

Why was Spain a global wind power before the Great Recession? The CECRE from 2006 to 2012

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Abstract. In the economic analysis that is conducted of the electrical regulatory framework, too much emphasis is made on tariffs and laws. However, technological and organizational innovations on a large scale, such as a centre for the integration in the electrical grid of electricity coming from renewable energy sources, are fundamental. This article presents the role in the growth of renewable energies of the first large-scale centre in the world that allowed an integrated and automated management of this type of energy sources: the Spanish CECRE of the company REE (Red Eléctrica de España. S.A.). This paper studies the period between 2004-2013, when Spain became the fourth country after China, the USA and Germany in installed capacity of renewable energies and, in relative terms, the second country after Denmark.

1. Introduction

The CECRE is the control centre for the integration in the Spanish electrical grid of electricity coming from renewable energy sources. It was inaugurated by Red Eléctrica de España S.A. (REE) in the year 2006. In the year 2009 Nobuo Tanaka, Executive Director of the International Energy Agency, pointed out that “the CECRE is, globally, the most important experience in the field.” In the same year John Podesta, former Assistant to President Bill Clinton and president of the Center for American Progress, asserted that “Visiting the CECRE is seeing the future.” The CECRE was the technological innovation that allowed Spain in 2013 to become the fourth country after China, the USA and Germany in installed capacity of renewable energies and, in relative terms, the second country after Denmark. In photovoltaic energy, Spain in 2007 surpassed Japan and the USA which ranked second and third.

With regards to concentrated and direct solar power, in 2010 the USA and Spain were the largest producers [1]. With respect to wind power, the countries with the higher installed capacity in 2012 were China (75 GW), the USA (60 GW), Germany (31 GW), Spain (23 GW) and India (18 GW) [2].

How did this situation come about? In 2004 both the Spanish government and private companies made a strong commitment to the development of renewable energy. However, Spain, in contrast to Denmark, was not an ideal country to develop renewable energies given its limited connection to the European electrical grid. Any problem of loss of electric flux, lack of wind or sunlight implied that the resulting lack of energy could not be solved by using energy coming from neighbouring countries as in the case of Denmark and Germany. This had three consequences: a) the necessity of developing an advanced control system for the integration of renewable energies into the electrical grid, b) the appearance of globally leading Spanish industries in the production of wind turbines given the high demand for as well as the specificity of the wind turbines [3], and c) the proliferation of installations



of combined cycles/gas-based cogeneration as a backup to renewable energies when the wind wasn't blowing or when luminous intensity was low. All of this allowed 50% of the installed power in 2012 to be equally made up of renewable energy sources and combined cycles of backup energies [4] (see figure 1).

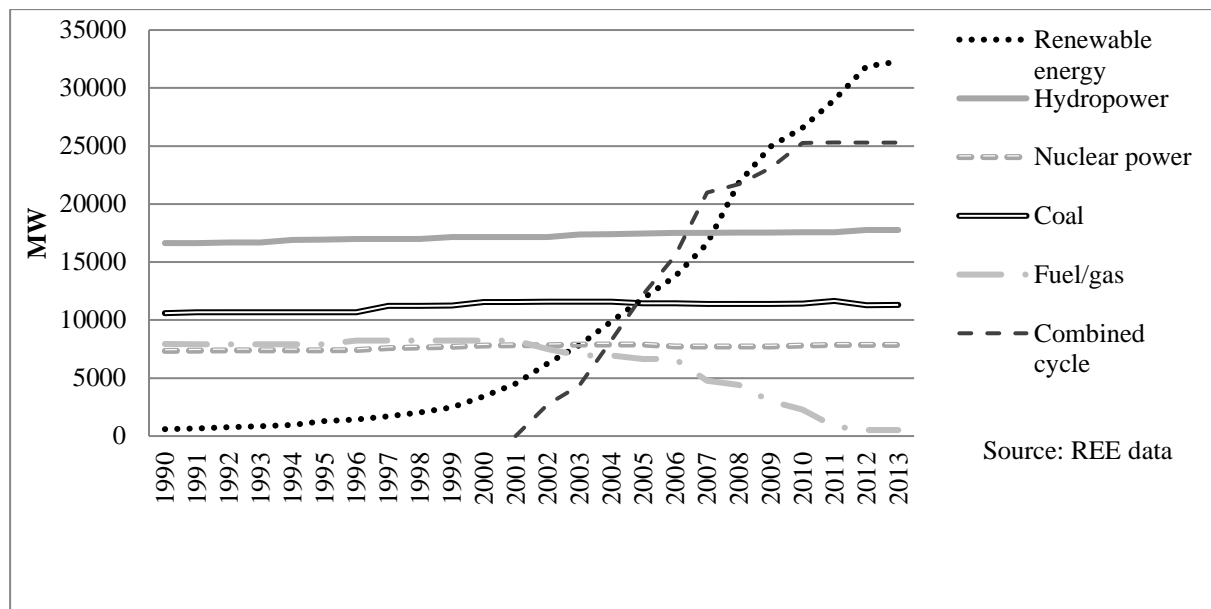


Figure 1. Installed power by sources of energy (1990-2013).

2. Spain and Portugal, an island energy-wise

Spain and Portugal are two well-interconnected electrical markets which make up a medium-sized area within the European electrical system. However, the peninsula has a small synchronous link with the rest of the continent in function both of the size of its network and of the existing electrical consumption. The interconnectivity of the Spanish network with the European one did not surpass during the examined period the 2.4% of its demand funneled through France, before Denmark's 40% and Germany's 12%. The high degree of isolationism with respect to the rest of the European system transformed Spain, energy-wise, into an island. The state authorities had to set unprecedented technological conditions with regards to wind turbines so that they would be as stable as possible and so that a voltage drop in one generator would not imply a chain disconnect of the network. State authorities also had to create a central control mechanism with the capacity to foresee on the spot the flux of the wind and the solar intensity [5].

The necessity to create the CECRE became manifest at the beginning of 2004 when the REE detected the difficulty of integrating the amount of energy coming from the wind turbines without assuming the high costs for the operation of the grid. REE did not have information about the wind power that could be entering the system. Predicting the potential wind power input on the spot had become imperative. Figure 2 reflects the effect that the CECRE had on the development of wind power in Spain. Its reading is simple. The figure shows three lines. Let us look initially at the dotted black and grey ones. The black dotted line represents the growth rate of the installed capacity of wind power and the grey dotted line, the growth rate of the installed capacity of wind power with respect to the totals of the installed capacity of all energies. The black dotted line is deduced from the absolute data and the grey dotted line from relative data.

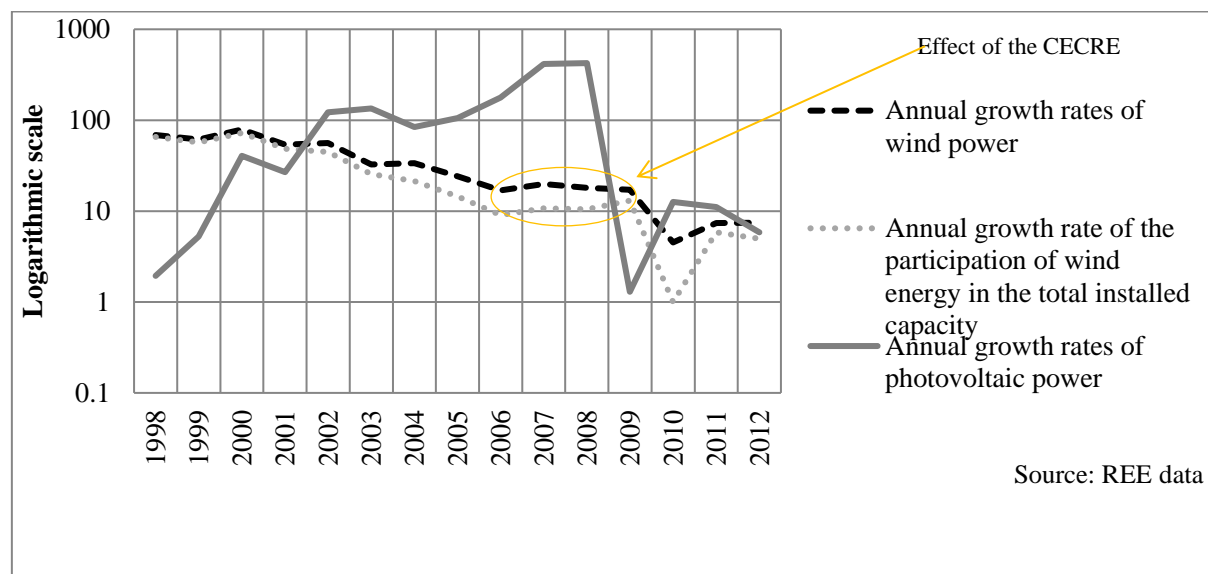


Figure 2. Annual growth rates of wind and photovoltaic power.

As it is logical in a growth process, the graphs have been expressed in logarithmic terms. The reason for this is obvious. It is much more difficult to sustain a constant growth rate when already there has been a large amount of growth than at the beginning of the process. For this reason, the dotted lines have a general downward tendency, except for the period that encompasses the CECRE's beginnings and its operation under normal conditions – that is, until the 2008 crisis.

Is this only due to the effect of the CECRE? Evidently, no – but there is much more to explain yet. At that moment, there wasn't an increase in government bonuses for the installation of wind power, nor did technology have unprecedented increases in efficiency with their attached reduction in costs of fabrication and installation. If anything, the opposite was true, given that wind turbines had to be adapted to the norms of the REE in order to be controlled and subsequently supply their energy production to the network. Furthermore, as an investment, wind power installations had to compete with photovoltaic ones, which were being supported by investments as well as being much more subsidized.

The maintenance of growth rates around the 18% in installed capacity (black dotted line) and 11% with relation to the total of installed capacity (grey dotted line) for the period between 2006 to 2009 is unrivalled globally in function of the amount of the demand of energy of the Spanish market. There is a rise from 11,000 MV to 19,000 MV in wind power and, within four years, the 15% of the demand is covered, as opposed to the previous 9%. But the most impressive thing is the increasing tendency in this period for the grey dotted line. This means not only that the CECRE had managed to maximise the costs of integration of wind power in a strong and constant manner, but that the process had gone further and had meant the quick dismantling of those installations based on other sources of energy which, although profitable, were not so in relation to the dynamics of wind power. Literally, wind power had paralysed any option that was not complementary to its growth (see figure 1). From the set-up of the CECRE, the objective of maximising the integration of wind power without affecting the security of the system was a success, and it provoked the maintenance of growth rates in the installation of wind turbines. That was how the installed capacity in wind power rose from 15% in 2006 to 17.5% in 2007 and sustained its rate in the following years until 2009.

3. Photovoltaic energy

Now we shall take a look at the solid grey line in figure 2. The initial objective of the CECRE was the integration and maximisation of the use of wind power, but soon the CECRE set itself the same objective with respect to photovoltaic and thermal solar energy as well as with cogeneration. The

growth rate of photovoltaic energy was spectacular from 2006 onwards, but particularly in the years 2007 and 2008. In 2007 there was an increase from 199 MW in installed capacity to 612 MW. A growth of the same caliber occurred the next year when there was yet another increase to 3,207 MW in installed capacity. The concessions made, and economic bonuses given by the Spanish government were decisive to the achievement of this growth. The tariffs from which photovoltaic energy benefitted made it possible for the industry to launch projects above the 50 MW mark, since they could benefit from a contract at a set price for a period of 25 years. The costs associated to scale economies and large installations were reduced and the installed capacity quadrupled annually [6]. In September of 2007 85% of the objective that the Government had set for the installation of renewable energies had been reached and the amount of bonuses for photovoltaic energy had just increased [7]. During this period (2007-2009) the projects of photovoltaic installations multiplied. As a result, 2,575 MW of photovoltaic energy were added to the system in 2008, breaking all the previous records and turning Spain into the world leader in photovoltaic installations that year [8]. The situation was stabilized in 2009 but come Spring of 2010 the need to exercise a similar control to that which had been exercised with wind power was evident. That year, the installed power had reached the 3,656 MW in photovoltaic energy and 532 MW in thermal solar energy. The CECRE had to assume control over these energies and add to their control panels for wind energy the management of photovoltaic, thermal solar and cogeneration plants in 2010. At the beginning of the year, the president of the company, Atienza, summarized his concerns thusly:

We have 3,300 megawatts (MW) of photovoltaic energy, which at this time we cannot see and the operator of the system, who is in charge of balancing supply and demand, does not know what is happening in real time with regards to our photovoltaic energy, which is equivalent to three and a half nuclear plants [9].

To the already very detailed information about wind power, which encompassed the degree of usage of wind power in each Autonomous Community as well as how many wind turbines were functioning, the density of production per region, the simulation of the perturbation which would produce the greatest loss of wind power at each moment, the meteorological conditions and their evolution in the following hours, now they had to add the information about solar power in similar terms. The CECRE then came to have a constant reference of the state of the generation of thermal solar power, of the state of solar photovoltaic power generation, of the installed solar photovoltaic power, of the prevision of insolation, of the savings generated in the combustion of hydrocarbons and their effect in the generation of CO₂ and of the instantaneous production of energy per cogeneration.

4. Conclusions

From the beginnings of the CECRE, its employees have made possible the maximum integration of renewable energies in the coverage of electrical demand in Spain, making it possible for these energies to supply as much as possible to the system [10]. This process was initiated by wind power and it has been completed with the rest of renewable energies until today, when an exhaustive control of these energies is in place. In its turn, this control has allowed energy producers to know in advance that there will be no technical problems for the integration of their energy production into the system. At times, in the economic analysis that is made of the regulatory framework, too much emphasis is made on tariffs and the law, however, technological and organizational innovations on a large scale, such as the CECRE, are also fundamental. In this sense, the value of the work carried out at the CECRE obtained its recognition in 2007 with the European Environmental Award and as a finalist in the European Business Awards for the Environment in the category of Product & Services awarded by the European Commission's Directorate-General for the Environment. This led to the visit of the managers of renewable energy from the leading world economies. In this sense, the visit of the United Nations Special Envoy for Climate Change, Gro Harlem Brundtland in 2010 and that of Li Keqiang, Vice Premier of the PRC, at the beginning of 2011, highlighted the importance of the management model developed by the CECRE.

Cossent *et al*, who believe that which has been achieved in Spain to be an innovative solution, have

also highlighted the importance of the CECRE:

Small amounts of DG/RES [distributed generation/renewable energy sources] could be integrated within the Spanish power system without causing a major impact. Nevertheless, as the amount of this generation increased, technical, economic and regulatory problems started to arise. Smart (or smarter) distribution networks may solve or mitigate several of the problems concerning the integration of DG/RES. Smart distribution grids require electricity consumers and DG units to play a more active role than the one traditionally assigned to them. Moreover, distribution system operators (DSOs) should also innovate to find new ways to plan and operate electricity distribution grids [11].

The Great Recession ended with the dream of continuing to increase the capacity of renewable energies. The shattering of this dream was clear already in 2008 with the fall in the growth rates of the installations (figure 2). From then on, Spain has lost positions in international rankings related to renewable energies. A great amount of debt with foreign investors has been generated, industrial firms have been absorbed or have moved abroad and the large companies of electricity management have installed themselves in other markets.

As a final remark, however, it seems necessary to highlight that the CECRE was designed in function of an electrical market dominated by a small number of big corporations with the power to influence political authorities, meaning that Spain had passed no laws allowing the incorporation to the national electrical grid of domestic solar and wind power installations. These policies are known as net metering policies. In Spain, the policy that had been thus far followed was that of not legislating, up until 2015 when the government legislated against its citizens's being able to output their surplus energy into the national grid. Even if one household's installation exceeded 10 kW (an average domestic installation usually has 4 kW) it had to pay although it did not put out its electricity. Thus, the conservative government made clear that there would be no transition of energy sources involving citizens. Nevertheless, the recent change in government has made it one of its first measures to repeal the laws against net metering (also known as the "Sun Tax"). Again, the CECRE faces a technological challenge: how will it efficiently absorb the energetic output of hundreds of thousands of small domestic installations?

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