industries were the second largest consumers, accounting for 26%. Heating oil in the residential and commercial sectors and some oil products used in the agricultural sector for machinery and heating green houses mostly made up the remaining 14%.

During the next ten years it is expected that final consumption of oil will grow by some 8%. The growth of total final oil consumption will be a bit higher than the growth of total primary energy consumption because the latter also includes the use of oil for power generation, which is expected to decrease. Slight growth in oil consumption is expected in all of the end-use sectors (see Figure 23).

In 1998, the share of diesel in the consumption of transport fuels was 55% and that of gasoline was 30%. The rest included aviation and other fuels, such as natural gas. Economic growth, as well as the increase in the number of passenger cars and in kilometres travelled were the primary reasons for greater fuel consumption in the transport sector. Compared to gasoline, the lower tax for diesel and its higher fuel efficiency stimulated demand for diesel. Growth in the consumption of gasoline levelled off in the late 1990s. In 1999, the consumption of unleaded gasoline surpassed that of leaded gasoline for the first time and the sale of leaded gasoline ended on 1 August 2001. The demand for aviation kerosene is increasing, reflecting growth in the tourism sector.

22. All forecasts are based on country submission 2000.

Figure 23
Final Consumption of Oil by Sector, 1973-2010



* includes commercial, public service and agricultural sectors.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

In terms of volume, liquefied petroleum gas (LPG) consumption in Spain is among the highest in OECD Europe. Consumption was 2.6 million metric tonnes in 1999, which has been the consumption level for the last 20 years with some fluctuation. About 11.5 million households use LPG for cooking and, to a lesser extent, for water and space heating.

Spain has some indigenous oil sources, but these cover less than 1% of demand. Domestic supplies have decreased from their peak of 1.8 million metric tonnes in 1984 to 0.3 million metric tonnes in 1999. The main domestic source of oil has been the Casablanca fields in the Mediterranean Sea. Most of the crude oil is imported, and imports have been growing. In 1999, total crude oil imports were about 58 million metric tonnes, 59% of which came from OPEC countries; the main crude oil suppliers were the Middle East with 32%, Nigeria 15%, Mexico 12% and Libya 11%.

Although Spain exports oil products, it is a net importer, and such imports have been slowly increasing. In 1999, 23% of total oil imports, or 17 million metric tonnes, were oil products. The imports came from diverse sources, the largest being Italy followed by Algeria, the United States, the former Soviet Union and the United Kingdom. The volume of oil product exports has been fluctuating. In 1999, Spain exported different oil products, a total of 6.9 million metric tonnes, mainly to the United States and Western Europe.

Altogether, investment in oil and natural gas exploration amounted to Pta 16.5 billion in 1996-1999. During this period, 18 exploratory drillings (10 onshore and 8 offshore) were carried out and new fields were discovered near the Casablanca area in the Mediterranean Sea. Moreover, 13 investigation permits have been granted (5 for onshore and 8 for offshore exploration).

PRICES

Transport fuel prices in Spain are among the lowest in Europe (see Figures 24 and 25). The pre-tax prices are about the same as the European average, but the tax level for these fuels is lower in Spain. In addition, the taxes on diesel (52% of the retail price) were lower than for gasoline (60.2%) in the first quarter of 2001. The excise tax for transport fuels is a fixed amount that is set usually once a year by the government. Figure 26 shows the difference in some fuel prices for industries and households, and the tax component of these prices in 1999. All consumers pay the same taxes for oil products.

The Hydrocarbons Act (34/1998) liberalised the pricing of petroleum products, except for LPG in some cases. Specifically, the price of LPG supplied by cylinder with a weight equal to or over 8 kg and that of LPG supplied by pipeline are subject to price ceilings set by the Ministry of Economy. These are evaluated twice a year for LPG supply by cylinder and monthly for supply by pipeline, and are set on a cost-plus-profit basis. The price ceilings will be maintained as long as there is not enough competition in the market. At present, LPG is subject to only a 7% VAT, and the prices for this fuel in Spain are about half of the European average.

Legislation (Royal Decree 6/2000) obliges retailers to inform the Energy Administration about the price evolution of petroleum products. Since August 2000, the fuel prices at almost all of the Spanish filling stations have been published monthly by the administration on the Internet, with a comparison to prices in other EU countries. The public has shown interest in price information and the site had attracted more than one million visitors by the end of January 2001.

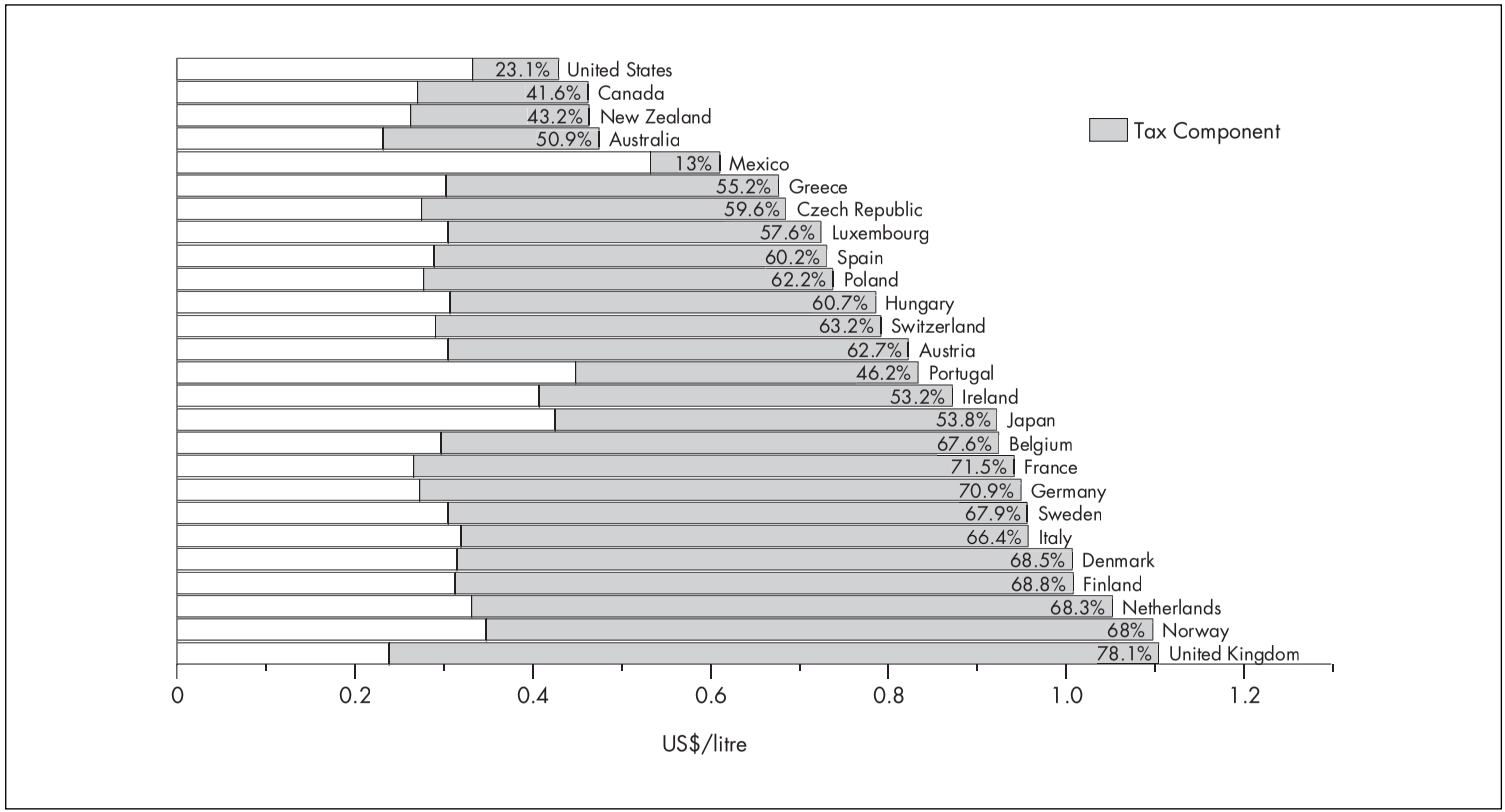
INDUSTRY STRUCTURE

Though the oil market has been opened to competition and new players have emerged, there is still considerable concentration in refining, transport and retailing. More competition is emerging in the wholesale market.

Spain has ten refineries, of which nine are located in different parts of the peninsula and one in the Canary Islands. The total refining capacity is 65 million metric tonnes per year. The majority of the refining capacity is owned by Repsol and Cepsa, and Petronor and BP have one refinery each. Repsol was a state-

Figure 24

Gasoline Prices and Taxes in OECD Countries 1st Quarter 2001

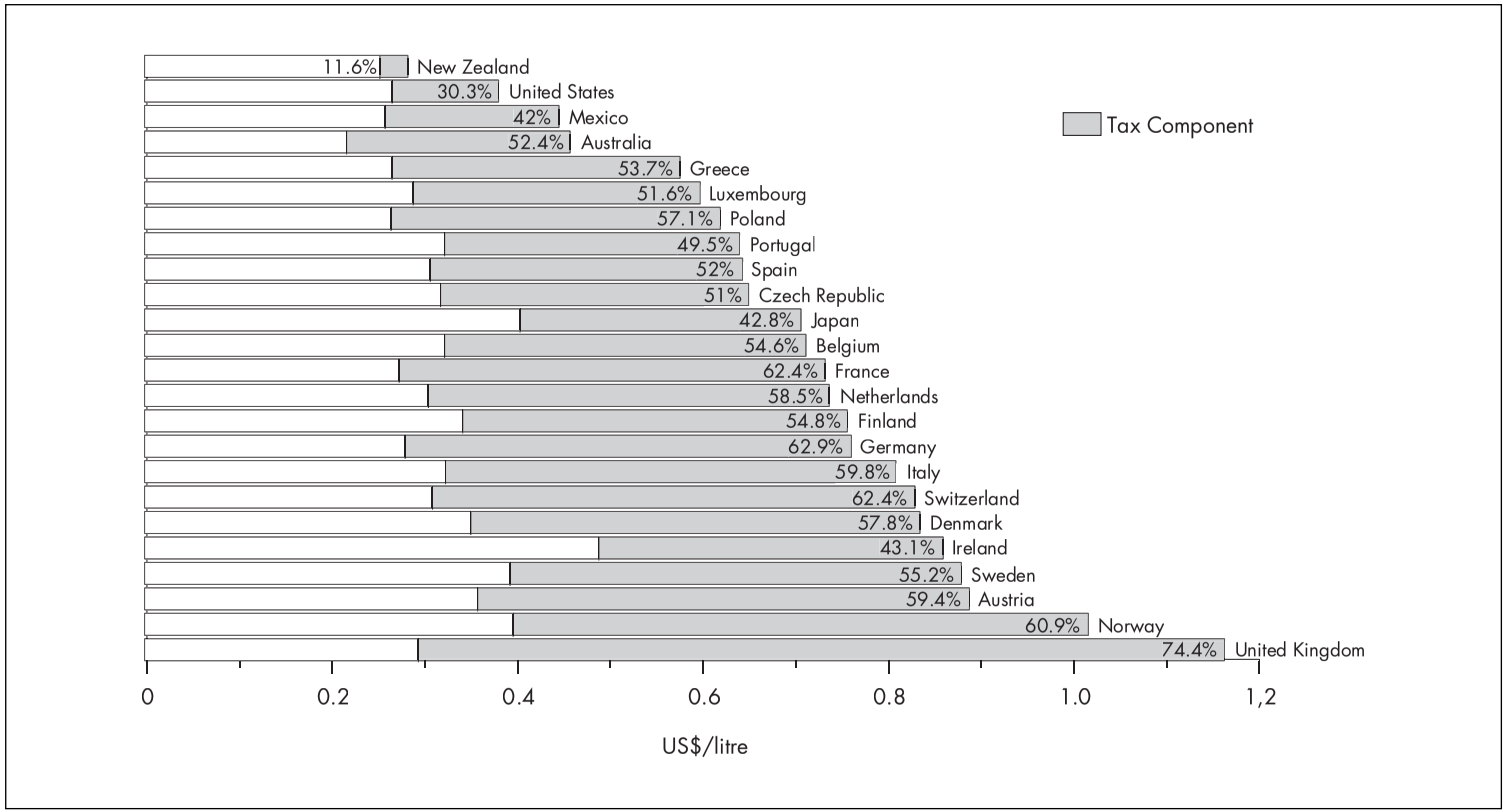


Note: Data not available for Turkey.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

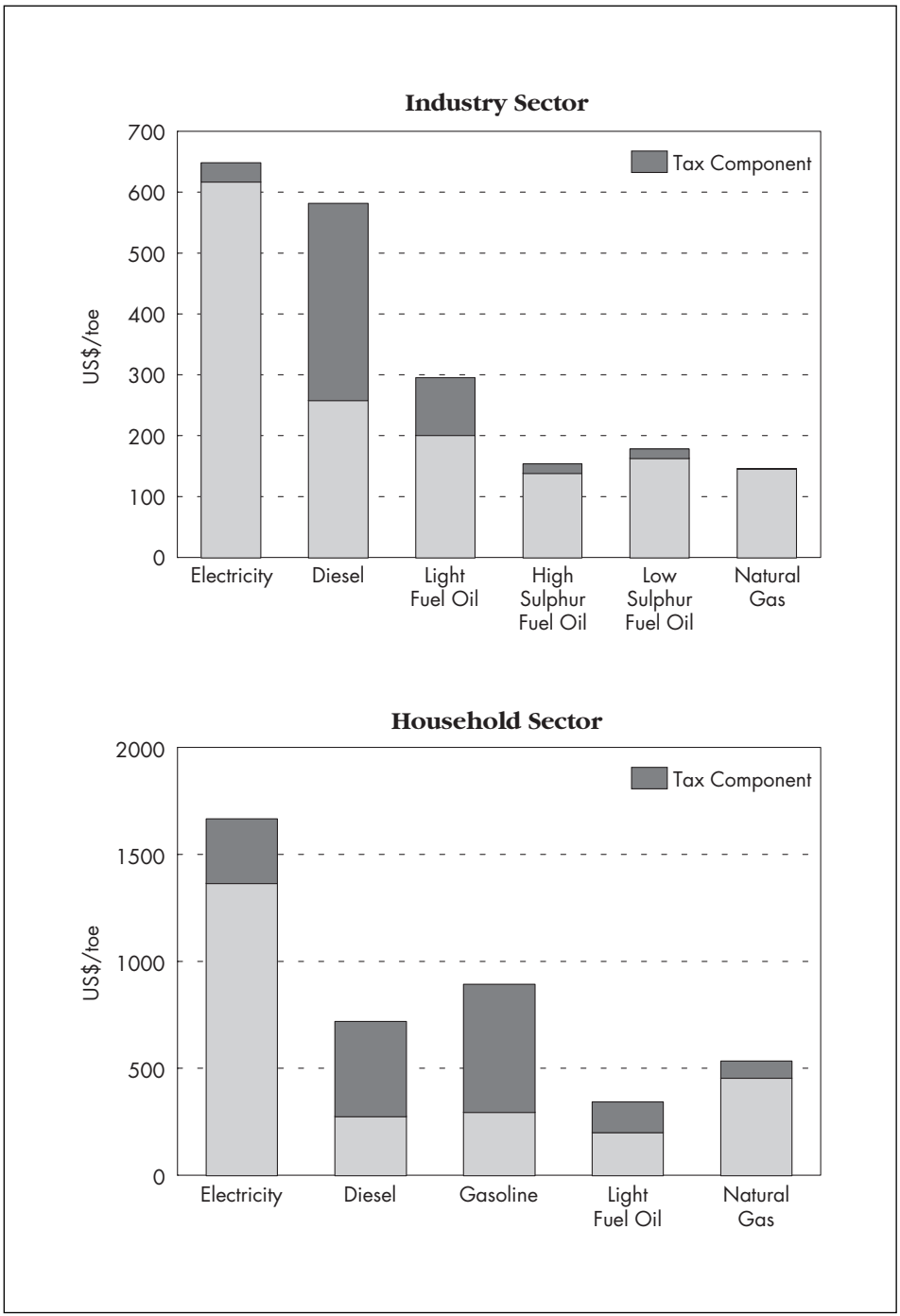
Figure 25

Automotive Diesel Prices and Taxes in OECD Countries, 1st Quarter 2001



Note: Data not available for Canada, Hungary and Turkey.
Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

Figure 26
Fuel Prices in Industry and Household Sectors, 1999



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2001.

owned company that has been gradually privatised[23]. Today, the government holds only one preferential share (golden share) in Repsol with a power of veto over strategic decisions. Cepsa[24] has been a private company since its creation in 1929. Petronor's main shareholder is Repsol[25].

Table 10
Refining Industry

Refinery	*Capacity* *Million metric tonnes/year*	*Owner*
Tenerife	4.3	Cepsa
Castellon	6.0	BP Oil España S.A.
Cartagena	5.4	Repsol
Huelva	4.9	Cepsa
La Coruña	6.0	Repsol
Puertollano	7.5	Repsol
Tarragona	1.1	Repsol
San Roque	10.6	Cepsa
Bilbao	11.0	Petronor
Tarragona	Produces bitumen	Asesa (50% Repsol, 50% Cepsa)

Source: Energy Administration, Ministry of Economy.

The *Compañía Logística de Hidrocarburos* (CLH) transports about 95% of oil products in Spain and owns most of the logistics, including storage facilities, pipelines, trucks and tankers. The Ministry of Defence still owns one major pipeline which was originally built for strategic reasons. At present, CLH has an administrative concession to use this pipeline, which is the "backbone" of the pipeline system for oil. CLH used to be a state-owned company but was privatised during the market liberalisation process. By law, the shareholding of any single owner of CLH is limited to 25% of the shares and voting rights. This is not strictly enforced because the government has not yet set a time frame for changing the ownership structure (by April 2001, no changes had taken place). Currently, the shareholders of CLH are Repsol 48.35%, Petróleos del Norte S.A. 13.11%, Cepsa

23. Repsol's shareholders are Bilbao Vizcaya Argentaria Bank, Barcelona Pensions and Savings Bank, Pemex and Repinves S.A (each with 5-10% share), different Spanish enterprises, funds, employees and private owners (altogether 32.5%), American investors (15.9%), European investors (17.2%) and the Government of Spain with one preferential share.
24. Cepsa's shares are held by TotalFinaElf, Santander Central Hispano Bank, Unión Fenosa and International Petroleum Investment Co.
25. Petronor's shareholders are Repsol (86%), Bilbao Bizkaia Kutxa (11%) and Compañía Logística de Hidrocarburo (3%).

25.1%, BP Oil España S.A 7.61%, Shell España 5% and others 0.83%. CLH and other smaller logistical operators have to grant third party access to their storage and transport facilities based on published access fees.

In January 2001, there were 35 wholesalers who had obtained a licence from the Ministry of Economy. Typically the wholesalers are owners of the refineries and their subsidiaries.

The distribution of oil products is still concentrated. In 1999, the share of Repsol in distribution was 44% (49% in 1995); Cepsa/Elf, 21% (25% in 1995); BP/Mobil, 7% (6% in 1995); and others, 28% (21% in 1995). In contrast to most other European countries, the number of filling stations in Spain is increasing; there were about 7,600 stations in 1999 as compared to about 6,300 in 1993.

Though supply and retail of bottled LPG has also been liberalised, in practice there is only one retailer, Repsol Butano (Repsol Gas), which controls 94% of the bottled LPG market. A few other companies have acquired supply licences, but their market share has remained marginal. Potential competitors claim that the price ceiling mechanism makes the profit margins too small for new entrants.

MARKET LIBERALISATION

The beginning of market liberalisation in the oil sector dates back to the late 1980s when new entrants were allowed into the market. The adaptation of the Spanish oil sector to the European Community framework was initiated in 1991. A year later, the passing of Law 34/1992 liberalised imports, distribution and sales of crude oil, and oil markets. The legal monopoly of Campsa, the state-owned import, transport and sales company, was abolished and CLH was created. CLH started to set the tariffs for access to transport facilities and prices were the same for every contractor. The former Ministry of Industry and Energy and the regions started to issue administrative authorisations for construction, refining, transport and distribution. The filling stations were given a choice either to stay under an old concession system with formal rights and obligations, or to adopt the new system of administrative authorisation. About 150 retailers chose to stay with the old system.

The new basic laws governing market liberalisation in the oil sector are the Hydrocarbons Act (law 34/1998) and two Royal Decrees (laws 15/1999 and 6/2000). The Hydrocarbons Act provides that the construction, start-up or closing of refining facilities, and the construction and operation of transport and storage facilities for petroleum products, are still subject to prior administrative authorisation. Authorisation for refineries and inter-regional transmission or exploration are granted by the Ministry of Economy, and for storage facilities by the autonomous regions. The law requires that the authorisation be objective, transparent and non-discriminatory. The law stipulates that the owners of fixed storage and transport facilities must allow access to third parties by a negotiated procedure, under non-discriminatory, transparent and objective technical and

economic conditions, applying prices that must be made public. The act liberalises the wholesale markets, but wholesalers nonetheless have to be registered with the Ministry of Economy in order to receive authorisation. This can be denied only if the wholesaler has not managed to prove compliance with the emergency stock requirements and does not have the legal, technical, economic and financial capacity to carry out the activity. The act has also removed restrictions from oil product distribution. The old concession system was completely abolished and distribution may be carried out by anyone who can meet the technical and safety criteria and the requirements of other laws, such as user and consumer protection. The distributors that meet the criteria and legal requirements are registered by the autonomous regions and in a central registry at the Ministry of Economy.

The Royal Decree 15/1999 aims at enhancing competition in retailing. It requires the government to set conditions for the installation of information panels along roadsides to inform consumers about the prices at the next filling stations. The decree also sets the planning criteria for determining the minimum number of filling stations needed in different areas of the country.

The Royal Decree 6/2000 (Law on Urgent Measures for Increasing Competition in Goods and Service Markets) modified the Hydrocarbons Act. The objective of the decree in the oil product markets is not only to enhance competition further but also to improve the level of service. It stipulates that:

- No single owner is allowed to have more than 25% of the shares or the voting rights of CLH.
- The access prices and conditions for access to transmission and storage facilities should be made public.
- The companies with more than a 30% market share in supplying transport fuels cannot expand capacity for five years, and those with a 15-30% share not for three years. The moratorium is effective from 2000.
- The opening of retailing outlets at large commercial establishments and seaports should be promoted.
- Providing information to the Energy Administration about the prices at filling stations is obligatory; the administration shall then publish them.

QUALITY CHECKS

Quality checks of oil products are carried out by the State Agency for Tax Administration to avoid tax fraud, and by the autonomous regions to avoid quality problems. The regions keep a registry of the number of samples taken each year and of samples that do not comply with fuel standards. No central registry is kept at the Ministry of Economy.

ENVIRONMENTAL ISSUES

The refineries are investing in adapting their processes to tighter environmental standards. Currently they meet with the EU's Auto-oil II requirements. The Spanish refineries have four years to change their processes to meet with the stricter fuel quality standards to be brought by the Euro 4-Standard in 2005. It is not clear yet what impact the new product standard will have on the European and Spanish refining industries. The oil companies may choose to invest in new technology for some of the refineries while closing others, typically the smaller units.

Filling stations, oil storage and heating oil tanks are currently subject to strict environmental standards. According to the Waste Law (10/1998), the owner of such facilities is fully responsible for repairing any harm they cause. The recently built filling stations have been constructed in compliance with the current tight standards and the risk of contamination is low. However, it is not known how many of the older stations and heating oil tanks may pose problems as there is no central registry for such facilities, and no inventories have been made.

EMERGENCY RESPONSE MEASURES

The Law of January 1988 constitutes the legal basis for civil emergency planning in Spain. It established the National Civil Emergency Planning Committee (CNPCE) as part of an organisation responsible for handling general crisis situations. Ten working committees operate under the CNPCE, including the National Energy Resources Committee (CSRE) which forms the basis for the Spanish National Emergency Sharing Organisation.

Law 34/1992 and Royal Decree 2111/1994 provide the government with the powers to ensure that oil stocks are sufficient to meet the IEA emergency reserve commitment and to draw stocks during an emergency under a wide range of situations. The decree requires that oil operators hold minimum emergency reserves of 90 days of sales, plus a 10% margin for unavailable stocks. It also established a stockholding agency (CORES), empowered to build and manage strategic stocks representing one-third of the total obligation, and to monitor industry's compliance with the remaining 60-day obligation. CORES is allowed to purchase strategic stocks or to rent up to half of them from operators.

During an emergency, strategic and company stocks would be drawn down according to the procedures agreed upon by the CSRE. CORES would be in charge of releasing its own stocks, but the National Emergency Sharing Organisation (NESO) would oversee the release of industry stocks. Since strategic stocks are held together with company stocks, they would be released to the market through competitive sales using the existing distribution channels.

Law 34/1992 specifies the demand restraint measures available to the government in case of an oil crisis. These include publicity campaigns to encourage voluntary

actions to reduce oil consumption, speed and traffic limitations for vehicles, and rationing of oil products as a last resort. The scope and sequence of such measures would depend on the nature and magnitude of the oil crisis.

CRITIQUE

Total oil consumption has grown by 37% from 1990 to 1999. According to the country submission 2000, much slower growth, some 5%, is expected for the period 1999-2010. This forecast is partly based on the assumption that natural gas will increasingly replace the use of oil in power generation and in the industrial sector. The highest rate of growth in oil consumption is expected in the residential and services sectors, where the growth estimate for this decade is 22%. The estimate for consumption in the transport sector indicates a dramatic decrease in the rate of growth, from 4.1% per year in the 1990s to 0.8% per year in the 2000s. This sharp reduction is not likely to occur without additional strong measures to curb oil consumption.

Spain has rapidly liberalised the oil markets, although authorisation through licences is still necessary for wholesalers, refineries, and transmission and storage infrastructure. Negotiated third party access has been established for transport and storage facilities. Following the changes in legislation and removal of most of the price ceilings on oil products, new wholesalers have obtained licences and competition is increasing in distribution. However, the new entrants (about 30) all have very small shares. One way to increase competition in retail would be to subject retailers with a significant market share to a 3-5-year restriction on establishing new outlets. Because the number of outlets in Spain is increasing, this measure could have an impact on the market structure. One concern is access for new entrants to transport and storage. The shareholding structure of CLH has not yet been modified in accordance with new legislation. This change should be implemented promptly to reduce the dominance of Repsol and ensure that the access fees are set in a non-discriminatory way and without excessive dividends to the shareholders. Another concern is that the refining industry remains concentrated, with the three main refining companies being vertically integrated with distribution.

The government has liberalised the LPG market but continues to set price ceilings for LPG that is supplied by the most common cylinder size and by pipeline. By law, the practice should be removed when adequate competition has emerged. At present, 90% of all LPG is supplied by a single incumbent, Repsol Butano, and the competitors consider that the price ceiling has been set too low for them to enter the market. If only one company can supply LPG under the ceiling price because its extensive distribution facilities allow it to keep product prices low, then competition cannot develop. The government should review the price ceiling system with a view to eventually phasing it out.

The regions should be encouraged to continue monitoring the chemical quality of oil products. In Spain, the State Agency for Tax Administration is responsible for

ensuring that there is no fuel tax fraud. As fuel taxes on some oil products, such as heating oil, are lower than those for diesel, distributors can commit tax fraud by mixing heating oil with diesel. Countries with such a taxation structure often face this problem. Therefore, quality monitoring by frequent checks is important to avoid this kind of tax fraud.

In case of soil contamination by leakage, the owners of filling stations are obliged to recover the land under new environmental regulations. In practice, financing the clean-up may be difficult, especially for the owners of small independent stations or when old stations are closed down. At present there is no central inventory of filling stations that have contaminated land, but data are available for each autonomous region. The problem may not be severe in Spain where many of the stations are recent (although even with newer stations leakage may occur accidentally). Spain could benefit from a study of the risks posed by such problems. If the results of the study suggest that the risks are indeed significant, then establishing a financing mechanism to support compliance should be considered. In this context, it might be noted that some other countries have approached this issue by establishing an oil spill fund for clean-ups, financed through a fee included in the price of oil products.

RECOMMENDATIONS

The Government of Spain should:

- ☐ Set a clear time frame for implementing legislation for increasing competition.
- ☐ Consider steps to facilitate new entries in LPG distribution.
- ☐ Continue monitoring compliance with oil product standards to avoid tax fraud and quality problems.

9

COAL

DEMAND AND SUPPLY

Though some annual variations can be observed, total coal demand has remained at approximately the same level between 1990 and 1999. In 1999 demand was 27.6 Mtce[26]. The total demand for coal is expected[27] to decrease by 41% between 1999 and 2010. The use of coal for energy production partially depends on the availability of hydropower.

Greater variation can be seen in the demand for the different types of coal. Whereas the consumption of brown coal has decreased from 20.8 Mt in 1990 to 12.6 Mt in 1998, the consumption of steam coal has slightly increased from 21.9 Mt to 23.5 Mt during the same period. The use of coking coal has decreased from 4.5 Mt in 1990 to 3.8 Mt in 1998 owing to new steel production methods requiring less coking coal.

The final consumption of coal has decreased from 4.6 Mtce[28] in 1990 to 1.9 Mtce in 1999 (see Figure 27). Coal is consumed mainly in the industrial sector (89% in 1999), but some coal is also used in the residential and commercial sectors (11%). In the industrial sector the biggest users of coal are the iron and steel industries. The main reason for the decrease in final coal consumption has been more use of natural gas and oil by the industrial sector and less use of coking coal for steel production. Coal use has also decreased in the residential and commercial sectors.

While there has been some annual variation in coal supplies, total supplies in 1999 (29.3 Mtce) were only slightly above the 1990 level (see Table 11). Coal is both imported and produced domestically. Imports have been growing constantly and exceeded domestic production for the first time in 1999, with imports accounting for about 60% of supplies and domestic production for about 40%.

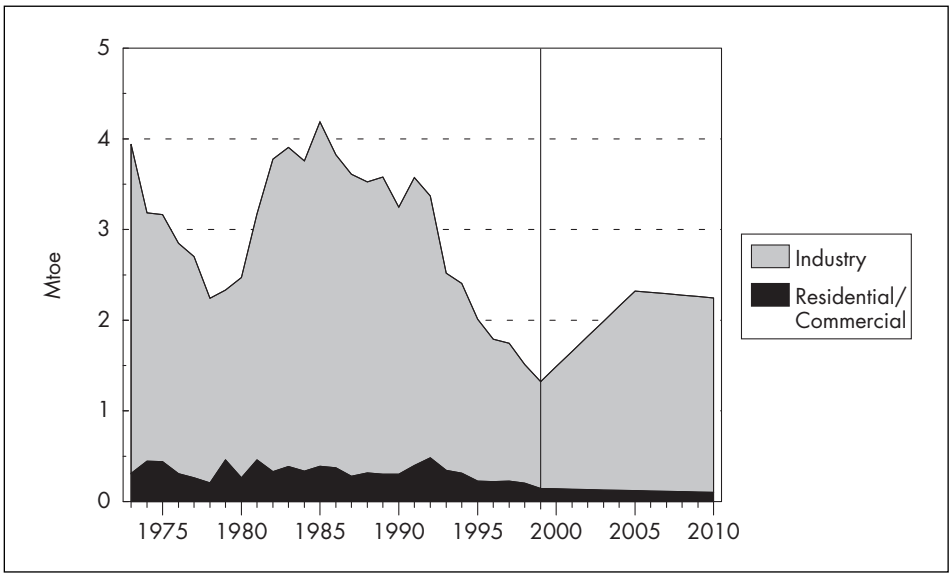
Table 11
Total Coal Supply, Mtce

	1980	*1990*	*1997*	*1998*	*1999*
Production	14.0	17.0	14.0	13.1	12.3
Imports	5.9	10.2	9.8	12.2	17.4
Exports	-0.0	0.05	-0.2	-0.5	0.4
Stock changes	-2.2	-0.14	2.4	-0.2	-1.9
Primary supply	**17.8**	**27.7**	**26.1**	**24.7**	**29.3**

Source: *Coal Information 1999*, OECD/IEA Paris, 2000.

26. Equivalent to 19.3 Mtoe.
27. Based on the country submission 2000.
28. Equivalent to 3.2 Mtoe in 1990 and 1.3 Mtoe in 1999.

Figure 27
Coal Consumption by Sector, 1973-2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2001, and country submission.

In 1999, the main import countries for coking coal were the United States (46%) and Australia (37%), and for steam coal they were South Africa (52%), Indonesia (19%), Russia (7%) and Australia (6%). Today, imported coal in Spain is not subject to duties or quotas set for specific countries.

Spain is the fifth largest coal producer in IEA Europe. However, owing to the reduction of coal prices on the world market, the increase in the cost of domestic mining, and quality problems with domestic coal, Spain has lost its competitiveness in the coal market.

In 1999, the production of hard coal was 11.7 Mt (8.4 Mtce); sub-bituminous coal, 3.7 Mt (1.66 Mtce); and brown lignite, 8.8 Mt (2.34 Mtce). Coking coal is no longer produced in Spain, and the only type of hard coal still produced is steam coal. Hard coal production is largely centred in the north of the country, in the Castilla-Léon and Asturias regions, with additional output in Palencia, Catalonia, Ciudad Real and Córdoba. The hard coal reserves are abundant but difficult to mine, making the mining expensive. Brown lignite is produced in La Coruña, in the north-western corner of Spain near the border of Portugal, but the mines will be completely depleted in 2-3 years.

INDUSTRY STRUCTURE

Since the mid-1980s, both the number of coal producers and the workforce in the coal industry have declined. There were about 100 coal producers in Spain in 1994, running 130 coal mines. At the beginning of 2000, there were 54 companies

mining hard coal and two companies mining brown lignite. The decrease in the number of coal companies over the last few years has been caused by some companies closing and others merging.

The leading producers of hard coal are the state-owned Huelleras del Norte S.A. (Hunosa) and the privatised Encasur, and Minas de Figadero, which has now merged with Hunosa. One of the major mergers took place in 1998-1999 when 17 previously independent mines in the regions of Léon and Palencia merged into one company, UMINSA, which produces 1.6 Mt of hard coal per year. The leading producer of lignite is Endesa.

Table 12
Spanish Hard Coal Producers (end of 1999)

Annual production capacity	*Number of companies*	*Total annual production (kt)*	*Share of total (%)*
Under 25 kt	16	267	1.7
25-50 kt	4	213	1.4
50-100 kt	12	982	6.4
100-500 kt	14	3,321	21.5
Over 500 kt	8	10,637	69
Total	**54**	**15,420**	**100%**

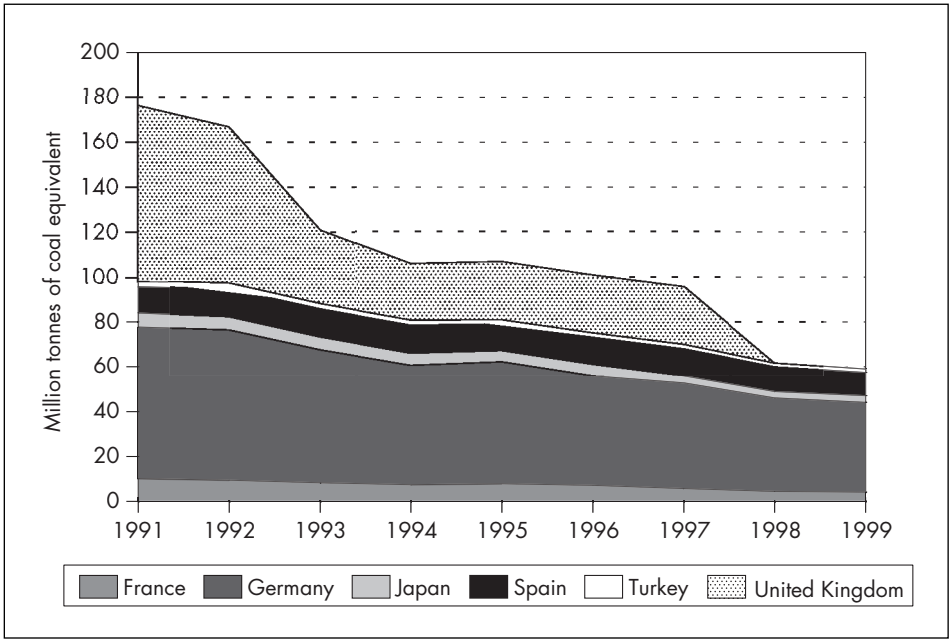
Source: Energy Administration, Ministry of Economy.

The coal sector has provided significant employment in the regions where mines exist. In the 1990s, the labour force in hard coal mining decreased at a rate of 4% per year. Employment is an important social and political issue in the Castilla-Léon and Asturias regions. At the end of 1999, the total number of employees working in the Spanish coal industry was about 18,400, of whom about a thousand work in brown lignite mining. Among the producers, 13 companies have fewer than 25 employees, 11 have 25-50 employees, 8 have 50-100, 16 have 100-500, and 6 companies have more than 500 workers.

COAL POLICY

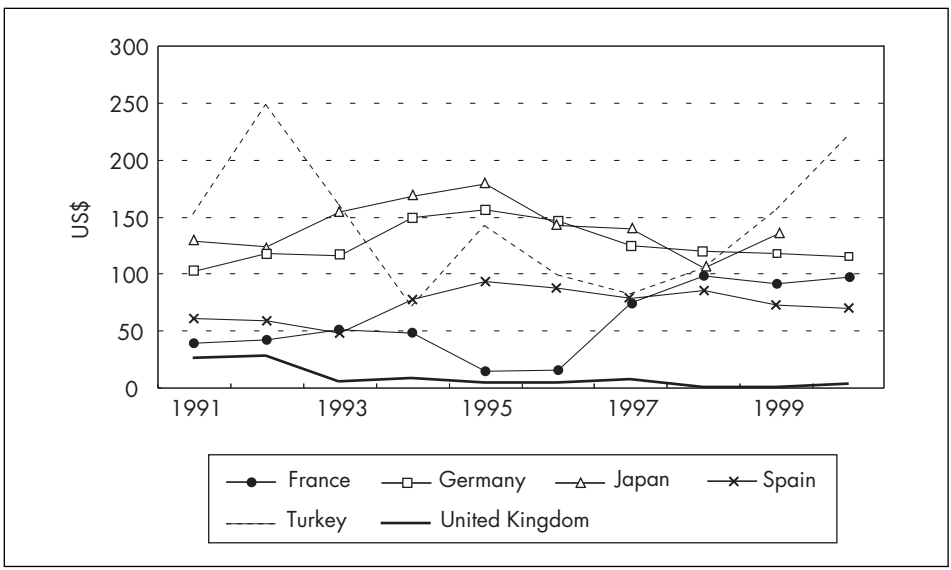
Spain has adopted a policy to adapt domestic coal mining to world market conditions. Since the beginning of the 1990s it has implemented three restructuring plans and one price reform. Spain gives more subsidies to its coal industries than other coal mining countries in the IEA, except for Germany (see Figure 28). However, the restructuring plans have managed to reduce state aid to the coal sector. Total subsidies for coal (mainly for operation), which were highest in 1998 at Pta 141 billion, decreased to Pta 118 billion in 1999.

Figure 28
Assisted Hard Coal Production in IEA Countries*, 1991-1999



* assisted sub-bituminous production in Spain is included. Belgium (production halted in 1992) and Portugal (production halted in 1994) have not been included.
Source: *Coal Information 1999*, OECD/IEA Paris, 2000.

Figure 29
Aid per Tonne of Coal Equivalent, 1991-2000



Source: *Coal Information 2000*, OECD/IEA Paris, 2001.

Only hard coal production is subsidised and no financial support is given to brown lignite producers. In 1999, state aid per tce was lower than in the mid-1990s when aid was at the highest level (see Figure 29). Subsidies vary depending on the mines, the coal type, mining cost and the distance from the consumers. For example, in 2000 subsidies for steam coal production were Pta 5,500 per tonne in Asturias, Pta 3,500 per tonne in Léon, and Pta 2,000-2,500 per tonne in other mines.

The last of the three restructuring plans was introduced on 15 July 1997 when the Ministry of Industry and Energy and the majority trade union federations signed the 1998-2005 Plan for Coal Mining and Alternative Development of Mining Regions. The target set in the plan is to reduce the production of hard and sub-bituminous coal to 14.5 Mt by 2002. The starting level was 17.7 Mt in 1997. With accumulated reductions in production amounting to 2.6 Mt, production was down to 15.1 Mt in 2000.

The plan determined the level of aid that mining companies will receive for different activities. Subsidies for production will represent 40% of total aid, and subsidies for closures and reducing activities, including measures for redundancies, will represent 60%. In 2000, 76% of the coal produced benefited from operation subsidies, and 24% received the latter type of assistance. Each year the European Commission approves the level of aid that the coal sector may be granted. For 2000, the commission approved a total aid package of Pta 186 billion for the following financial measures:

- Pta 49 billion for the operation of 42 undertakings producing 11.1 million tonnes per year.
- Pta 67 billion for reduction of activity of 11 undertakings, and of 5 production units operated by other undertakings, producing 3.5 million tonnes per year.
- Pta 55 billion to cover aid to be paid to 12,700 workers taking early retirement.
- Pta 15 billion to cover the technical costs of closing down mining installations.

The total level of aid approved by the commission is higher than the above-mentioned operational aid (*e.g.* Pta 118 billion in 1999). Direct state aid for coal production is scheduled to decrease at an annual rate of 4% after 1999.

Funds to finance aid to coal were formerly collected through a coal levy included in the consumers' electricity bill. This levy has been removed and aid to coal is now financed through the state budget. Electricity consumers support Spanish coal through stranded cost payments (*i.e.* costs of transition to competition, or CTCs), a part of which is allocated for premiums (Pta 42 billion in 2000) that are paid to power utilities to purchase domestic coal and to maintain stocks. The Electric Power Act obliges the utilities to purchase domestic coal and sets the quantities that the generators have to buy from the domestic coal market. The plan sets specific quotas for each of the power stations for 1998-2005, but reduces them by 28% over this period. The producers are free to choose their supplier and prices are

negotiated between the supplier and the buyer at the world market price level. The funds collected by the government are to compensate coal producers for the difference between the extraction cost of domestic coal and the negotiated market price. Furthermore, the plan defines reductions in coal supplies to thermal power stations from 1998 to 2005.

The plan that was agreed between the Ministry of Industry and Energy and the trade union federations also regulates aid intended for the economic development of coal regions, including support for developing infrastructures, education and vocational training and projects to create jobs. The parties agreed that a government agency should be established to help the coal industry in the restructuring process.

The Law 66/1997 regarding Tax, Administrative and Social Measures created the Institute for the Restructuring of Coal Mining and Alternative Development of Mining Regions as an autonomous body with its own assets to promote economic activities in the mining regions and create alternative employment opportunities for the population. In 1998-99, Pta 9 billion were allocated to 336 new infrastructure projects and 121 business projects, requiring a total investment of Pta 189 billion and 51 billion respectively. The projects created over 2,000 new jobs. In year 2000, Pta 45 billion were budgeted to finance the alternative economic development of coal mining regions.

CRITIQUE

Domestic coal production was developed in the 1970s and 1980s to increase fuel diversification and security of supply. However, Spanish coal mining has lost its competitiveness in the international market. In the 1990s the government successfully launched several plans to restructure the coal industries, which managed to increase productivity, decrease production and reduce aid paid to domestic coal producers. Consequently, between 1990 and 1999, coal production (measured in Mtce) was reduced by 28% and the number of employees in the sector declined by almost 60%. The restructuring plans have been complemented by economic development programmes in coal mining areas in order to reduce the social impacts of production cuts. Unemployment in the Castilla-Léon and Asturias regions remains a serious social and political issue. However, at the current rate of reduction in production, the target for 2002 will be met one year ahead of schedule and the government should be commended for the solid progress that has been made in restructuring.

Spain has made an attempt to liberalise its coal markets. Duties for imported coal have been removed and there are no more quotas for imports from other countries. Furthermore, power producers can freely negotiate coal prices with domestic suppliers. However, power producers are obliged by law to use a certain amount of domestic coal. This creates several problems. Because Spanish coal has a low calorific value and high sulphur content, using it may become very expensive for power producers when they will have to meet stricter

environmental requirements. Further, despite the premiums they receive, the use obligation is a financial burden to power producers because it reduces their possibilities for optimising their fuel mix.

RECOMMENDATION

The Government of Spain should:

- ☐ Continue restructuring the coal industry, cut subsidies, eliminate other distortions and progressively decrease the industry's size, while limiting welfare and regional effects by industrial restructuring in the affected regions.

10

RENEWABLE ENERGY

SUPPLY

In 1999, energy from renewable sources (including waste) amounted to 6.3 Mtoe[29], of which 2.0 Mtoe was hydropower. This is a slight increase from 1990, when the renewables supply totalled 5.6 Mtoe, with 2.2 Mtoe coming from hydropower. The contribution of renewables to the total primary energy supply (TPES) was 5.3% in 1999.

In 1999, electricity production from renewables was 28.5 GWh, representing 6.7% of total gross generation. Hydropower contributed 22.9 GWh, combustible renewables and waste 2.9 GWh, and wind and solar power 2.8 GWh. Production from wind, solar and biomass increased in the 1990s. However, hydropower generation fluctuated and was significantly influenced by weather conditions from year to year.

At the end of 1998, the installed power generation capacity of hydropower was 16.4 GW (of which 5.1 GW is pumped storage); wind could generate 0.8 GW, and solar power, 0.01 GW. Wind power capacity grew sharply after 1998, when an additional 750 MW of capacity was installed in 1999. Spain is the third largest wind power generator in the world, following the United States and Germany. Wind capacity continued to increase in 2000.

Hydropower is generated throughout the country. Wind power plants are at present concentrated in the north-western region of Galicia and the southern region of Andalucia, but there are plans to install wind power in many other areas of Spain.

INDUSTRY STRUCTURE

All the large hydropower plants are owned by the four largest power producers: Iberdrola (8.3 GW), Endesa (6.1 GW), Unión Fenosa (1.7 GW) and Hidrocantábrico (0.4 GW).

Several companies have wind generation facilities and are increasing their capacity for producing wind power. Energía Hidroeléctrica de Navarra (EHN), an affiliated company of Iberdrola with installed capacity of 0.4 GW in 2000, is building new capacity of 1.4 GW to meet its target of 3.2 GW by 2003. Endesa's wind power capacity was 0.46 GW in 2000, but the company plans to increase the capacity to 2.0 GW by 2005. In addition, some smaller generators have emerged, and several domestic and foreign developers have introduced plans to invest in wind power in Spain.

29. According to the data published by the Ministry of Economy and the Ministry of Science and Technology, the contribution of energy from renewable sources to TPES was 6.6 Mtoe (of which 2.2 Mtoe was hydropower), representing a total contribution of 5.4% to TPES in 1999. The discrepancy is explained by Spain's different accounting method for non-hydro renewables.

One of Spain's largest renewable energy companies is Sinae Energía y Medioambiente, which was created in 1988 as a subsidiary of Hidrocantábrico. The company is active in wind power, biomass and co-generation.

POLICY

The 1992 Energy Saving and Efficiency Plan (PAEE) set a target to increase the use of renewables by 1.1 Mtoe[30] 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. This support is being continued. Furthermore, Spain participates actively in research programmes of the European Union in the field of renewables. The target set for primary energy supply was almost reached as the contribution of renewables to TPES in 1999 was 0.92 Mtoe above the 1991 level of 3.4 Mtoe. In power generation the target was exceeded, with the share of non-hydro renewables reaching 2.7% in 1999. 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. The PFER was elaborated by IDAE under the direction of the former Ministry of Industry and Energy, in collaboration with the autonomous regions, different ministries and various agencies of the sector.

By law, PFER is an indicative document to promote the use of renewables. To that end, the plan provides an in-depth analysis of the state of technology, the energy resources available, the structure of the domestic and overseas markets, and the technical, legislative and socio-economic barriers that need to be overcome. This analysis was used to establish new targets for the different renewable energy sources and to introduce adequate measures and incentives to attain them. The objective was to achieve maximum integration of renewable energy into the market and eventually to develop each source to its fullest potential.

The plan includes a target to achieve a 12% share of renewables in TPES by 2010, which is in line with the EU target defined in the European Community's White Paper for Renewable Energy Sources. This means that by 2010 renewables should account for 16.6 Mtoe of TPES; in 1998, they amounted to 7.2 Mtoe[31], or 6.3% of TPES. The

30. The target includes use of waste for energy production but excludes the annual variation in hydropower production.
31. All the figures here are based on the statistical system used in Spain which differs slightly from the method applied by the IEA.

EU has set an indicative target for Spain requiring that 29.4% of power corresponding to 76.6 TWh in 2010 be generated by renewables. The plan acknowledges that the targets are ambitious and depend on the success of other policies, including those for energy efficiency to curb the growth of energy consumption.

PFER has made an estimate for the renewables mix in 2010, which is markedly different from the situation in 1998 (see Table 13). Since power production from hydro is expected to remain at the current level, the share of hydropower in energy supplied by renewables is expected to decrease. A significant increase is projected for energy from biomass and wind. 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. The plan sets the target for wind power at 8,140 MW of new capacity, with production of almost 20 TWh in 2010. While there has been environmental opposition to some wind power projects, wind power has generally gained environmental acceptance. Low temperature solar thermal energy, which is a mature technology, will also be used more. Some other technologies, such as biofuels, biogas, thermoelectric solar and solar photovoltaics, that are currently hardly used in Spain, will be developed. The increase in total demand for renewables is expected to amount to 9.4 Mtoe, of which 1.7 Mtoe will be used for heating applications.

Table 13
Supply of Renewable Energy in 1998 and Projections for 2010

	1998		*2010*	
	Ktoe	*%*	*Ktoe*	*%*
Biomass	3,644	50.8	9,640	58.1
Hydroelectric > 50 MW	2,645	36.9	2,121	12.8
Hydroelectric 10-50 MW			542	3.3
Small scale hydro <10 MW	482	6.7	594	3.6
Wind	123	1.7	1,852	11.2
Solid urban waste	244	3.4	681	4.1
Biofuels	–	–	500	3.0
Biogas	–	–	150	0.9
Solar thermal	27	0.4	335	2.0
Thermoelectric solar	–	–	180	1.1
Photovoltaic solar	1	0.0	19	0.1
Geothermal	4	0.05	3	0.02
Total	**7,173**	**100**	**16,619**	**100**

Sources: Ministry of Science and Technology and IDAE/*Plan for the Promotion of Renewable Energy in Spain.*

The contribution that renewables could make to the reduction of CO_2 was estimated in the plan. This reduction depends largely on the technologies that renewables would replace. For example, if renewables were to replace coal, the total reduction in emissions would be 41.5 Mt in 2010; however, if renewables were to replace generation by combined cycle gas turbines, the emissions reduction would be 19.5 Mt.

The plan concludes that a significant volume of public funds must be mobilised to achieve the targets. Though the final targets of the plan are set for 2010, current financing and sub-targets have been defined only until 2006. The target set for the period of 1999-2006 is to increase the supply from renewables by 4.8 Mtoe. The associated investments are estimated at Pta 1,689 billion, which includes generation equipment (Pta 1,582 billion), electricity transmission and distribution networks (Pta 72 billion), equipment manufacturing (Pta 23 billion) and supervisory systems, such as co-ordination, monitoring and evaluation (Pta 12 billion). Public aid is estimated to constitute 13.1%, or Pta 221 billion, of the total investments. In addition, it is estimated that Pta 59 billion of public aid will be necessary for making energy crops available, and Pta 164 billion for using forestry waste. In total, public subsidies for investments and operating costs[32] are expected to amount to Pta 280 billion. If tax incentives for the period of 1999-2006 are included, the total amount of required public resources will be Pta 444 billion, of which 49.7% will be for investment, 13.3% for supporting the production of biomass fuels, and 37.0% for funding tax incentives.

About 73% of government aid to support renewable energy sources is expected to be financed by the European Community and 27% by domestic sources (see Table 14). European Community support will most likely be provided by the European Regional Development Fund (ERDF), Cohesion Fund, European Agricultural Guarantee and Guidance Fund (EAGGF), European Social Fund (ESF), and Internet & Database Technology (I&DT) actions within the Fifth Framework Programme.

Table 14
Subsidies to Renewable Energy Sources, 1999-2006

Administration	*Total subsidies*[1] *billion Pta*	*Contribution %*
National	48	17.1
Autonomous regions	17	5.9
Local	12	4.2
European Community	204	72.8
Total	**280**	**100**

[1] excluding tax incentives.

Sources: Ministry of Science and Technology and IDAE/*Plan for the Promotion of Renewable Energy in Spain*.

32. Power generators using renewables are guaranteed under the "special system" that they can sell their electricity at regulated prices. In 2000, the regulated prices for mini-hydro and wind power were Pta 11 per kWh, and for photovoltaics it was Pta 60 per kWh.

According to the Plan for the Promotion of Renewable Energy in Spain, special emphasis should be given to the essential role that the autonomous regions and local organisations can play in achieving the plan's objectives. They have considerable legislative and regulatory powers, and often have the responsibility, for example, for granting permits.

The plan has also identified various barriers to developing renewable energy sources. These include:

- Economical and financial constraints.
- Lack of information and social awareness.
- Lack of legislation.
- Poor collaboration among different administrations.
- Insufficient research and technological development in some areas.
- Insufficient tax incentives.
- Poor stability, quality and security for connecting to the grid, especially for wind power.

The plan has recognised that in order to meet the targets, a series of incentives and measures will be necessary to remove these barriers. It suggests various measures without going into much detail about their implementation, and makes these recommendations:

- Tax incentives should favour projects with technological innovation and low environmental impact; today, there are no such criteria for giving tax incentives.
- The requirements and procedures for environmental impact assessment should be harmonised across the regions.
- New regulations should be established to set minimum requirements for the generation of wind power in each municipality.
- Hydropower resources currently in the public domain should be made available to private use.
- Premiums under the special system should be reallocated to favour less developed technologies.
- The building certificate system currently under development should promote the use of solar energy in buildings.

- The regulations and legislation for grid-connected photovoltaic systems should be renewed.

- Incentives should be developed to support investment in the development of new technologies.

- Developers of projects for renewable energy sources should get discounts for their payments to mutual guarantee societies.

CRITIQUE

In the 1990s Spain pursued a policy of increasing the use of energy from renewable sources to meet with the objectives and targets defined in the Energy Saving and Efficiency Plan. Active promotion efforts, partly based on financial incentives, increased the share of renewable energy in the primary energy supply almost to the target level, and the targets set for electricity generation were exceeded.

In 1999, Spain introduced the Plan for the Promotion of Renewable Energy in Spain. This new plan set targets to be consistent with the EU targets on renewables. If these are met, renewables could make a significant contribution to curbing the growth of CO_2 emissions. However, the targets are ambitious.

The plan includes an estimate of public funding needed for implementation and suggests various measures to promote – or remove the barriers to – the use of renewables. The plan is only an indicative document and the responsibility for choosing the appropriate measures and allocating funds remains with the government. Ensuring that effective measures will be taken at the right moment is still a challenge for the government.

The measures used today to promote the production of energy from renewable sources are mainly financial in nature, such as premiums paid under the special system and tax incentives. The plan proposes restructuring these to take better into account technological innovation and the environmental impacts of projects for developing renewable energy. This is wise because some of the technologies are reaching a level of maturity where very little support may be necessary. Currently there is a debate on the level of subsidies that should be paid for using renewable energy sources.

One of the initiatives introduced by the plan is to involve the regions and local authorities even more in its implementation than during the implementation of the Energy Saving and Efficiency Plan. During the implementation of that plan, the regions accumulated valuable experience in the promotion of renewables. Also, along with the central government, the regions and municipalities will participate in financing the 1999 plan. Effective co-ordination between the central and regional governments and among the regions is essential. Today, for example, environmental requirements vary from region to region, and problems have been identified in the collaboration of different authorities. This can delay the

implementation of new projects and create uncertainty among the project developers. Furthermore, careful monitoring of the results, analysis of the effectiveness of the different measures, and a constant evaluation of benefits and the need for aid are crucial to ensure an efficient use of resources.

The plan suggests that solar energy should be used more in buildings. Spain is currently formulating a building energy certification system (see Chapter 5), and is planning to include the passive use of solar energy as one of the parameters of the system. However, including applications for other renewables in the energy certification system should also be explored.

The Spanish government has set independent targets for different sources of renewable energy and does not assume that there will be competition among renewable sources. Such target-setting may help the government design policy measures for achieving measurable results in each of the renewable sources. However, such an approach may not necessarily lead to maximum economic efficiency since more efficient renewable sources could have wider shares in the market if competition among renewable sources is introduced. The introduction of competition could also help the government to minimise public spending for stimulating the use of renewable energy. The government may consider introducing measures for this purpose, including a nation-wide "green certificate system", which has been adopted, or is under consideration, in many IEA countries. Such a system obliges electric utilities to supply customers with a percentage of renewable electricity (green quotas) and then allows these quotas to be traded. As a result, green certificates systems can ensure that a certain percentage of electricity is generated from renewables.

RECOMMENDATIONS

The Government of Spain should:

- ☐ Elaborate and implement co-ordinated initiatives and measures, including adequate public funding as proposed by the Plan for the Promotion of Renewable Energy in Spain.

- ☐ Co-ordinate efforts of the different actors in the sector, while respecting the role of the autonomous regions and local governments in the implementation of the Plan for the Promotion of Renewable Energy in Spain.

- ☐ Study the benefits of developing a nation-wide green certificate system as part of a least-cost strategy to achieve the Kyoto objectives.

11

ENERGY RESEARCH AND DEVELOPMENT

INSTITUTIONAL FRAMEWORK

The new Ministry of Science and Technology, established in 2000, is responsible for all R&D policies in the energy sector. The budget for energy research, however, is prepared in collaboration with the Energy Administration in the Ministry of Economy.

The Research Centre for Energy, Environment and Technology (CIEMAT) is the public organisation responsible in Spain for research and technological development in the areas of energy and the environment. It is supported by the Ministry of Science and Technology through the State Secretariat of Scientific Policy and Technology. CIEMAT's main objectives are finding solutions for increasing the efficiency of resource use and energy generation, developing alternative energy sources and helping Spanish companies to address problems regarding energy production and use and their impact on the environment. CIEMAT employs a total of 1,150 people at locations in Madrid, Almeria (Tabernas) and Soria (Lubia). The Institute for the Diversification and Saving of Energy, IDAE (see Chapter 5), is active in demonstration projects, especially in the fields of energy efficiency, renewables and co-generation.

Energy R&D co-operation between the government and industry has been implemented through four research co-ordination organisations (OCIs) working in the areas of electricity, coal, natural gas and oil. Each OCI has a committee with equal numbers of government and industry representatives – although the government has the decisive vote – who evaluate project proposals and their funding. In 1994, the total budget of the OCIs – which was funded through levies on energy prices – was Pta 7.3 billion. By 1999 the budget had been reduced to Pta 1.5 billion. Since 1997 the OCIs have financed only 4-year projects and no new projects have been funded by OCIs since then.

POLICY OBJECTIVES AND TARGET AREAS

Spain has recently launched a new plan to define R&D priorities in different sectors for the period 2000-2003: the National Plan for Scientific Research, Development and Technological Innovation (*Plan Nacional de Investigación Cientifica, Desarrollo e Innovación Tecnologica*). The priorities include more efficient and less polluting energy systems (with a special focus on renewables and fuel cells); more economic and efficient energy transmission, sorting, distribution and use; alternative systems for propulsion; and new fuels for the transport sector, with special attention being given to the reduction of carbon dioxide emissions.

Government policy objectives for energy sector R&D policies are outlined in the National Energy Programme (*Programa Nacional de Energía*, PROFIT-Energía) launched in 1999. The general objectives are to develop effective, clean and safe technologies that guarantee compatibility of energy use, biospheric equilibrium and economic development. The programme focuses on two objectives: to promote the use of less polluting energy systems, including renewables, and to advance the economic and efficient generation and use of energy in a competitive market. Some of the government's R&D budget is allocated to projects through PROFIT-Energía.

The first objective aims at minimising the environmental impact of energy production and use. The programme anticipates that the development of cleaner energy will contribute to energy diversification, technological autonomy and job generation, in addition to reducing pollution and helping to achieve the national Kyoto target. In this respect, the top priorities in R&D are given to the following areas:

- The generation of electricity and heat with lower CO_2, SO_2 and NO_x emissions.
- Development and demonstration of new and renewable energy sources, in particular biomass, fuel cells, wind and solar technologies.
- The integration of new and renewable energy sources into energy systems.
- Environmental pollution control technologies for energy production.

The second objective aims at providing a reliable, efficient, safe and economical energy supply, leading to increased competitiveness of the domestic industry. The programme recognises the need to take action in all phases of the energy cycle, that is, production, distribution and final use. Efficient energy use is considered very important by the government because it has a positive effect on the competitiveness of companies, the balance of payments and the reduction of CO_2 emissions. The government aims to improve production processes and increase the safety of facilities. The following areas are given priority:

- Technologies for the rational and efficient end use of energy.
- Technologies to increase the efficiency of energy transmission and distribution.
- Technologies for storing electricity, on both a large and small scale.
- Improving the performance of exploration, mining/removal and production of fossil fuels.
- Reducing the costs of new and renewable energy sources.
- Research on supply and demand in economic, environmental and energy systems, and especially on their interaction, as well as analyses of the profitability and performance of all new and renewable energy sources based on costs during their entire lifecycle.

R&D FINANCING

In 1999, the total government budget for energy R&D in Spain was Pta 8.6 billion of which 3.1 billion were allocated to nuclear R&D. The 1999 budget is clearly lower than in the early 1990s. In 1998, the R&D expenditure of Spain was 36% of the average R&D expenditure in IEA countries. The areas that received financing in 1999 were nuclear fission/fusion (40%), renewables (28%), energy system analysis (14%), fossil fuels (10%), energy conservation (6%), and power and storage technology (2%). The public support is allocated through three different channels, namely direct financing to CIEMAT (59%), OCIs (18%) and TEIDE (23%)[33].

INTERNATIONAL COLLABORATION

Spain has been an active participant in international R&D programmes on energy. The EU energy programmes that Spain has been participating in recently are the Energy Programme of the 5th Framework Programme, ALTENER Programme, SAVE Programme, the former JOULE and THERMIE Programmes and the EURATOM Programme. Spain also participates in various IEA Implementing Agreements[34].

NUCLEAR R&D

Nuclear research is carried out by a number of different institutions. The nuclear power companies finance the operation of *Desarrollo Tecnologico Nuclear* (DTN). The research agreements between CIEMAT, ENRESA, the Nuclear Safety Council, and the European Union constitute the general framework for research in the field of nuclear fission. These agreements were signed to ensure continued research with adequate resources, in spite of uncertainties regarding the development of the electricity sector and nuclear power. R&D projects in the area of nuclear power plant safety and nuclear power life extension have been developed in accordance with the research being carried out by other international research centres.

Thermonuclear fusion research has been included in the National Plan for Scientific Research, Development and Technological Innovation. The National Fusion Programme was started in the 1980s as a joint effort of CIEMAT and EURATOM, with

33. TEIDE was the programme established to finance energy R&D before it was replaced by PROFIT-Energía in 2000.

34. Demand-Side Management, Energy Storage, Energy Technology Data Exchange (ETDE), Energy Technology Systems Analysis Project (ETSAP), Fluidised Bed Conversion, Gas Technology Information Centre, Greenhouse Gases, Heat Pumping Technologies, Hydrogen, Hydropower, IEA Coal Research, Photovoltaic Power Systems, Pulp and Paper, Solar Heating and Cooling, SolarPACES, and Wind Turbine Systems.

research being done by the National Laboratory for Fusion. Fusion technology development is carried out in co-operation with international partners. Activities relating to materials for fusion reactors follow the objectives of the European Union's Technological Fusion Programme. Particle physics activities are carried out within the National High-Energy Physics Programme, integrated in the national R&D plan, and closely connected to the experimental programme of the European Centre for Nuclear Research (CERN).

Research is being done on the possibilities for deep geological storage of radioactive waste and on the long-term behaviour of radioactive contaminants in geological systems and in the biosphere. Experiments with hydration and heating of the clay barrier in a mock-up (CIEMAT) and in an underground laboratory (Grimsel) are being carried out. Furthermore, the design of a mock-up incorporating radioactive tracers, which would allow connected thermal, hydraulic and geochemical simulation models to be calibrated, has begun.

CRITIQUE

The Ministry of Science and Technology was created in April 2000 and the responsibility for energy R&D has been transferred to it from the former Ministry of Energy. This may suggest that an additional co-ordination mechanism will be necessary to ensure that R&D activities are consistent with national energy policy objectives. Government plans for R&D have become more important in this respect, which is demonstrated by the National Plan for Scientific Research, Development and Technological Innovation for the period 2000-2003. The Technological Programme for Energy R&D (TEIDE), within the National Plan, provides R&D strategies specifically for the field of energy. As co-ordination among government agencies, industry, and research institutes is essential for the preparation of a workable plan, it was prepared under the initiative of the Ministry of Economy involving various players in the energy sector, including businesses and research institutes. The National Plan was introduced too recently to be able to assess its effectiveness yet. Nonetheless, it is important for the government to monitor carefully the activities that are carried out under the National Plan so that it can assess its performance and improve the co-ordination process in the future.

Energy-related R&D objectives focus on developing the use of less polluting energy systems, including renewable energy, and promoting economic and efficient energy production and use in a competitive framework. Priority research areas for reaching these objectives have been clearly defined. The allocation of resources should be done in a manner that is consistent with the objectives.

Only a few of the currently operating coal power plants use fluidised bed technology. Instead of increasing the use of this cleaner coal technology, the intention is to adopt coal gasification. To do this, Spain needs to continue supporting the development and demonstration of this technology. Also, Spain has not yet developed a long-term solution for the final disposal of high-level radioactive

waste and further efforts are necessary in this area. Given the ambitious targets that have been set for increasing the use of renewable and alternative energy sources, continuing R&D in this field is also essential.

At present, no instruments exist to evaluate the performance of R&D projects in energy. The outcome of completed and currently implemented programmes is therefore not clear. Assessing the performance and results of these projects would lead to a more efficient and effective use of resources.

Spain is currently participating actively in the research programmes of the European Union. There is room for increasing participation in the activities of the IEA Implementing Agreements, such as the energy end-use programmes, especially given the rapid growth of energy consumption in Spain.

RECOMMENDATIONS

The Government of Spain should:

- ☐ Ensure co-ordination among the Ministry of Science and Technology, the General Department for Energy and Mining Policy, and research organisations.
- ☐ Continue adequate support for the development and demonstration of clean coal technologies, and for research on final management of high-level radioactive waste and on renewable and alternative energy sources.
- ☐ Develop tools to assess and evaluate the performance of R&D activities.
- ☐ Increase participation in IEA Implementing Agreements, particularly in the energy end-use programmes, and continue involvement with the research activities of the European Union.

A

ANNEX

ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY

		1973	1990	1998	1999	2005	2010	2020
TOTAL PRODUCTION		**11.3**	**34.0**	**31.9**	**30.7**	**..**	**..**	**..**
Coal[1]		6.5	11.9	9.2	8.6	..	..	..
Oil		0.7	1.2	0.5	0.3	..	..	..
Gas		0.0	1.3	0.1	0.1	..	..	..
Comb. Renewables & Wastes[2]		0.0	3.4	3.7	4.1	..	..	..
Nuclear		1.7	14.1	15.4	15.3	..	..	..
Hydro		2.5	2.2	2.9	2.0	..	..	..
Geothermal		–	–	0.0	0.0	..	..	..
Solar/Wind/Other[3]		–	0.0	0.1	0.3	..	..	..
TOTAL NET IMPORTS[4]		**42.5**	**56.6**	**82.6**	**89.3**	**..**	**..**	**..**
Coal[1]	Exports	0.0	0.0	0.3	0.3	..	..	..
	Imports	2.2	7.1	8.6	11.3	..	..	..
	Net Imports	2.2	7.1	8.2	11.0	..	..	..
Oil	Exports	4.3	12.3	9.0	7.1	..	..	..
	Imports	45.3	61.8	77.0	76.9	..	..	..
	Bunkers	1.4	3.7	6.0	5.9	..	..	..
	Net Imports	39.6	45.9	62.0	63.9	..	..	..
Gas	Exports	–	–	–	–	..	..	..
	Imports	0.9	3.7	12.1	13.9	..	..	..
	Net Imports	0.9	3.7	12.1	13.9	..	..	..
Electricity	Exports	0.2	0.3	0.5	0.5	..	..	..
	Imports	0.0	0.3	0.8	1.0	..	..	..
	Net Imports	–0.2	–0.0	0.3	0.5	..	..	..
TOTAL STOCK CHANGES		**–1.5**	**–0.1**	**–1.8**	**–1.5**	**..**	**..**	**..**
TOTAL SUPPLY (TPES)		**52.4**	**90.5**	**112.8**	**118.5**	**128.3**	**135.0**	**..**
Coal[1]		9.0	19.4	17.3	19.3	13.2	11.4	..
Oil		38.4	46.5	61.5	63.8	66.8	67.2	..
Gas		0.9	5.0	11.6	13.3	20.6	22.9	..
Comb. Renewables & Wastes[2]		0.0	3.4	3.7	4.1	6.6	11.0	..
Nuclear		1.7	14.1	15.4	15.3	16.4	16.4	..
Hydro		2.5	2.2	2.9	2.0	3.2	3.3	..
Geothermal		–	–	0.0	0.0	0.0	0.0	..
Solar/Wind/Other[3]		–	0.0	0.1	0.3	1.2	2.4	..
Electricity Trade[5]		–0.2	–0.0	0.3	0.5	0.4	0.4	..
Shares (%)								
Coal		*17.2*	*21.5*	*15.3*	*16.3*	*10.3*	*8.4*	..
Oil		*73.3*	*51.3*	*54.5*	*53.8*	*52.0*	*49.8*	..
Gas		*1.8*	*5.5*	*10.3*	*11.2*	*16.0*	*17.0*	..
Comb. Renewables & Wastes		*–*	*3.7*	*3.2*	*3.4*	*5.1*	*8.1*	..
Nuclear		*3.3*	*15.6*	*13.6*	*12.9*	*12.8*	*12.2*	..
Hydro		*4.7*	*2.4*	*2.6*	*1.7*	*2.5*	*2.4*	..
Geothermal		*–*	*–*	*–*	*–*	*–*	*–*	..
Solar/Wind/Other		*–*	*–*	*0.1*	*0.2*	*0.9*	*1.8*	..
Electricity Trade		*–0.3*	*–*	*0.3*	*0.4*	*0.3*	*0.3*	..

0 is negligible. – is nil, .. is not available.

Unit: Mtoe

DEMAND

FINAL CONSUMPTION BY SECTOR

	1973	1990	1998	1999	2005	2010	2020
TFC	**39.9**	**61.4**	**80.5**	**83.2**	**93.9**	**97.8**	**..**
Coal[1]	4.0	3.2	1.5	1.3	2.3	2.2	..
Oil	30.1	39.9	52.8	53.4	58.0	58.1	..
Gas	0.7	4.6	9.2	10.1	12.1	13.3	..
Comb. Renewables & Wastes[2]	–	2.8	2.6	3.0	4.0	4.9	..
Geothermal	–	–	0.0	0.0	0.0	0.0	..
Solar/Wind/Other	–	–	0.0	0.0	0.1	0.3	..
Electricity	5.1	10.8	14.2	15.2	17.4	19.0	..
Heat	–	0.0	0.1	0.1	–	–	..
Shares (%)							
Coal	*9.9*	*5.3*	*1.9*	*1.6*	*2.5*	*2.3*	..
Oil	*75.6*	*65.0*	*65.6*	*64.2*	*61.7*	*59.4*	..
Gas	*1.8*	*7.5*	*11.5*	*12.1*	*12.9*	*13.6*	..
Comb. Renewables & Wastes	–	*4.5*	*3.3*	*3.7*	*4.3*	*5.0*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	*0.1*	*0.3*	..
Electricity	*12.7*	*17.6*	*17.6*	*18.3*	*18.5*	*19.4*	..
Heat	–	–	*0.1*	*0.1*	–	–	..
TOTAL INDUSTRY[6]	**20.7**	**24.4**	**30.6**	**30.3**	**36.0**	**37.5**	**..**
Coal[1]	3.6	2.9	1.3	1.2	2.2	2.1	..
Oil	13.4	11.3	15.1	13.8	14.7	14.5	..
Gas	0.4	3.8	7.2	7.7	9.2	9.9	..
Comb. Renewables & Wastes[2]	–	0.9	0.8	1.0	1.8	2.3	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	0.0	–	–	–	..
Electricity	3.3	5.4	6.1	6.6	8.1	8.7	..
Heat	–	–	0.1	0.1	–	–	..
Shares (%)							
Coal	*17.5*	*12.1*	*4.3*	*3.9*	*6.1*	*5.7*	..
Oil	*64.7*	*46.4*	*49.2*	*45.4*	*40.9*	*38.6*	..
Gas	*2.0*	*15.5*	*23.6*	*25.4*	*25.5*	*26.5*	..
Comb. Renewables & Wastes	–	*3.7*	*2.7*	*3.4*	*4.9*	*6.1*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	–	–	–	–	..
Electricity	*15.8*	*22.3*	*20.0*	*21.7*	*22.5*	*23.1*	..
Heat	–	–	*0.2*	*0.2*	–	–	..
TRANSPORT[7]	**11.9**	**22.8**	**31.2**	**32.7**	**34.7**	**35.6**	**..**
TOTAL OTHER SECTORS[8]	**7.2**	**14.2**	**18.7**	**20.2**	**23.2**	**24.6**	**..**
Coal[1]	0.3	0.3	0.2	0.1	0.1	0.1	..
Oil	4.9	6.1	6.9	7.3	9.0	8.9	..
Gas	0.3	0.8	2.0	2.4	2.9	3.3	..
Comb. Renewables & Wastes[2]	–	1.9	1.8	2.0	2.1	2.1	..
Geothermal	–	–	0.0	0.0	0.0	0.0	..
Solar/Wind/Other	–	–	0.0	0.0	0.1	0.3	..
Electricity	1.7	5.1	7.7	8.4	8.9	9.9	..
Heat	–	0.0	–	–	–	–	..
Shares (%)							
Coal	*4.3*	*2.1*	*1.1*	*0.7*	*0.5*	*0.4*	..
Oil	*68.2*	*43.0*	*36.9*	*36.0*	*39.0*	*36.0*	..
Gas	*4.1*	*5.9*	*10.7*	*11.8*	*12.7*	*13.6*	..
Comb. Renewables & Wastes	–	*13.3*	*9.8*	*10.0*	*8.9*	*8.5*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	–	*0.1*	*0.1*	*0.4*	*1.4*	..
Electricity	*23.4*	*35.7*	*41.4*	*41.3*	*38.4*	*40.1*	..
Heat	–	–	–	–	–	–	..

Unit: Mtoe

DEMAND

ENERGY TRANSFORMATION AND LOSSES

	1973	1990	1998	1999	2005	2010	2020
ELECTRICITY GENERATION[9]							
INPUT (Mtoe)	**12.6**	**33.4**	**38.9**	**42.9**	**..**	**..**	**..**
OUTPUT (Mtoe)	**6.5**	**13.0**	**16.6**	**17.7**	**20.2**	**22.2**	**..**
(TWh gross)	75.7	151.2	193.5	206.3	235.0	257.9	..
Output Shares (%)							
Coal	*18.9*	*40.1*	*32.6*	*36.6*	*18.6*	*14.2*	..
Oil	*33.2*	*5.7*	*9.0*	*11.8*	*7.5*	*7.6*	..
Gas	*1.0*	*1.0*	*8.4*	*9.2*	*23.3*	*24.1*	..
Comb. Renewables & Wastes	*0.1*	*0.5*	*1.2*	*1.4*	*3.1*	*6.3*	..
Nuclear	*8.7*	*35.9*	*30.5*	*28.5*	*26.8*	*24.4*	..
Hydro	*38.2*	*16.8*	*17.6*	*11.1*	*15.6*	*14.7*	..
Geothermal	–	–	–	–	–	–	..
Solar/Wind/Other	–	*0.0*	*0.7*	*1.3*	*5.1*	*8.6*	..
TOTAL LOSSES	**12.5**	**28.8**	**31.4**	**34.2**	**..**	**..**	**..**
of which:							
Electricity and Heat Generation[10]	6.1	20.4	22.2	25.0	..	..	..
Other Transformation	2.7	2.3	1.7	1.4	..	..	..
Own Use and Losses[11]	3.7	6.1	7.5	7.8	..	..	..
Statistical Differences	**0.0**	**0.3**	**0.8**	**1.1**	**..**	**..**	**..**

INDICATORS

	1973	1990	1998	1999	2005	2010	2020
GDP (billion 1995 US$)	350.50	546.53	648.85	674.95	779.53	878.96	..
Population (millions)	34.81	38.85	39.37	39.42	39.60	39.80	..
TPES/GDP[12]	0.15	0.17	0.17	0.18	0.16	0.15	..
Energy Production/TPES	0.22	0.38	0.28	0.26	..	..	..
Per Capita TPES[13]	1.50	2.33	2.86	3.01	3.24	3.39	..
Oil Supply/GDP[12]	0.11	0.09	0.09	0.09	0.09	0.08	..
TFC/GDP[12]	0.11	0.11	0.12	0.12	0.12	0.11	..
Per Capita TFC[13]	1.15	1.58	2.04	2.11	2.37	2.46	..
Energy–related CO_2 Emissions (Mt CO_2)[14]	144.4	211.5	254.0	272.0	289.6	289.3	..
CO_2 Emissions from Bunkers (Mt CO_2)	7.0	15.0	26.6	26.4	..	..	..

GROWTH RATES (% per year)

	73–79	79–90	90–98	98–99	99–05	05–10	10–20
TPES	4.1	2.8	2.8	5.0	1.3	1.0	..
Coal	3.0	5.5	–1.4	11.3	–6.1	–2.9	..
Oil	4.1	–0.5	3.6	3.7	0.8	0.1	..
Gas	6.7	12.3	11.2	14.5	7.6	2.2	..
Comb. Renewables & Wastes	24.8	47.0	0.9	11.9	8.3	10.7	..
Nuclear	0.4	20.9	1.0	–0.2	1.1	–	..
Hydro	8.2	–5.3	3.7	–32.8	8.2	0.8	..
Geothermal	–	–	–	25.0	–8.2	–	..
Solar/Wind/Other	–	–	70.5	85.3	28.6	14.8	..
TFC	4.1	1.7	3.5	3.3	2.0	0.8	..
Electricity Consumption	6.4	3.6	3.5	7.3	2.2	1.8	..
Energy Production	5.5	7.3	–0.8	-3.9	..	..	..
Net Oil Imports	3.2	–0.4	3.8	3.0	..	..	..
GDP	2.3	2.8	2.2	4.0	2.4	2.4	..
Growth in the TPES/GDP Ratio	1.8	–0.0	0.6	1.0	–1.1	–1.4	..
Growth in the TFC/GDP Ratio	1.8	–1.1	1.3	–0.7	–0.4	–1.6	..

Please note: Rounding may cause totals to differ from the sum of the elements.

Footnotes to Energy Balances and Key Statistical Data

1. Includes lignite and peat, except for Finland, Ireland and Sweden. In these three cases, peat is shown separately.

2. Comprises solid biomass, liquid biomass, biogas, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.

3. Other includes tide, wave and ambient heat used in heat pumps.

4. Total net imports include combustible renewables and waste.

5. Total supply of electricity represents net trade. A negative number indicates that exports are greater than imports.

6. Includes non-energy use.

7. Includes less than 1% non-oil fuels.

8. Includes residential, commercial, public service and agricultural sectors.

9. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.

10. Losses arising in the production of electricity and heat at public utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 33% for nuclear, 10% for geothermal and 100% for hydro.

11. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.

12. Toe per thousand US dollars at 1995 prices and exchange rates.

13. Toe per person.

14. "Energy-related CO_2 emissions" specifically means CO_2 from the combustion of the fossil fuel components of TPES (*i.e.* coal and coal products, peat, crude oil and derived products and natural gas), while CO_2 emissions from the remaining components of TPES (*i.e.* electricity from hydro, other renewables and nuclear) are zero. Emissions from the combustion of biomass-derived fuels are not included, in accordance with the IPCC greenhouse gas inventory methodology. Also in accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 1999 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

B

ANNEX

INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The Member countries* of the International Energy Agency (IEA) seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

1 **Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2 Energy systems should have **the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3 **The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.

4 **More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of

* Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

IEA Members wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5 **Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6 **Continued research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

7 **Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8 **Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9 **Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

C

ANNEX

GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and abbreviated subsequently, this glossary provides a quick and central reference for many of the abbreviations used.

BWR	boiling water reactor.
CCGT	combined cycle gas turbine.
CCPO	Spanish Climate Change Prevention Office.
CHP	combined production of heat and power; sometimes, when referring to industrial CHP, the term "co-generation" is used.
CIEMAT	Research Centre for Energy, Environment and Technology
CLH	Compañia Logistica de Hidrocarburos.
CNC	National Climate Council.
CNE	National Energy Commission.
CNPCE	National Civil Emergency Planning Committee.
CORES	Strategic Reserves Corporation.
CSN	Nuclear Safety Council.
CSRE	National Energy Resources Committee.
CTC	cost of transition to competition.
ENRESA	National Radioactive Waste Corporation
ENUSA	Empresa nacional de Uranio
EU	The European Union.
GDP	gross domestic product.
GHG	Greenhouse gases (see footnote 4).
GW	gigawatt, or 1 watt $\times 10^9$.
GWh	gigawatt-hour, or 1 gigawatt $\times$ 1 hour.

IDAE	Institute for the Diversification and Saving of Energy.
IEA	International Energy Agency.
kt	thousand tonnes.
kV	kilovolt, or 1 volt × 10^3.
kWh	kilowatt-hour, or 1 kilowatt × one hour.
LNG	liquefied natural gas.
LPG	liquefied petroleum gas.
m^3	cubic metre.
Mt	million tonnes.
Mtce	million tonnes of coal equivalent (1 Mtce = 0.7 Mtoe).
Mtoe	million tonnes of oil equivalent; see toe.
MW	megawatt, or 1 watt × 10^6.
MW_e	megawatt of electrical capacity.
MWh	megawatt-hour, or 1 megawatt × one hour.
NESO	National Emergency Sharing Organisation.
OCI	research co-ordination organisation.
OECD	Organisation for Economic Co-operation and Development.
OMEL	Compañia Operadora del Mercado Español de Electricidad, S.A.; Electricity Market Operator.
OPEC	Organisation of the Petroleum Exporting Countries.
PAEE	Energy Saving and Efficiency Plan.
PEN	National Energy Plan.
PFER	Plan for the Promotion of Renewable Energy in Spain.
PPP	purchasing power parity.
PROFIT-Energía	National Energy Programme.
PWR	pressurised water reactor.

R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well.
SME	small and medium-sized enterprises.
tce	tonne of coal equivalent.
TEIDE	Technological Programme for Energy R&D.
TFC	total final consumption of energy.
TJ	terajoule, or 1 joule $\times 10^{12}$.
toe	tonne of oil equivalent, defined as 10^7 kcal.
TPA	third party access.
TPES	total primary energy supply.
TSO	Transmission System Operator.
TWh	terawatt-hour, or 1 terawatt $\times$ 1 hour.
UNFCCC	United Nations Framework Convention on Climate Change.
VAT	value-added tax.

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