Techno-Economic Analysis of the Electricity Sector in Portugal and Spain
Study of the Electricity Sector in Portugal and Spain

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Abstract — The electricity sector has been suffering a big transformation in the past twenty years. On the one hand, the European Union imposed environmental and energetic targets to the countries until 2020 and, in the other hand, the electricity sector started the economic liberalization. The promotion of renewable energy in Portugal and Spain to reduce the Greenhouse effect brought expensive costs to the production of electricity. These producers receive “Feed-In” tariffs and they have the guarantee that they sell everything they produce. These incentives menace the profitability of non-renewable producers who demand a compensation package caused by the difficulty of selling power to the grid. In 2006, the Portuguese and Spanish Governments, obliged by the lack of competition between producers, created the tariff debt in order to stop the increase of electricity prices. In 2011, the International Monetary Fund obliged Portugal to reduce the electricity costs but, in spite of that, the tariff debt will reach 5.080 Millions of euros in 2015. In order to reduce the costs of these policies, Portugal and Spain asked the European Union to improve the interconnection of electricity with France so that they can sell energy to other countries. Despite this, if in the future France doesn’t import energy, Portugal and Spain will only pay to benefit French customers. In conclusion, the energetic policy in Portugal and Spain has been good to the environment but with the wrong costs.

Index Terms — Electricity Sector, Economics, Tariff Debt, Renewable Production, Non-Renewable Production and Interconnections.

I. INTRODUCTION

The European Union has been worried with the climate changes. In order to promote less carbon footprint, in 1990 the EU decided to stable these levels until 2020. It was decided that energy and climate were the most important issues and the objective was to reduce 20% of carbon emissions comparing 1990. Until 2050, the objective is to reduce the carbon emissions between 80% and 95% comparing 1990.

A. Strategy «Europe 2020»

The strategy «Europe 2020» has five main issues and one of them is the climate change. The objective is: reduction of 20% of carbon emissions; 20% of energy produced by renewable sources and 20% more of energy efficiency in EU space. The last package of laws related with climate started in June of 2009.

Every member of EU has its own targets and it depends of the development of each one. In 2014, the European Commission presented «Europe 2030» with more ambitious targets.

B. Structure of Electricity Sector in Portugal and Spain.

In 2003, the European Parliament established rules to all countries. These rules are applied to production, transport and distribution of electricity, access to market, contests, exploration of power grids and authorizations. It was decided too that after 1st of July 2007 each consumer can decide each electrical power supplier wants. The liberalization of Electricity Sector is equal in all European members and it is characterized by three areas:

Production – This area operates in an open market and with competition. There are two systems: Ordinary Regime Production and Special Regime Production. The first one depends of non-renewable energy. The second one depends of renewable sources and cogeneration.

Transport and Distribution – In Portugal, the responsible for the transport in High Voltage is National Grid o Transport and the operator is REN. The distribution in low and medium voltage is responsibility of National Grid of Distribution and Municipal Grids. The operator is “EDP Distribuição”. In Spain, the transport operator is “Red Electrica de España” and in distribution there are some operators like Endesa and Iberdrola.

Commercialization – It works in open market and with competition. If the market is not efficient, there is a operator called Supplier of Last Resort that ensures the service. In Portugal this operator is “EDP – Serviço Universal, SU” and
in Spain there are “Endesa Energía XXI, SL”, “Iberdrola SAU”, “Unión Fenosa, Metra, SL”, “Hidrocantábrico SAU” and “E.ON SL”.

C. Natural Monopolies

With this process, in one hand the consumer can choose its supplier of electricity. But, in the other hand, the consumer can’t choose the transport and distribution operators because it is economically more efficient to have only one operator in each case. In this case, the grids operators are ruled by a regulator.

D. Wholesale Market - Portugal

In December of 2014, the installed power in Portugal was 17,840 MW (10,854 MW of Ordinary Regime Production and 6,986 MW of Special Regime Production).

In Portugal, carbon and hydro are the most important technologies of Ordinary Regime Producers. From the Special Regime Producers, the most important one is Wind technology.

It is possible to conclude that in 2013 and 2014 the consumption decreased and the difference between both numbers is increasing. It is caused by the Special Regime Production because these technologies are intermittent and they are growing. If Portugal was isolated, without wind and water, the electricity sector wouldn’t be ensured with this mix.
E. Wholesale Market - Spain

In December of 2014, the installed power in Spain was 102.265 MW (62.497 MW of Ordinary Regime Production and 39.765 MW of Special Regime Production).

The production non-renewable in Spain depends historically from carbon and nuclear technologies. Like in Portugal, renewable energy has been growing in the past ten years and wind is already very important. It is possible to see that carbon has increased the production in 2013. It happened because the price of carbon is lower than the price of the gas.

In Spain, the Special Regime Production has been increasing like in Portugal.

It is possible to conclude that consumption has been decreasing and the difference between both numbers is increasing. It is caused by the Special Regime Production because these technologies are intermittent and they are growing. In spite of Portugal, if Spain was isolated, the power installed would ensure the electricity sector.

In Spain, there is no information about the power installed by company. But, it is possible to see the energy produced.
F. Compensations to Ordinary Regime Production in Portugal

CMEC - Before the liberalization of the electricity sector in Portugal, the production was based in CAE (Contracts of Energy Acquisition). Those contracts were signed between the producers and the only buyer (REN) and REN was responsible to give supply energy to the distribution. After 2007, the producers with these contracts had to change to CMEC (Cost of Maintenance of Contractual Equilibrium). The contractual equilibrium had to be kept in order to do these changes easier. With CMEC, the producers must sell their production in the market and after that they receive an extra to compensate what they lost with the end of CAE. In 2013 this value was 441,497 k€ and in 2014 was 233,848 k€.

CAE – There are some producers that still have CAE (Tejo Energia and Turbogas). These producers must sell their production to REN Trading and this company is the responsible to sell this energy in the open market. The difference of the price is included in the tariffs every year. In 2013, the extracost was 162,929 k€ and in 2014 it was 130,149 k€.

Power Insurance System – Some Ordinary Regime Producers were able to receive this subsidize. The electricity sector is obliged to ensure that service is not interrupted. In order to ensure that, some producers would be prepared to start producing if it was needed. The Power Insurance System is suspended since the beginning of Financing Assistance although.

II. Diary, Intraday and Forward Market

Diary Market – The electricity is transacted every day, and the transaction occurs always in the previous day. The platform is operated by OMIE and there is a price to every hour of the following day. The price is the intersection of the demand curve with the supply curve.

Forward Market – This market doesn’t define the price to the forward day. It is based in financial derivatives and the purchase and sale of energy is done some time after the definition of the price. There are Future Contracts, Forward Contracts and Swap Contracts. The most common are the Forward Contracts.

III. Carbon Dioxide Emission Licenses

A. European Trade of Emission Permits

In 2003, the European Parliament imposed the creation of a market where the producers can trade the permits of carbon dioxide emissions. This market aims to reduce the emission of green house gases in accordance with the Kyoto Protocol. To do that, the European Union is obliged to reduce the licenses annually. Until 2012, the producers of electricity used to receive these licenses for free. Since then, the European Commission decided to exclude this exception. In one hand, it is believed that the producers can support the costs with licenses. In the other hand, the inclusion of these costs can increase even more the price of electricity.

The distribution of licenses trough sectors and facilities are responsibility of each country.

B. Situation in Portugal

Portugal was approved in the EEX Platform in 9th of November of 2012 and started trading the licenses in 27th November of the same year. The Portuguese producers must buy the licenses by auctioning, as on other European countries.
C. Situation in Spain

Spain started the trading of licenses earlier, in 2005. The difference between Portugal and Spain is in the way how licenses are distributed. In Spain, the responsibility of the auction belongs to Spanish Autonomous Communities.

IV. PARTICIPATION OF SPECIAL REGIME PRODUCTION IN MARKET

A. Situation in Portugal

In 1988 with the DL 189/1988 Portugal reinforced the promotion of the Special Regime Production (Cogeneration and Renewable Production). To encourage the investment in these technologies, these producers receive Feed-In Tariffs and the guarantee that the Supplier of Last Resort (EDP SU) acquires all the production. Then, EDP SU sells it in open market and the difference between the cost with Feed-In Tariffs and the price in market (extracost) is included in Global Tariffs.

It is possible to conclude that Special Regime Power is increasing more and more in Portugal. With more installed power, more Special Production will contribute to demand.

As it is possible to see, there is a big difference between both kinds of technologies. Special Regime Production is much more expensive.

These technologies are expensive and they have disadvantages. The renewable sources are not predictable and in order to guarantee the supply, the ordinary producers must be prepared to start producing when it is needed. Ordinary producers receive amounts to guarantee the service and it
contributes directly to Tariff Debt.

With the increase of Special Regime Power, the cost of energy increase too. To avoid this situation, these producers should not receive so much per MWh and they should not have the guarantee of acquisition of all production.

![Fig. 1.18 – Production and Demand in Portugal](image)

In this picture it is possible to see the production and the demand in Portugal. Even when more production is not needed, the Cogeneration producers produce more than needed. It wouldn’t be necessary but they do it because they have priority treatment.

![Fig. 1.19 – Special Production in Portugal](image)

B. Water Storage Dams

This system is able to filter the renewable and unpredictable production. If there is more production than demand, some dams start pumping the water up and they are able to store energy.

![Fig. 1.20 – Storage Dams](image)

This system is very expensive. It needs more energy than what it saves and the energy saved should be sold when the prices are higher. If it doesn’t happen, these dams are not profitable.

C. Situation in Spain

Spain had to increase the share of renewable production too. The Special Regime is similar to the Portuguese system.

![Fig. 1.21 – Evolution of Special Regime Power in Spain](image)

In Spain in 2014, the Special Regime Power was 40.294 MW and the production was 111.667 GWh in 2013. The technologies that increased more were wind and solar, like in Portugal. To improve the renewable production, the Spanish Government created a plan in order to increase the supply of the demand to 20% in 2020. The costs with this regime are very significant like in Portugal.

In 2014, it was decided by the government that wind facilities older than 2005 can’t receive more privileges. The Government believes that these producers don’t need “Feed-In Tariffs” anymore. Furthermore, wind producers younger than 2005 will receive 50% less of tariffs.

In the results of EDP, it is possible to see that the cut in the Spanish tariffs doesn’t menace the profitability of the companies.

V. INTERCONNECTIONS

A. Available Capacity

Storing energy in a large scale is impossible. So, with this characteristic, the electricity sector has some technical and economical particularities. To share some support, Portugal and Spain created the first interconnection in 1961 in Saucella. These interconnections are important to both countries because they contribute to the quality of the service.

In 2014, the interconnection capacity power arrived to 3.000MW. This number is important because it avoids the separation of the markets “Market Splitting”.

B. Utilization

The utilization of the Interconnection capacity is very high. As it is possible to see, the investments in these lines were important to avoid the “Market Splitting”. The figure shows that Spain exports more energy to Portugal than the opposite.

![Fig. 1.22 – Interconnection Utilization between Portugal and Spain](image)

C. Interconnection with Europe

With the increase of renewable production in Portugal and Spain, the interconnection with France is very important. The excess of renewable production can’t be sold with the actual interconnection capacity and the Portuguese Government presented to the European Commission a proposal to increase it 25%. The target will be only 15% although. It is believed that with more interconnections, Portugal and Spain will be able to share the high costs of renewable production. In one hand, Portugal and Spain will be able to sell energy to the rest of the EU but in the other hand France must buy this energy. If the price of the pool is lower in France, the extra costs won’t be shared as wished and Portugal and Spain will only benefit French costumers.

![Fig. 1.23 – Important Interconnections in EU until 2020.](image)

VI. Tariff Deficit

A. Situation in Portugal

Tariff Deficit is the difference between the profits and the costs in the electricity sector due to policies. In fact, it is caused by the sum of successive costs and extra costs that were not recovered in the tariffs.

In 2006, with the increase of the prices of electricity, the Portuguese Government decided to freeze them, despite the raise of the costs. In this way, the costs with the interests of these loans must be included in the global tariffs.

![Fig. 1.24 – Composition of Prices of Electricity in Portugal](image)

As it is possible to see, CIEG or Costs with General Economical Interest are heavy in the electricity tariffs. These costs include compensations to Special and Ordinary Regimes, rents to counties, costs with islands and loan interests. The costs with CIEG have been increasing a lot in the past years.

![Fig. 1.25 - Evolution of CIEG](image)

This impressive increase is caused by the costs of Special Regime Production that is increasing and compensations to Ordinary Regime like CAE, CMEC and Power Insurance System. With the decision of the Government in 2006 the costs haven’t been included in the tariffs. This situation creates a debt. The companies sell their debt to some creditors and the debt increases more and more.

It’s important to emphasize that the extracost with Special Regime Production in 2013 and 2014 was 1.073,6 M € and 1.267,1 M€ respectively.
Accordingly with a document from ERSE, the total debt in 2015 will be 5.080 M€. To slow down the increase of this debt, the Government decided to create a Fund that is supported by all companies of the sector. It will help but it won’t be totally effective. The fund will contribute only with 150M€ (50M€ to the Electricity Sector and 100M€ to State Budget). To slow down this deficit, Special Regime Producers must sell their energy in the market, without help or priority and guarantee of acquisition.

The Government suspended the attribution of new contracts to Special Regime Producers, decreased the interests paid to EDP and decreased the tariffs of some Special Regime Producers.

In 2013, the Portuguese Government created the DL35/2013. This law cut the “Feed in Tariffs” with Wind Producers in 5.000 and 5.800 € per MW installed but the producers had their contracts extended for five, six or seven years. This plan decreases the deficit in 25M€ per year but it will create a new debt much bigger: The value expected is 1.1000M€.

To Portugal, this debt damages the economy. It is very secure and creditors prefer to invest their money in this kind of debts, despite small and medium companies. Additionally, with this debt there is less money available to other sectors of the economy.

In Spain, in 2002 the Government decided to create a deficit too, but earlier. It was decided that the price of electricity wasn’t allowed to increase more than inflation, like in Portugal.

The total debt in Spain is bigger and the value expected to 2015 is 28.466 M€.

It’s possible to see that in Spain the global costs started to increase with the increase of the costs with Special Regime Production. Despite this, the situation in Spain is different from Portugal. Spanish companies had difficulties in selling the Tariff Debts to creditors and the Government created a state fund to finance the electricity sector.

It was decided too that Special Regime Producers must return 1.000M€ that they received with “Feed-In Tariffs”.

In the first Chapter, it is possible to understand the structure of the Electricity Sector. Portugal depends mostly of Thermic Production (carbon and gas) but in the last years the Special Regime Production is assuming more and more importance. From Special Regime technologies, the most important is the wind. In Spain, the most important thermic technologies are nuclear and carbon. From Special Regime, the most important technologies are wind and solar. It’s important to remember that with the increase of renewable and carbon technologies, the Ordinary Producers sell less and less energy in market. Despite this, they must maintain their profitability so, they must receive compensations.

In the second chapter, it is possible to understand how the markets work like the diary, intraday and forward markets.
The Market of Emission Permits is explained in the third chapter. It started in the EU in 2003 and the first objective was to reduce the emissions of green house gases in accordance with the Kyoto Protocol.

The fourth chapter is about the Special Regime Production in Portugal and Spain. This Regime comprehends cogeneration and renewable technologies unless the Big Hydro. These producers receive “Feed-in tariffs” and they have priority to sell their production. This Regime is more expensive than Ordinary Regime and it contributes to the increase of the global costs with the production of electricity.

In the fifth chapter it is possible to understand that Portugal and Spain are isolated from the rest of Europe and more interconnections are very important in order to allow these companies to sell the excess of renewable production. Although, if the price in France is not higher, Portuguese and Spanish consumers will pay the extracosts alone and they will contribute directly French consumers.

In the last chapter, it is possible to understand the most important issue. The tariff debt is a menace to both economies. The increase of global costs is contributing to the increase of the debt in both countries. In Portugal the debt will be 5.080M€ in 2015 and in Spain it will be 28.466M€. National banks are financing these debts and there is less money available to small and medium companies. In Spain, the bank crisis obliged the Spanish Government to create a national fund to finance the electricity sector.

The Electricity Sector has not been managed efficiently. The companies are not competitors as it was expected. The policies are correct but with exaggerated costs. If nothing is done, the costs will keep increasing. Economy depends of the price of energy and with high prices it won’t be possible to relaunch the economy in Portugal and Spain.

REFERENCES