

# THE HISTORY OF ENERGY RESOURCES IN PORTUGAL

- **THE REPORT (written version of the video)**

## **1 - Portugal and the concentration of resources**

A look at the history of energy consumption in Portugal over the twenties shows a trend of a delayed adaptation to the changes of the international market.

At the dawn of the twenties, there is a whole subordination to coal in the energy component of trade, complemented with firewood and rivers that feed wheels and hydraulic turbines. Once the coal must be almost all imported, the alternative hydro-electric becomes a great solution for economic nationalism. Hydro-electricity is cheaper, more accessible and more efficient. But, as the progress is very slow, only in the fifties does the country wake up and starts investing stronger in developing its own properties. Since then, the evolution is absolutely speedy. The dams which are used to produce only 7% of primary commercial energy consumed in Portugal in the 1930s come to 31% in the 1950s and 40% in the 1960s.

However, around 1969, the enthusiasm of the dam decreases because of the low price of oil and we start to have an economy focused on oil. Only in 1974 do we start importing other energy resources.

The "green energy" of natural gas has recently introduced bigger changes to the Portuguese landscape of energy. It extended the assortment of available resources, but it should be remembered that this is a delayed process of adoption, in many ways similar to what has been described in the hydro-electricity and oil.

So, we will look at the evolution of each energy resource in Portugal with a reporter on the spot.

## **2 – Hydraulic Energy: (Caniçada Dam)**

In front of us is the dam of Caniçada.

It is located between Terras de Bouro and Vieira do Minho, in the basin of the river Cávado, in the northern part of the country.

Its structure was concluded in 1955. It has a height of 76m, a length of a crowning of 246m.

Its volume is about 90 000 m<sup>3</sup>, and it has a maximum capacity of discharge of 1 700 m<sup>3</sup>/s. It is a kind of arch dam. The installed capacity is 60 MW, producing an average of 346 GWh per year.

Although the hydraulic power of watercourses has been the first natural resource used by humans to obtain energy, its development started only in the beginning of the twentieth century. Nowadays, Portugal is, among all European countries, the one who less uses its hydraulic ability. This is not because of lack of structures, but because we have extremely favourable characteristics for its development. Its use is below 40%.

However, there is a plan to build 10 new dams. These 10 new dams produce the equivalent of 2 thousand megawatts, and - with wind power - will be decisive to put Portugal as the third European country with greater use of renewable energy, just behind Sweden and Austria.

We can also be proud because we transform energy in electricity with great success. We are the EU country with the highest percentage of electricity produced by hydropower. We have 48.6% of electricity available for final consumption.

Currently in Portugal, about 30% of the electricity consumed in the country stems from hydropower, and the potential for exploitation of hydropower is distributed throughout the national territory, with greater concentration in the north and centre of the country.

### **3 - Geothermal: (Caldas da Saúde or Caldas do Gerês)**

In the continent, there is no recent magmatic activity. So, we will talk about the thermal activities that are common across the north of the country. For example, Caldas do Gerês and Caldas da Saúde.

A complex and diverse geology has given to the country a considerable geothermal potential, evidenced by the high number of occurrences with temperatures exceeding 20°C. In the continent, in the field of traditional geothermal, which are excluded high temperatures, the geothermal potential can be harnessed in two ways:

#### ***I:***

- The development of resources of half hundred thermal existing poles with temperatures between 20°C and 76°C, with a potential estimated at around 20 MWt.

And

- The exploitation of deep aquifers in western sedimentary edges and Algarve, revealed by the recognition of oil holes.

In the first case we have small investments in S. Pedro do Sul and Chaves. Furthermore, we can find spots where it's available the market as well as the resource, like Alcafache, Manteigas, Monção, Vizela, Carvalhal and so on.

Among the low enthalpy, we use geothermal energy in balneotherapy, in environmental heating and greenhouses, and there is potential to use geothermal energy for fish culture. These uses can and should be done in an integrated manner in order to obtain the best management of the resource.

#### ***II:***

The usage of geothermal energy to produce electricity is reduced to the geothermal springs which are located in broken areas. However, there is «Furnas dos Açores», where the water has temperatures that exceed the 200°C.

Island	Power [MWt]
S. Miguel	173,0
Terceira	25,0
Faial	8,9
Pico	12,0
S. Jorge	8,0
Graciosa	5,0
Flores	2,5
Corvo	1,1
<b>Total</b>	<b>235,5</b>

#### **4 - Wind Energy : (Marão Eolic Park)**

Aerogenerators that are found here take part of the Wind Park of Pena Suar. This park was installed in 1997 and it is composed by 20 towers. Each one has 42 meters and a power of 10 MW.

Since mid-century XII that wind power is harnessed in Portugal, through the use of tilting at windmills.

The first wind farm was established in 1988 in Santa Maria (Azores), with the installation of a wind farm in Figueira with an installed capacity of 270 kW. This production structure contributed annually with an average of about 4% of total production of the island. At present the distribution of these plants cover almost the entire country with approximately 150 MW of installed power by 2001.

On the continent, only in the last decade some studies have begun. These were conducted in order to the use of this form of energy as a source of electricity.

At the end of 2007, Portugal was the tenth world producer of wind energy in absolute terms, and the fourth in relative terms

There was installed a capacity of 2,150 megawatts (MW), which represents 2.3% of the world market.

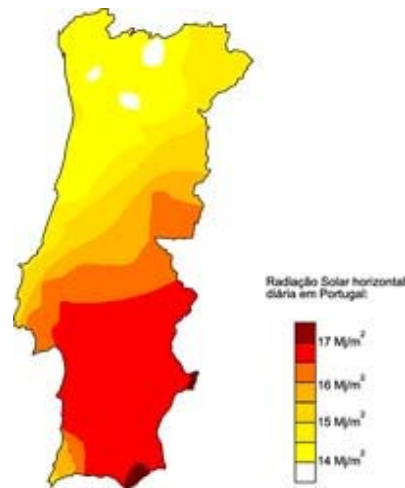
<b>Country</b>	<u>Portugal</u>
<b>MW</b>	2.150
<b>%</b>	2,3

#### **5 - Waves Energy: (Matosinhos Sea)**

The production of electricity through the use of energy from waves and tides is not very practicable in Portugal because the waves are too low and their magnitude cannot be increased due to the lack of area on the coast. However, this year, the city of Povoia de Varzim received the world's first park use of wave energy. This infrastructure produces enough power for 250 000 inhabitants.

#### **6 - Solar Energy: (A Factory in Santiago d'Antas, Famalicão)**

Solar energy deals with the use of direct sunlight to produce energy. This is an enterprise targeted for solar energy and for its conversion into both electrical and thermal energy. Solar radiation daily in Portugal:



This process started because this system was more advantageous than the coal and wood, and artificial gas and electricity were too expensive.

Portugal is one of the European countries with greater availability of solar radiation;

In Lisbon, in an inclined plane (about 40°) and targeted the South, the average daily power of direct solar radiation can reach 414 W/m.

As it's the energy of the sun, it would make sense at the Portuguese territory. This is because our country has around 2100 to 3100 hours of sunshine per year, equivalent to 1700 these KWH per square meter.

### **7 – Biomass Fuel: (Top of Caniçada Dam – Gerês Mountain)**

We are in the mountains, where we can see the pureness of the wild nature and feel the cleanness of an unpolluted air. We came here to talk about biomass.

The use of biomass fuel for energy purposes is done through some practices such as direct burning and anaerobic digestion.

Industries of forestry have being used biomass to produce thermal and electric energy for 30 years. All together, they spent, in 2003, 35 300 TJ of primary energy from biomass, which represent 73 % of the total waste of fuel.

As we can see in the table, plants more used to create energy are black liquor (83%), eucalyptus and pine (15%) and others (2%).

Values related to the biomass consumption from 2003 are 52% higher than the same values from 1990, as well as values related to the production of electricity show an improvement of 119%.

The energy which results from biomass, supply a reducing of the CO2 emissions by 60 tons per year.

### **8 - Nuclear Energy: (General View)**

Portugal hasn't got any thermonuclear central. There is only a reactor (the Portuguese Research Reactor) operating in the Nuclear and Technological Institute in order to do some research.

## 9 - Fossil Fuels: (A Refinery in Oporto)

As we can see over work, fossil fuels are still the largest resource of energy used in the country. Although there is already a large adherence to natural gas, it is still polluting and finite, not constituting a feasible and eternal solution.

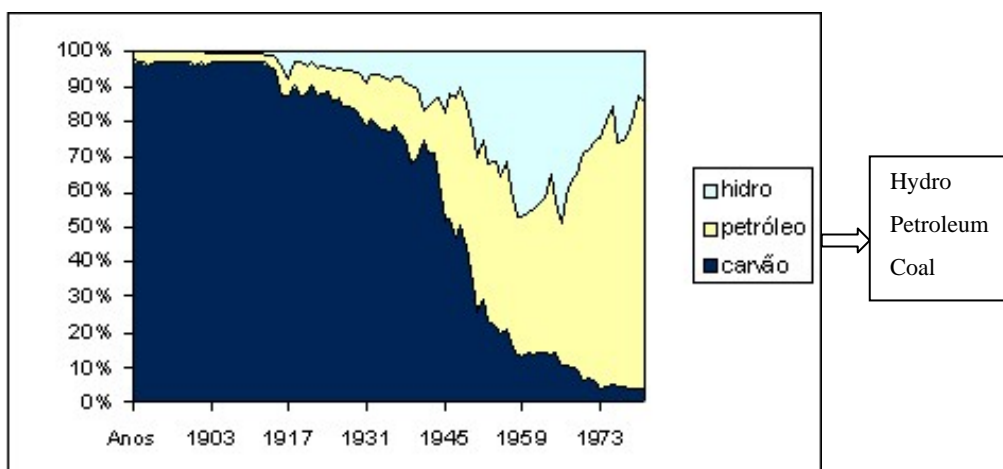
Portugal doesn't have any oil wells either on land or on the coast. At least, they haven't been found yet, once we will start investigations and drillings on Peniche's coast.

Nevertheless, we have two oil refineries. There, we can obtain various by-products of imported material. They are the refinery of Sines and the refinery of Porto.

Working since 1978, the refinery of Sines is one of the biggest in Europe in distillation capacity - 10.8 million tonne per year (223 000 barrels per day).

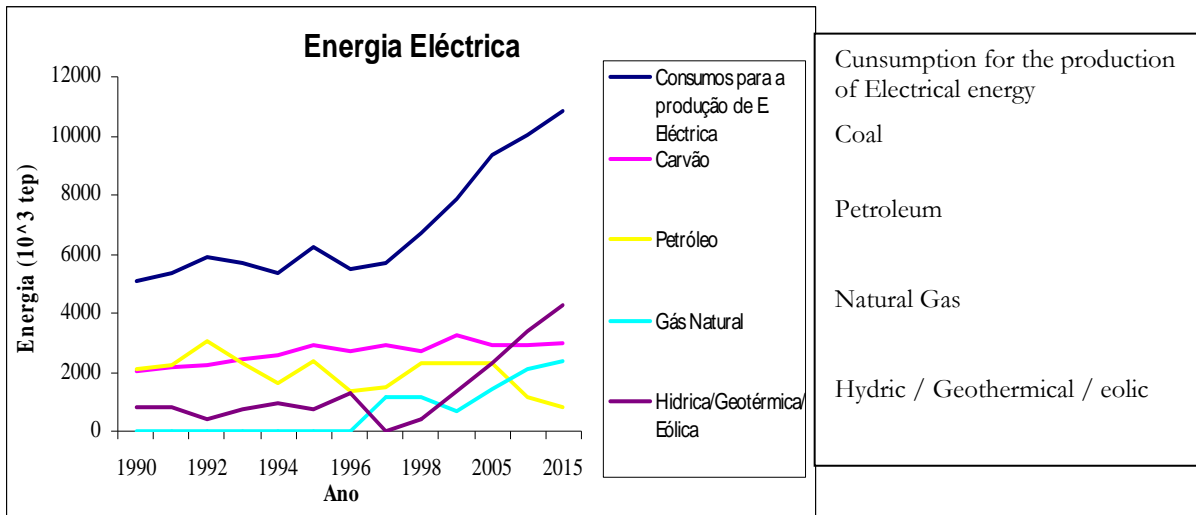
The refinery of Oporto is where we are now. It is in the Industrial Complex, located in the county of Matosinhos. It has 1.88.000 m<sup>3</sup> of storage capacity, of which about 680,000 m<sup>3</sup> are for crude oil and 1,200,000 m<sup>3</sup> to intermediate and final products.

Since 1903, the usage of coal, the main energetic resource of Median and Modern Age, has been decreasing. Actually, it was practically replaced by petrol and hydraulic energy after 1960.

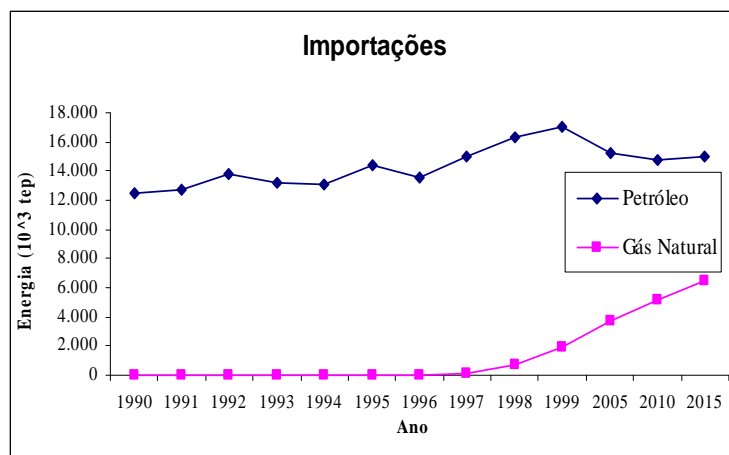
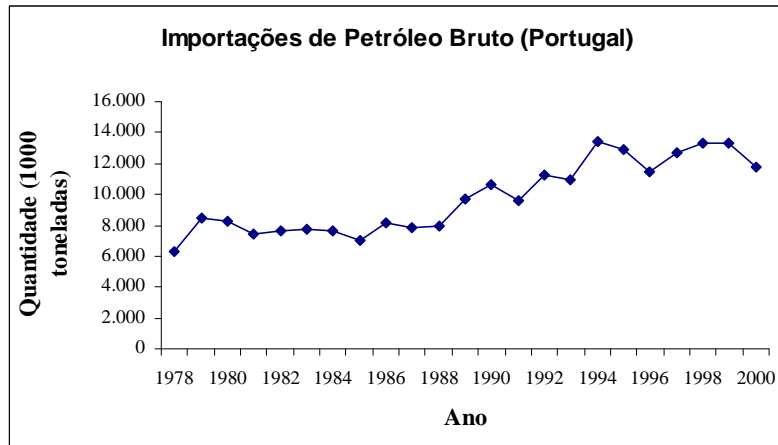


Analysing the graphic, we understand that the production of electric energy through non-polluting renewable resources has been growing faster in the last decade. This tendency is also followed by the natural gas.

All of them are counteracting petrol which, after 2006, and perhaps because of its high price, has been decreasing its contribution to the electricity.



If we try to link the previous graphic to this one, we conclude that the low rate of importations to Portugal is directly related to the decrease of its usage to obtain electric energy. Provided that renewable energy has begun to gain ground, oil began to be imported in smaller quantities.



Even to the natural gas, oil has lost ground. This is because, in terms of imports, the gas tends to rise and oil to fall, continuing like that into the future.

## **Conclusion:**

These statistics only prove what we were already expecting. The oil should be replaced by clean, but powerful energy resources. Despite the fact that this situation should have been anticipated and resolved sooner, we start now waking up and trying to recuperate the lost time by investing in better ways of obtaining electricity and heat. And Portugal is able to continue the process of change with success because almost all resources of energy, and at least the most feasible, are applicable very easily in Portugal. Now it is up to us, citizens, to realize that a more diversified energy economy is an economy less exposed to factors of uncertainty, and fight for it.

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Help from:

<http://www.historia-energia.com/imagens/conteudos/A3NMST.pdf>

<http://movv.org/2007/10/05/alguns-numeros-sobre-a-energia-hidrica-em-portugal-e-sobre-as-novas-10-barragens/>

<http://www.naturlink.pt/canais/Artigo.asp?iArtigo=4148&iLingua=1>

<http://miguel675.tripod.com/id3.html>

[http://www.energiasrenovaveis.com/images/upload/Biomassa\\_uma\\_opcao\\_justificavel.pdf](http://www.energiasrenovaveis.com/images/upload/Biomassa_uma_opcao_justificavel.pdf)

[http://in3.dem.ist.utl.pt/master/02energy/pres8\\_1.pps#370,2,Importações de Petróleo \(Portugal\)](http://in3.dem.ist.utl.pt/master/02energy/pres8_1.pps#370,2,Importações de Petróleo (Portugal))

<http://www.mundopt.com/n-ondas-utilizadas-para-gerar-energia-na-povoa-de-varzim-9068.html>

[http://pt.wikipedia.org/wiki/\*\*Barragem da Caniçada\*\*](http://pt.wikipedia.org/wiki/Barragem_da_Caniçada)

*Written by:*

*Hilário Rafael, Hugo Silva, Joana Silva, Sara Pereira*