



SPAIN

Esther Chacón

INTA

INTRODUCTION AND BACKGROUND

The shortage of fossil primary energy deposits in Spain has led to historically high rates of energy dependence. At present, Spain has some of the highest energy dependencies in Europe, which introduce additional risks such as price volatility in the international markets, in production processes.

Development of renewable energies has been increasing in the electric sector; 32.6% of total energy production in 2010 came from renewable energy, which was more than 9 points over 2009 and 2.9% above the target set in the 2005-2010 Renewable Energy Plan.

Especially remarkable are the roles played by wind and hydroelectric energy production, which comprise 14.6% and 14.1% respectively of the total energy production. The combined production is about 81.7% of all renewable electricity production in Spain. In 2010, wind power was consolidated as the first renewable source for electricity generation ahead of hydro, which has traditionally led the renewable electricity production in Spain.

VITAL STATISTICS

EU member state

Population

47.190,5 (January 2011)¹

Territory

Total Area: 504.782 km²

Land: 499.542 km²

Water: 5.240 km²

Capital

Madrid

GDP (2010 est.)¹

\$1.369 trillion

GDP/capita

\$29.400 (2010 est.)¹

Recent average GDP Growth

- 0,7% real growth rate (2010 est.)¹

Primary Energy Structure

Consumption

132.123 Ktoe.(2010)²

| Type | % of total production |
|------|-----------------------|
|------|-----------------------|

Fossil Fuels
102.006 Ktoe 77,2%

Sub-Type % of sub-total

Coal 8.463 Ktoe 8,30%

Natural Gas (dry) 31.003 Ktoe 7.573%

Crude Oil 62.540 Ktoe 61,31%

Nuclear 16.155 Ktoe 12,2%

Renewables 14.67 Ktoe 11,10%

Hydro 3.390 Ktoe 23,10%

Wind 3.765 Ktoe 25,65%

Biomass 5.046 Ktoe 34,38%

Biofuels 1.442 Ktoe 9,82%

Solar 1.014 Ktoe 6,91%

Geothermal 21 Ktoe 0,14%

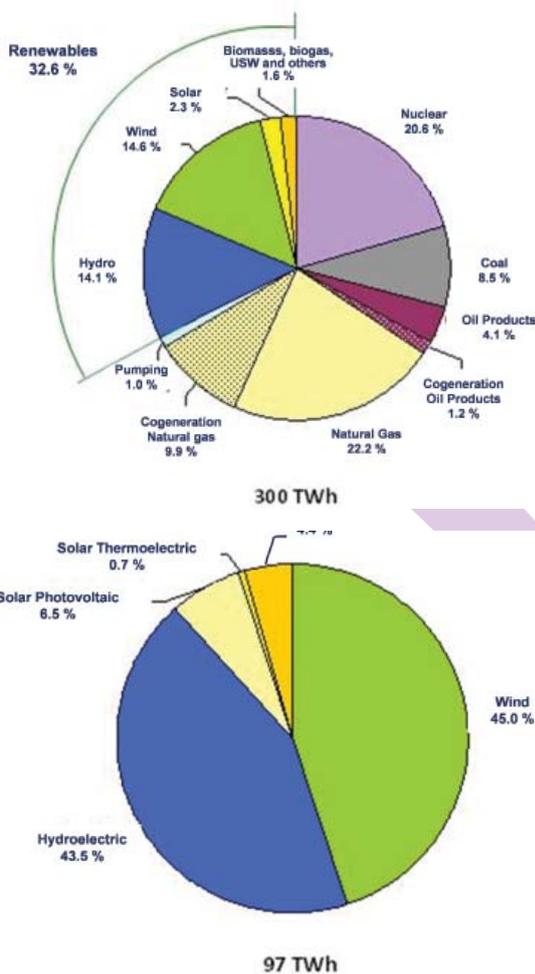


Figure 1: Spanish's electricity breakdown

Meanwhile, photovoltaic production reached 2.1% of the total, one-tenth more than last year, and biomass reached nearly 1% of the total electricity production.

Figure 2: Renewables contribution to electricity

The final energy consumption has experienced a recovery of 2.3%, with a more pronounced recovery in coal (18.6%) and gas (13.2%) and less pronounced for electric energy (2.1%).

Consumption of oil products, despite recovering from the sharp fall of 2009 (-7.2%), continues registering a rate of -1.3%. Likewise, renewable energies used for final applications increased by 11.3% due to the increase of biofuels and biogas consumption and solar thermal production.



Imports UPDATE ON MEMBER'S ENERGY FRAMEWORK

98.431 Ktoe. (2010)²

UPDATE ON RELEVANT POLICIES

| Type | % of total production |
|-------------|-----------------------|
| Petroleum | |
| 62.362 Ktoe | 63,36% |
| Natural Gas | |
| 31.049 Ktoe | 31,54% |
| Crude Oil | |
| 5.020 Ktoe | 5,1% |

The Action Plan for 2008–2012 was approved. The Plan will generate savings worth 87.9 million tons of oil equivalent (the equivalent to 60% consumption of primary energy in Spain during 2006) and will enable reduction of 238 million tons of CO2 emissions in the atmosphere. It focuses its efforts on 7 sectors (Industry, Transport, Building Public Services, Residential and computer equipment, Farming, and Energy Transformation) and specifies particular measures for each of them.

Exports

N.A.

There are 59 actions identified, 36 of which are articulated by means of economic incentives. Three (3) relate to the promotion of initiatives, which include a general plan for communication. Four (4) measures are aimed at the training of both users and market agents. Moreover, up to 16 legislative actions will be developed.

National Production

34.461 Ktoe (2010)

In addition, in 2011 a Public-Private-Partnership named “ALINNE” (Alliance for energy research and innovation) was set up among the Spanish Ministry of Science and Innovation and the Spanish energy sector. The Alliance is an instrument of science and technology policy which should enable responses to the main challenges on research, development, and innovation in the energy field, and contributions to the definition of an energy strategy at the Spanish level with European positioning in line with EERA (European Energy Research Alliance). The Spanish H2 and FC Technological Platform is also a member of “ALINNE”.

Production Subtotal and %

| Type | % of total production |
|-------------|-----------------------|
| Coal | |
| 3.448 Ktoe | 10% |
| Natural Gas | |
| 55 Ktoe | 0,2% |
| Oil | |
| 126 | 0,4% |
| Nuclear | |
| 16.155 | 46,9% |
| Hydro | |
| 3.390 | 9,8% |
| Renewables | |
| 11.288 Ktoe | 32,8% |

UPDATE OVERVIEW ON RELEVANT PROGRAMS AND PROJECTS

Funding

Public Administrations contribute a total amount of 2,367 million euros to the Action Plan for period 2008–2012, 20.2% over the established figure in E4 (Energy Saving and Efficiency Strategy in Spain) for period 2008-2012.

With this Action Plan, the government consolidated the effort carried out with Action Plan 2005-2007 and reinforced the measures that proved excellent in the improvement of energy efficiency.

The MOVELE Plan, name of the Action Plan 2010-2012, is part of the Integral Strategy to Promote Electric Vehicle in Spain 2010-2014. This plan consists of a series of measures to be implemented over the next two years to encourage the introduction of electric vehicles. The Ministry of Industry, Tourism and Trade has allocated 72 million euros as direct aid for the purchase of electric vehicles in 2011.

Highlights of Progress

The role of renewable energies is an essential component of a sustainable energy model that respects environment concerns and attempts to reduce dependence on foreign energy while securing a stable energy supply in Spain,

Through the industry effort and the energy policy accomplished by the government during last year's focus on energy savings and energy efficiency, renewable energies commitment, and the gradual replacement of the most polluting technologies in electricity production, the 2020 objectives are closer to being met.





In fact, the increase of renewable contribution in the 2010 energy mix has been one of the keys for the energy dependency reduction registered in 2010. During 2010, renewable energies increased their participation relative to 2009, reaching the 13.2% of the final energy. So while the Spanish self-sufficiency energy rate in 2009 was 22.8% of the final energy consumption, in 2010 it accounted for 25.9%.

Furthermore, thanks to the evolution towards cleaner technologies for electricity production, an improvement in CO₂ emissions per GWh was observed in 2010 from the previous year. In 2009, 306 tons of CO₂ per GWh were emitted and one year later this figure was reduced to 247 tons, i.e., a 19.28% decrease, which enables Spain to fulfill the internationally adopted commitments.

HYDROGEN R,D&D SPECIFICS

“HY-ROBRES WIND FARM” PROJECT

The project called “Hy-Robres Wind Farm” counts with 24MW of wind power installed and its goal is to demonstrate the possibilities of wind power storage and reconversion through Hydrogen. H₂ will be produced and stored, to be used as backup system for electricity production during peak hours. It is an R+D installation, expected to be operational in 2012.



Figure 3: Robres wind farm

The system consists of 3 new turbines of 2 MW nominal power each connected to the Robres Wind Farm grid. It comprises the following components: 500 kW Alkaline Electrolyser without purification; 20,000 liters tank at 25 bars; two internal combustion engines of 240 kW and 40 kW.

Electricity

Production

300.241 Gwh (2010)¹

Production Subtotal and %

| Type | % of total production |
|---------------|-----------------------|
| Hydro pumping | |
| 3002,41 Gwh | 1% |
| Coal | |
| 25520,49 Gwh | 8,5% |
| Natural Gas | |
| 96077,1 Gwh | 32,0% |
| Oil | |
| 16513,26 Gwh | 5,5% |
| Nuclear | |
| 61849,65 | 20,6% |
| Renewables | |
| 99677,60 Ktoe | 32,2% |

Imports

5.206 Gwh (2010)

Exports

13.539 Gwh (2010)

Total Demand/Consumption

277.996 GWh (2010)

Source: “La Energía en España 2010”, Ministry of Industry, Tourism and Trade. www.mityc.es



The total investment of the project amounted 11 M€ (Wind = 6,630,000€; hydrogen = 2,806,000€ in components + 73,527€ in H₂ civil works).

INJECTION TECHNOLOGY OF HYDROGEN AND METHANE IN DIESEL ENGINES FOR USE IN HEAVY TRANSPORT' LAUNCHED IN CARTAGENA, SPAIN

This is an innovative project launched in 2010 by the Government of Murcia (southeast of Spain) that would permit a 7% reduction of greenhouse gases emissions and fuel consumption by injecting hydrogen into diesel engines in trucks.

After a first year devoted mainly to instrumentation and facilities adaptation of the Polytechnic University of Cartagena (Murcia), the project is about to start the testing phase.

So far, the estimations are quite promising, and it seems that carbon monoxide and hydrocarbons emissions reduction per kilometer could be around 25% and nitrogen oxides by 15%. In addition, the opacity of smoke would decrease by 50%.

The second phase goal is the design of a prototype to be used by companies. This activity will be carried out in an IVECO test bench. It is possible that once the first results have been obtained, it can be applied to other heavy vehicles like buses.

SHEL: SUSTAINABLE HYDROGEN EVALUATION IN LOGISTICS

Shel is a demonstration project of the market readiness of Fuel Cell Hydrogen powered (FCH) materials handling vehicles, hydrogen refuelling infrastructure, and end user acceptance.



Figure 4: Forklifts from the SHEL project

Its main goal is the acceleration of early market take-up of Fuel Cell Hydrogen Fork Lift Trucks (FCH FLT) in Europe.

The project will demonstrate 10 units of 1.5-2.5 ton FCH FLT and a Hydrogen refuelling infrastructure across 3 sites in Europe: UK, Spain, and Turkey.





ENDNOTES

“La Energía en España 2010”, 1Ministry of Industry, Tourism and Trade. www.mityc.es

REFERENCES

MEMBER WEBSITE:

WWW.INTA.ES

OTHER IMPORTANT WEBSITES:

www.mityc.es

www.micinn.es

www.ine.es

CONTACT INFORMATION

Antonio G. García – Conde

glezgca@inta.es

Esther Chacón

chaconce@inta.es

Pilar Argumosa

argumosa@inta.es