Primary Energy Market and Electric Market interaction

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Abstract- A liberalised market is a market where customers can freely choose their supplier. This market model came with the introduction of competition into non-competitive regulated markets. In a non-competitive environment, supply and prices are regulated, while in a liberalized market regulation aims at avoiding the abuse of market power. In the case of electricity, the starting point was the rigorous analysis of the sectors of the industry which were natural monopolies and the identification of the activities where the barriers to entry were such that no competition will develop naturally. It had been assumed in former market organization that the whole of the electricity industry was a natural monopoly which led to the acceptance of vertically integrated monopoly supply utilities. On a closer inspection it was found that only certain activities were natural monopolies, in particular the transmission and distribution networks. This discovery led reformers to search for mechanisms of introducing competition wherever this seemed possible. Bearing in mind the upcoming Iberian Electricity Market – MIBEL, we studied the sensitivity of the Market Clearing Price to changes in the production inputs, such as coal, natural gas and fuel.

***Index Terms*— Electricity markets integration, Sensitivity analysis, Market Clearing Price**

1. INTRODUCTION

Parallel to the privatization process of electricity utilities and the liberalization of the European electricity markets, the Portuguese and Spanish markets engaged in a process of integration which will lead to the upcoming Iberian Electricity Market (MIBEL). In both countries it has been introduced changes in the production, transmission and distribution of electricity sectors with the aim of achieving a legally, socially and economically unified market.

1) The liberalization process in Portugal

The market opening corresponds to the share of the national electric energy costumers potentially subjected to the competition and market mechanisms, integrating the global consumption of the eligible customers and the share of energy needs that the entailed deliverers can acquire in the scope of this free regime. At present, eligible customers are those at Medium Voltage (MV), High Voltage (HV) and Very High Voltage (VHV), with effective annual consumption.

By the end of the 80's it started to be designed the current model of the Portuguese system (called SEN – *Sistema Eléctrico Nacional*), which promoted the privatization process through the publication of the Decree Law (DL) 449/88, of December 10th. The electricity sector passed through another key moment with the publication of DL 182 and the 187/95 that established the organization bases of the SEN and the principles of the activities of production, transmission, distribution, cogeneration and regulation of the Sector. In 19th of December of 1996 the European Union published the 96/92/CE that establishes common rules for the domestic market of electricity, which had started in 19th of February of 1997. This European Rule (CE), negotiated by the State Members of the European Union, obligated a review in the 1995 legislation, resulting then the DL 56/97. This also introduced the necessary changes to the process of privatization of the national electricity utility (EDP). The law suit was complemented with the approval of the Proceeding Manual (MP) by the Regulator (ERSE – *Entidade Reguladora dos Serviços Energéticos*), in 29th of February of 2000. So far, the legislative structure is completed by a set of seven regulations: four from the ERSE and three from the Economic Ministry (DGE - Direcção Geral de Energia). [1], [3], [4], [7], [9]

2) *The liberalization process in Spain*

In Spain, the government initiated the process in 1998, after the Ministry of the Industry and Energy signed a protocol with the utilities in December of 1996. Up to this date the system was regulated by the MLE (Marco Legal Estable), which compensated the sunk costs, aiming the return of investment, the increase of the operation efficiency and the increase of the competitiveness of the national production. After the 70's oil crisis, this body looked for stimulating the nuclear central offices (a process that was blocked in 1985 due to fear of terrorist attacks), the national coal and the lignite (both of weak quality and low energy rentability that by itself would not be competitive to the majority power plants) in order to decrease the existing dependence to the crude. Since the Spanish civil war (1936-1939) that the state-owned company (ENDESA), situated essentially the north and northeast, turned to these primary energy sources. Since 1985 the National Grid (REE - *Red Eléctrica de España*) operates the net, dispatch the system and owns the transmission grid. In 1991 the Iberduero and the Hidroeléctrica Española companies joined, creating the Iberdrola, and in October of 1996 ENDESA (already with the offices Viesgo and Enher) acquired 75% of the companies FECSA and Sevillana.

The regulating entity is now the CNE (*Comisión Nacional de Energía*) that replaced the CSEN (*Comisión del Sistema Eléctrico Nacional*). Since 1996 it strongly opposed to any company fusion. Due to its historic agreements, the liberalization process is difficult and slow. In this scenario, the entrance of new not competitive producers is possible which will increase the final tariffs, thus opposing the initial goals of the free market. In 24th of December of 1997 it was created the OMEL (*Compañía Operadora del Mercado Español de Electricidad, S.A.*), related in the article 33 of the Law 54/97 and the Real Proceeding R.D. 2019/97. [1], [3], [4], [6], [7]

2. DATA COLLECTION

For the purposes of our study I started by searching the market prices for different inputs: coal, fuel, natural gas and diesel. Based on different load factors of the different technologies and different installed capacities, applying a conversion factor (from thermal to electrical energy) and the plant efficiency, it was possible to reach the marginal cost of production for each technology. Then, a quadratic cost function was estimated for the coal, fuel, natural gas and diesel power plants, applying a different approach to the hydro, nuclear and renewable production. Concerning the hydro power plants it was considered its installed capacity. It was considered, thus, an almost constant and coherent cost with the remaining costs. For the nuclear, constant cost for all was considered. For the renewals, as they are not dispatchable, as established in D.L. 339-C/2001, its production was accounted as a load decrease. In parallel, the characterization of the installed power and the produced energy of the Portuguese and Spanish grids were made. One can, then, shape the curves of cost of production curve of the Portuguese, Spanish and the aggregate System. [4], [5], [7], [8]

3. SIMULATION RESULTS

The simulation results for the winter scenario (PH) are:

- Market-clearing price (MCP): 32.4075 €/ MWh
- Market-clearing quantity (MCQ): 46165.7028 MWh

And for the summer scenario (VS) are:

- Market-clearing price (MCP): 11.7925 €/ MWh
- Market-clearing quantity (MCQ): 22420.0432 MWh

Changing the price of the fuel in percentage, I achieved the values for the MCP presented in Figure 1 in the appendix.

For each scenario I have represented the corresponding trend line, as shown in fig. 2 and in fig. 3 in the appendix.

In the winter scenario (PH) the water resources are not enough to satisfy the demand. The cheapest fuel is the coal, so will be the next technology to be used. The MCP is immune to coal price variations indicating that the marginal production came from another technology. Follows the electric production by oil resource. I can see that there are some competition between oil and the gas. So, if the price of any of these two change there is a reflection in the MCP. If the price of oil decreases there is no change in

MCP because the marginal production technology is gas. However, as the price of oil raises, less units will be produced by this technology and the MCP will also raise because there will be competition between gas and oil. In the Summer scenario (VS) the water and the coal fuels are enough to satisfy the demand. So, changes in gas and oil prices will not be reflected in MCP because neither are the marginal technology. However, raising the price of the coal too much or decreasing the price of oil too much will bring some competition between them and will be reflected in MCP.

Note that MCP goes from 32 €/MWh to 11 €/MWh as the MWh units produced goes from 46 165 to 22 420.

4. CONCLUSIONS

It is often being argued that a liberalised market will lead to real competition, with the consequence of welfare improvements, but that is not necessarily true. The basic assumption of a competitive market is, among others, the possibility to choose between different suppliers and that these suppliers are able to generate electricity at the lowest possible costs.

This paper focus on the sensitivity of the Market Clearing Price (MCP) to the change of the fuel price. Other sensitivities can be explored, such as demand curve, lost of an interconnection, lack of water resources, among others. One of the powerful tools of this simulator is analyse these kinds of sensitivities. Others are the impacts of the aggregation for both Countries and for all players.

I stress that in a liberalized market volatility of MCP is a key issue. Demand forecast is quite difficult if compared to other commodities, giving a wider confidence range. Risk management joins this two properties and faces possible errors in the forecasting tools.

5. REFERENCES

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6. APPENDIX

		Fuel Price				
Technology	Scenarios	80,00%	90,00%	100,00%	110,00%	120,00%
Coal	PH	32,41	32,41	32,41	32,41	32,41
	VS	9,43	10,61	11,79	12,97	14,15
Oil	PH	32,40	32,40	32,41	33,10	33,41
	VS	11,79	11,79	11,79	11,79	11,79
Gas	PH	26,73	29,87	32,41	35,64	38,88
	VS	11,79	11,79	11,79	11,79	11,79

Figure 1: MCP sensitive table for fuel price changes in €/MWh

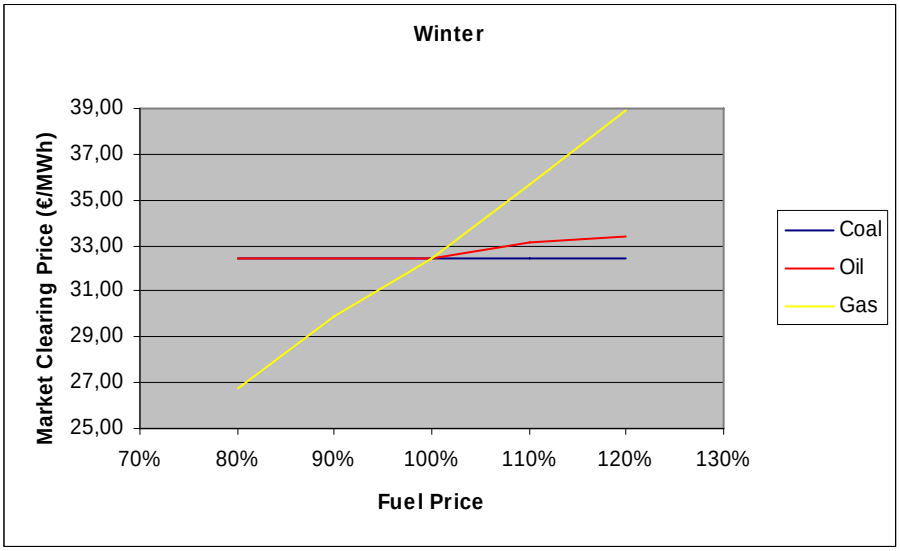

Figure 2: MCP sensitive table for fuel price changes in the Winter scenario

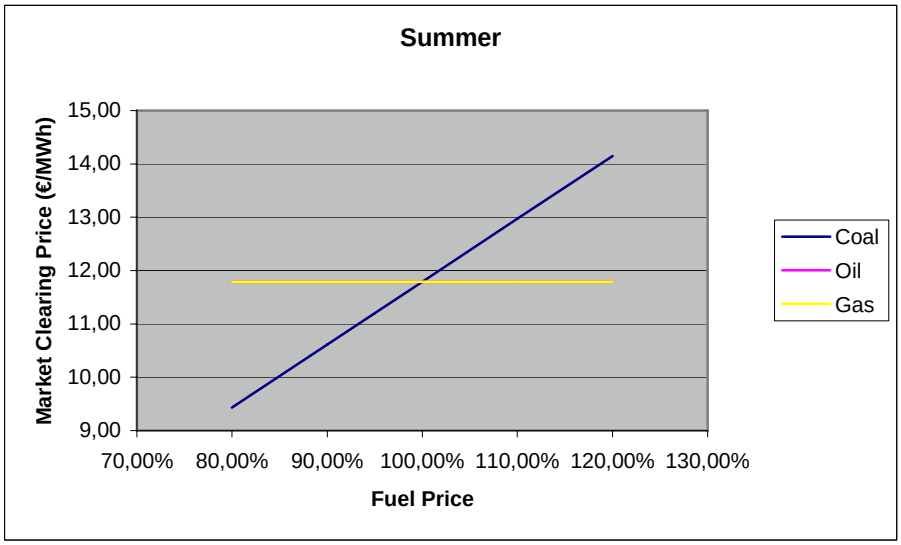

Figure 3: MCP sensitive table for fuel price changes in the Summer scenario