Key Figures and Current Situation of the Spanish Electrical Energy Sector

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The Spanish Energy Policy has been attracting much attention in the last years, first because of the favourable political framework for the deployment of renewable energies between the years 2004 and 2008, and afterwards because of restrictions to further deployment of renewable energies and even penalties to energy generation of existing renewable power plants. Last July a new law for the electrical sector has been proposed by the Spanish government, eliminating any subsidies to renewable energies and creating a new tax for installations for energy self-consumption. When analysing Spain's actual energy situation, several questions arise, regarding the **reasons and goals** for this change in policy, the **effectiveness** of the adopted measures to control the electricity cost, the fact whether this new law is a **sustainable long-term solution or a short-term patch** and if it will be **possible to reduce the dependence on foreign oil and gas imports**. This article gives the key figures of the Spanish electrical sector in order to explain the overall situation. The main problem that is identified in the Spanish energy sector is the high dependence on foreign imports of energy products, more than 60% of the total primary energy demand, and this high share penalizes severely the national trade balance.

1. Introduction

This article presents the evolution of key figures of the Spanish electrical sector between the years 2000 to 2012. Four years have been selected that are linked to political regulations that affected significantly the evolution of the electrical sector. The selected years are 2000, 2004, 2008 and 2012.

Period 2000-2004: This period is used as a starting point in this article for the evolution of the electrical sector in Spain. Until 2004 no significant installations of renewable energy were made, with exception of wind energy that in 2000 had a share of 2,3% of the total installed electrical capacity.

Period 2004-2008: In march of 2004 a Royal Decree was approved, which established the economic and legal basis for the subsidies of renewable energies in the so-called *Special Regime*. This lead to massive installations of renewable energy sources.

Period 2008-2012: During this period several Royal Decrees were approved in order to decrease the cost of the electricity generation in Spain. The first one was approved in September 2008, which reduced the incentives for new PV installations and limited the total new installed capacity per year to 400MW. The second one (approved in February 2010) established an increase in coal consumption up to 15% of the total electrical energy generation. The third Royal Decree was approved in December 2010 and limited severely the yearly operating hours, at which the generated electricity is obtaining subsidies, of already installed PV power plants.

Additionally, the international financial crisis that is affecting Spain started at the beginning of the period 2008-2012. This fact is reflected in the decrease of both, primary energy demand and electrical energy demand between 2008 and 2009, which was of 3,5% for primary energy and of 4,7% for electrical energy. The accumulated decrease for all the period 2008-2012 was of 9,7% for primary energy and of 4,5% for electrical energy.

The Spanish legislation distinguishes between two regimes in which electricity can be produced. The first one is the so-called *Ordinary Regime* in which all the traditional energy sources that do not have any subsidies are included (i.e. nuclear, hydro, coal and co-generation), and the so-called *Special Regime*, in which the technologies that are subsidized are included. In this latter one are included renewable as well as non-renewable energy sources.

This article is based on a previous one [1] in which additional information regarding the evolution of the Spanish legal framework and reasons for the uncontrolled evolution of the Spanish energy sector can be found.

2. Share of primary Energy Sources in Spain

To understand better the situation and constraints of the Spanish electrical energy market, it is worth to have a quick view on the global energy market in Spain. For this purpose, the evolution of the share of different energy sources to the overall energy market is given in Figure 1. This figure shows the share of the energy sources from 2000 to 2012. It can be observed in that figure that the share of oil is gradually decreasing since 2000 while the share of gas is increasing basically with the same share as the decrease of oil. The sum of the shares of oil and gas for the years 2000, 2004, 2008 and 2012 were of 65,72%, 69,27%, 72,68% and 64,18%, respectively. The value for 2012 is slightly lower because of the lower primary energy demand. Between 2008 and 2012 the primary energy consumption of oil decreased by 20,8% and of gas by 19,1%.

Regarding the dependence of Spain on imports of energy products (mainly oil and gas) it can be said that the dependence on these products has not been reduced since the year 2000, despite the introduction of renewable energies during that period. In fact, and as described in [1], the share of foreign energy product imports did not change much since 1973, the year of the 1st oil crisis in which the share of oil and gas was of 68,2%. This high share on imports of energy products is very critical to Spain's economy, because on one hand it makes Spain's economy and economical growth to be very dependent on price fluctuations of these raw materials, and on the other hand, because of its negative impact on the national trade balance. This means that in order to have a well-adjusted trade balance, Spain has to export more to compensate the value of these imports.

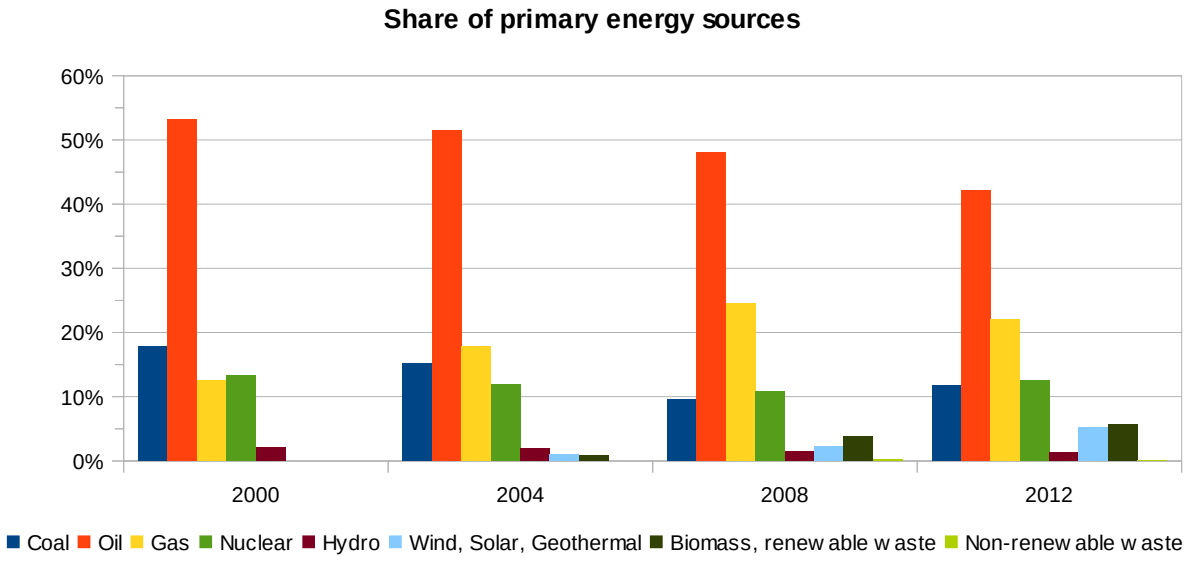

Figure 1. *Evolution for the years 2000 – 2012 of the share of primary energy source in Spain. [2]*

3. Impact of the Share of Energy Sources on the Spanish Trade Balance

The effect of the high share of oil and gas in the Spanish primary energy mix can be analysed with the evolution of Export, Import and Balance of Spain's national trade balance, which is given in Table 1. As can be seen, the cost of imports of energy products (in Euros) tripled between the years 2000 and 2012. In this period the increase of the imports of oil and gas were basically due to the increase of its price at its origin, since the amount of imports (in ktep) were similar in both years. To be more precise, for the period 2000 – 2012 and increase in the amount of oil and gas of 3,1% led to an increase in cost of 208%, and for the period between 2008 and 2012, a decrease in the purchase of oil and gas of 20% led to an increase in cost of 11%.

Since Spain imports more goods and services than it exports, the balance of the total foreign trade is negative. To this negative difference in the total trade balance, the balance of energy products (exports minus imports) contributed with 35% in 2000, 28,91% in 2004 and 46,37% in 2008. From 2008 to 2012 the negative balance (the debt) of the total trade in Spain got reduced by a factor of 3. This has been possible due to an increase of exports of non-energy products of 17,7% and an decrease of imports of non-energy products of 15,2%, but these have not been sufficient to compensate the large import of energy products of 45.503,7 million Euros, so that the balance of the total foreign trade of Spain was of -30.757,4 million Euros. This means, that with less dependence on foreign energy products, Spain's trade balance and economy could be in a much better shape, balancing imports and exports.

Spanish Foreign Trade (in million Euros)

Export	**2000**	**2004**	**2008**	**2012**
Energy Products	***4.573,0***	***5.561,7***	***12.947,3***	***16.445,0***
Oil and by-products	4.291,4	4.517,1	10.699,7	14.677,8
Gas	66,9	377,6	167,9	852,1
Coal and Electricity	214,7	667,0	2.079,7	915,1
Total Foreign Trade	**124.177,3**	**146.924,7**	**188.184,4**	**222.643,9**
% of Energy products from total	**3,68%**	**3,79%**	**6,88%**	**7,39%**

Import	**2000**	**2004**	**2008**	**2012**
Energy Products	***20.433,2***	***23.337,2***	***56.563,2***	***61.948,7***
Oil and by-products	16.240,3	18.098,5	42.622,3	48.525,3
Gas	3.190,8	3.658,0	11.308,7	11.288,8
Coal and Electricity	1.002,1	1.580,7	2.632,2	2.134,6
Total Foreign Trade	**169.468,1**	**208.410,7**	**282.251,3**	**253.401,3**
% of Energy products from total	**12,06%**	**11,20%**	**20,04%**	**24,45%**

Balance	**2000**	**2004**	**2008**	**2012**
Energy Products	***-15.860,2***	***-17.775,5***	***-43.615,9***	***-45.503,7***
Oil and by-products	-11.948,9	-13.581,4	-31.922,6	-33.847,5
Gas	-3.123,9	-3.280,4	-11.140,8	-10.436,7
Coal and Electricity	-787,4	-913,7	-552,5	-1.219,5
Total Foreign Trade	**-45.290,8**	**-61.486,0**	**-94.066,9**	**-30.757,4**
% of Energy products from total	**35,02%**	**28,91%**	**46,37%**	**147,94%**

Table 1. *Evolution for the years 2000 – 2012 of the exports, imports and balance of energy products of the Spanish Trade balance [**3**]*

Additionally, since the price of electricity in Spain is regulated by the Government, and the production cost is higher than the selling cost of the electricity, there is a so-called tariff-deficit that has been accumulating debts in the last years, especially since 2004 with introduction of renewable energies and its related costs. These accumulated debts were by May 10th 2013 of 26.062,51 Million Euro [4], which accounts to 2,48% of Spain's GDP of 2012. This means that in order to make the energy system in Spain sustainable, both costs, the one of energy imports and the one of electrical energy generation have to be reduced. These should be the main objectives of any new regulation of the electrical sector.

4. Evolution and Situation of the Electrical Energy Sector

There are also other aspects that are specific to the electrical sector and that have enhanced the negative evolution of this sector. Between the years 2008 and 2012 the national demand on electricity has decreased, while the installed power capacity has increased. This has increased the cost of the Spanish electrical system, since the overall installed power capacity is not being exploited as it could and should, keeping an important part of the infrastructure unused.

The evolution of the electricity generation (or demand) and the installed generation capacity are shown in Figures 2 and 3 for the period 2000 to 2012. In Figure 2 the decrease in energy demand between 2008 and 2012 can be observed. The decrease was of 4,5% for the period 2008-2012. Despite the decreasing energy consumption since 2008, the installed capacity for energy generation (see Figure 3) continued increasing until 2012. This increase in capacity was of 11.44% for the total capacity of the Spanish electrical system. This increase in capacity was basically due to new installations of co-generation and renewable energies, and corresponds to an increase in generated electricity of 14% of the the total electricity demand of Spain in 2012. From this 14%, the contributions of the different technologies are 39% of co-generation, 37% of wind energy, 9% of CSP and 5% for each of the following technologies: PV, thermal renewable and thermal non-renewable.

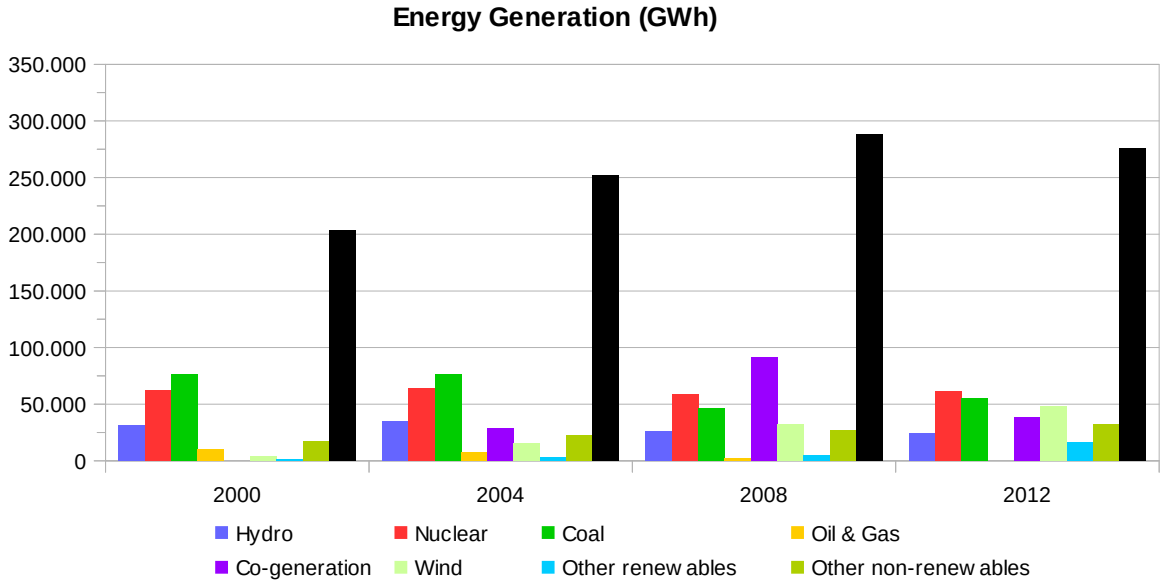

Figure 2. *Evolution of the electricity demand in GWh in Spain for the years 2000 to 2012 [5]*

Figure 4 shows the share of different energy sources of the Spanish electricity generation for the years 2008 and 2012. The decrease in demand lead to the fact that the usage of part of the installations had to be reduced, especially co-generation, because the consumption of nuclear power and power from renewable energies are prioritized in the Spanish electrical energy system. This fact is reflected by the share of co-generation, which in 2008 was close to 32% and in 2012 barely reached 14%. In order to quantify the usage and efficiency of different technologies the load factor has been calculated and is given in Table 2. This factor indicates how much energy is generated with a given installed capacity. It can be seen that while most of the technologies increased their load factor in the period between 2008 and 2012 (what means that the efficiency or utilization of the system is increasing), in the case of co-generation the load factor was reduced almost by a factor of 3, telling that in 2012 only 1/3 of the installed capacity of 2008 has been used for power generation, if a constant load factor is assumed.

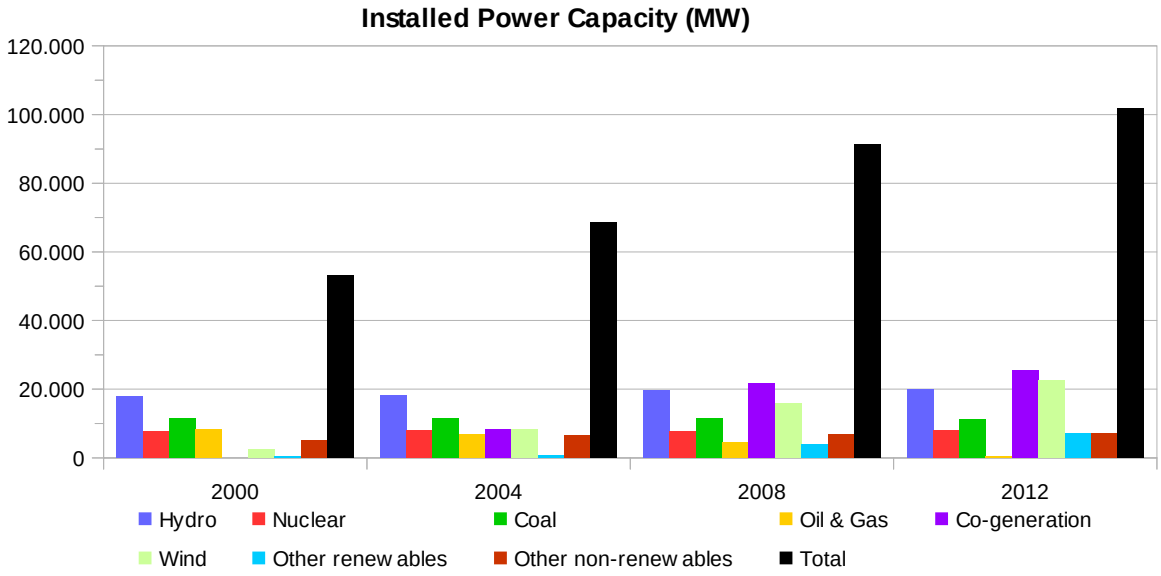

Figure 3. *Evolution of the installed capacity of the Spanish Electrical Sector for the years 2000 to 2012 [5]*

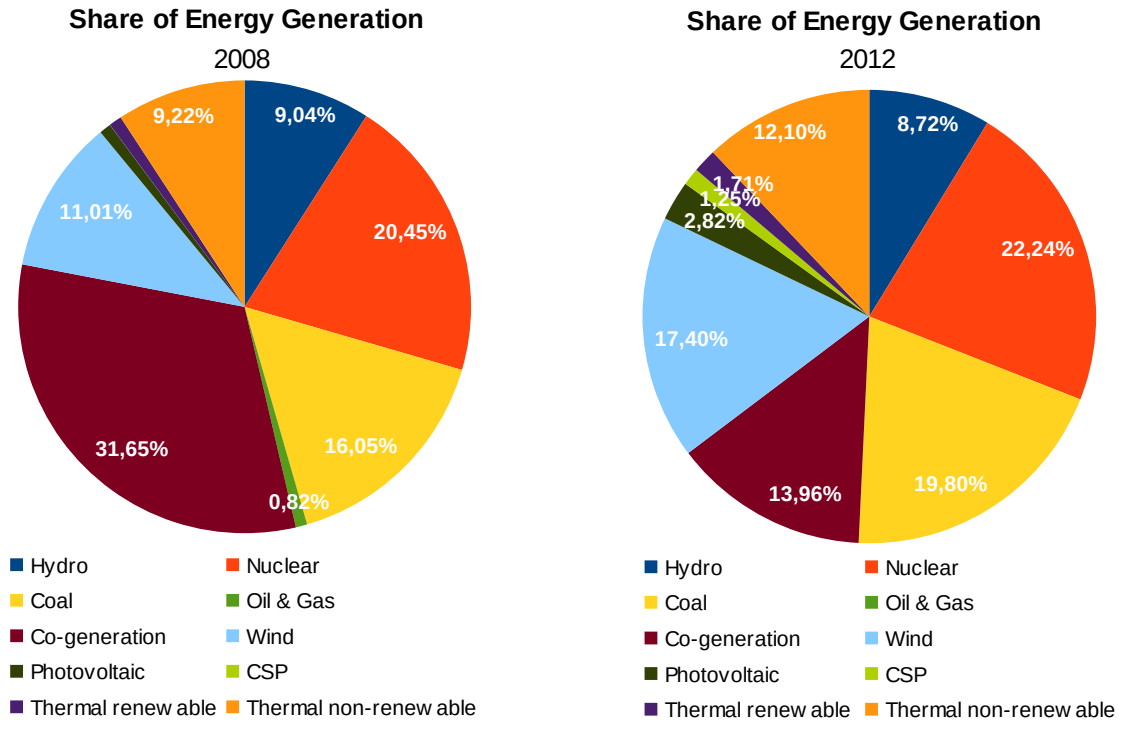

Figure 4. *Share of the generated energy in Spain for the years 2008 and 2012. The share of co-generation has been reduced significantly due to the decrease in demand during this period [5]*

Load factor (GWh/MW)

	2000	2004	2008	2012
Hydro	1,77	1,88	1,33	1,22
Nuclear	7,98	8,08	7,64	7,83
Coal	6,62	6,60	4,07	4,86
Oil & Gas	1,25	1,11	0,54	
CHP		3,50	4,20	1,52
Wind	1,94	1,89	1,99	2,13
Other renewable	4,04	4,01	1,31	2,20
Other non-renewable	3,42	3,51	3,91	4,49
Total electrical energy system	**3,83**	**3,69**	**3,16**	**2,70**

Table 2. *Evolution of the load factor of the Spanish Electrical Sector for the years 2000 to 2012 [5]*

The share of renewable energy sources in the Spanish electrical energy mix was of 7,45% in 2004, 12,8% in 2008 and of 23,2% in 2012. For co-generation, the share in 2004 has been 11,5%, in 2008 of 31,7% and in 2012 of 14%. It has to be considered that in 2012 the electricity consumption was lower than in 2008, and that the generation with renewable energies was prioritized against generation with co-generation. That means that the value of the share for 2012 of renewable energies and co-generation gives the share of what has been generated in 2012, but does not give the value of the share of Spain's electrical energy system (i.e. what could have been produced with the installed capacity) since an important part of the installed power capacity has not been used. If it is assumed that all of the installed power capacity would contribute to the generation of electricity and assuming a reasonable value for the load factor (i.e. values of 2012 for nuclear and coal, average value for hydro and maximum values for co-generation and renewable energies), than the share of the renewable energies in the Spanish mix would be around 18,5% and the one of co-generation would be of 30%.

5. Summary and Conclusions

In this article it has been shown that between the years 2008 to 2012:

- the consumption of electrical energy in Spain has decreased by 9,7%,
- the installed electrical power capacity has increased by 11,4%, which is equivalent to an additional electricity generation of 14% of the total electricity demand of Spain in 2012.
- the utilization of the to Spanish electrical system (i.e. the load factor) has decreased by 14,3%
- the share of oil and gas in the primary energy mix is very high, of 64,2% in 2012, which has not varied much in the last 40 years (it was of 68,2% in 1973)
- the cost of imported energy products (mainly oil and gas) increased by 9,5%, even though the amount of imported energy products (in ktep) was reduced by 20,8% for oil by 19,1% for gas

The reasons for the decay of the electrical energy system in Spain might have several reasons, and depending on the interests of each industry, the arguments might vary. But from our point of view, the two main reasons for this decay are the high dependence on imports of energy products and the lack of central coordination and planning in the development of the electrical energy sector. The lack of coordination enabled to increase the installed capacity of the Spanish energy system by two groups of producers separately, on one hand by the traditional utilities installing new co-generation power plants and on the other hand by producers of renewable energies [1], and that led to an unnecessary increase in power capacity and an uncompensated mix of the shares of different technologies.

The recently proposed law of the electrical sector is an answer to try to control in a short-term the negative evolution of Spanish Energy Sector, especially its cost. This law excludes any subsidy to new renewable energy power plants and introduces an additional tax to installations for self-consumption. Also the consumption of energy will be favoured by reducing the cost of the kWh for the consumer and increasing the amount of the fixed part of the electricity bill. These facts and the analysis of the presented data lead us to the conclusion that the goal of the government is to increase the utilization of co-generation power plants. This will increase the share of gas in the Spanish energy mix and consequently also the amount of gas imports. With this also the deficit of the balance of energy products will increase, making any recovery of Spain's economy more difficult. In any case, this new electrical law does not seem to give a sustainable long-term solution to reduce the cost of Spain's electricity generation, and neither a medium to long-term planning for the Spanish energy sector to reach a balanced energy mix. It will keep and increase Spain's dependence on imports of energy products and its dependence on price fluctuations of these raw materials.

6. References

[1] J. Rodríguez de Pablo and E. Rodriguez Messmer, The Electrical Energy Sector and the Development of Renewable Energies in Spain, available also in Spanish at www.soltunecpv.com (2012)

[2] Ministerio de Industria, Energía y Turismo, Secretaría de Estado de la Energía (Spanish Ministry of Industry, Energy and Tourism), www.minetur.gob.es

[3] El comercio exterior de España. Boletín Económico ICE. www.revistasice.com

[4] Comisión Nacional de la Energía (CNE, it is the Spanish regulatory agency for the energy sector), www.cne.es

[5] Red Eléctrica de España (Red Eléctrica is the sole transmission agent and operator of the Spanish electricity system), www.ree.es