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Wind energy trends in Catalonia. Environmental Compatibility.

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Abstract

Catalonia pioneered wind turbine installation in Spain. In this process, the ICAEN (Catalan Institute for Energy) and the Polytechnics school of the University of Girona worked together in the mark of the National Energy Plan (PEN).

The objectives of this collaboration, in the early eighties, were the development of the National Wind Map of Spain, and the location of the firsts wind turbines in Spain, in Girona Province.

Despite being a pioneer in wind energy in Spain, nowadays Catalonia occupies a low/mid position among the different Spanish autonomic communities.

Wind energy resources in Catalonia aren't the problem; they are copious and well identified. So, what factors slow down the wind energy development in Catalonia?

Mainly, the problem has been the incompatibility between Catalan environmental and industry departments in the Catalonian government. Finally was difficult to know were the location of wind turbines were acceptable and were not, so, wind energy projects in Catalonia were mostly rejected or procrastinated.

In this paper, wind farms projected in Catalonia will be evaluated, and how the actual situation of wind energy in Catalonia could be different if the most of these projects could have been approved and constructed, as well as data about natural parks in Catalonia and other zones where wind energy utilization is restricted.

Introduction

Nowadays, Spain is one of the leader countries in installed wind energy power, just behind Germany, with little more than 20 GW installed by the end of 2010 and the European country with more wind energy power installed during 2010, with more than 1,5 GW.

In Spain, the first Wind Farm connected to the grid was installed in Catalonia at 1994. The location chosen was Garriguella at the north area of Catalonia. This pioneer wind farm was composed by 5 wind turbines of 24 kW each one.

After its demonstrating objectives, the wind farm was dismantled in 1998.

The pioneer autonomous region of one of the pioneer countries in Europe, it's supposed to have a very developed internal Market, but it is so?

In order to assess the development of the internal market of an area, there are various criteria that can be studied, for example the compliance with the Energy plans or the optimum exploitation of the natural resources.

Wind energy behaviour in Spain

Win energy in Spain has had an important increase in the installed power, in fact nowadays is the second European country by installed power and the first one in market grow.

The impulse of wind energy in Spain has been so important, that in fact all energy plans has underestimated it.

In 1999 an energy plan about renewable energies in Spain was approved PLAFER (Plan de Fomento de las Energies Renovables). This plan, estimated a wind energy installed power of 8.974 MW by 2010. The reality was very different, in 2004, the 94% of that power objective was already installed.

By 2002, it was clear that Plafer objective was too much conservative, and an gas and electrical sectorial plan was approved. This new addenda to the original plan estimated the wind energy power installation by 2010 in 13.000 MW. In fact, by 2006 approximately the 90% of that objective was already done.

By 2005, in was clear that the original plan, and the addenda that changed it, really underestimated the importance of wind energy in Spain, so, because of this, and other factors, a new renewable energy plan was redacted in 2005, that lasted until 2010, The PER 2005-2010 (Plan de las Energia Renovables 2005-2010).

The PER estimated an objective for the wind energy in 2010 of 20.155 MW, a 155% more than the last plan three years before.

The real data in 2010, was that the wind energy power in Spain was 20.676 MW, so, the ambitious objective of the renewable energy plan in Spain was accomplished.

It's fair to say, that Wind energy in Spain has been a success, even more than initial plans and evidences indicated.

Wind energy behaviour in Catalonia.

It's fair thinking, that in a country where wind energy has been a success, in the pioneer area, where the first Wind Farm connected to the grid was installed, the wind energy also has been a success, but … It is so?

The PLAFER estimated an objective for wind energy power in Catalonia of 425MW.

As has been exposed in the anterior section, in the whole Spain this objective was almost completed in 2004, in Catalonia was completed in 2008.

So seems that, the success of wind energy in Catalonia is a less success than the rest of Spain.

In the renewable energy plan of 2005, also established an objective for wind energy power in Catalonia of 1.000 MW at 2010.

The truth is that in 2010, in Catalonia there were a wind energy installed power of approximately 850 MW, so the objective was not accomplished, really only 85% of the objective in Catalonia was really done, meanwhile the objective for the whole Spain, as has been stated, was accomplished.

Catalonia has it's own Energy Plan, redacted originally in 2002 and modified by 2005. This plan has objectives until 2015 and for 2010 basically is in line with Spanish objectives.

The Catalan Renewable Energy Plan PEC2015, estimates two scenarios, the BASE scenario, which is a conservative scenario, and the intensive in renewable energies IER scenario, which assumes some effort from public administrations and some inversions in renewable energies, and describe the "best" development renewable energies can experiment in Catalonia.

The BASE objective in Catalonia is 1.000 MW (in line with Spanish estimations) and in IER scenario the objective is 2.750 MW.

It is clear, by the real figures of Catalonia at 2010, that none of these objectives were accomplished.

In the next figure, the real evolution of wind energy in Catalonia can be compared with the estimations of the Catalan Energy Plan, year by year.

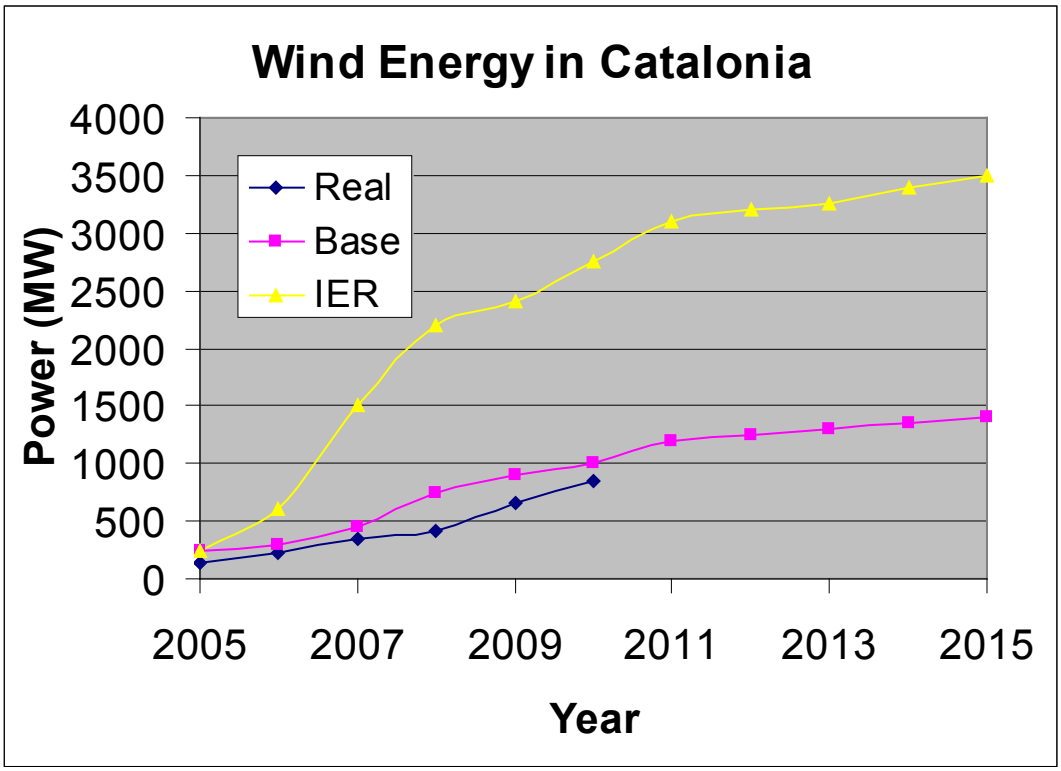

Fig. 1.- Evolution of wind energy in Catalonia, compared with the Catalan energy plan.

As can be seen in figure 1, the reality of wind energy in Catalonia is always under even the most conservative estimations of BASE scenario, and very far from the most optimistic objectives of IER scenario.

So, from 2005 to 2010, the estimated accumulated energy produced by wind turbines was 8.500 GWh in Base scenario and 22.795 GWh in IER scenario.

This data has been calculated considering a mean annual operation at full power of Spanish wind farms of 2.350 hours per year, as is stated in the Spanish energy plan of 2005.

The real energy produced, in comparison, and by the same hypothesis is 6.187 GWh, a 72% and 27% of BASE and IER scenarios respectively.

The actual factor emission of CO_2 by electrical generation, in Catalonia is estimated, by the electrical mix, in roughly 385 T CO_2 / GWh.

So the non compliance of renewable energy plans, by wind energy has supposed the emission of 920.000 T CO_2 respect BASE scenario and 6.400.000 T CO_2 respect IER scenario.

It's clear that the development of wind energy in Catalonia is not as successful as the rest of Spain. What happened?

Wind energy problems in Catalonia

The no-so-successful development of win energy in Catalonia, compared to the rest of Spain, can be ascribed to environmental compatibility. Publicly, this has been the most visible problem.

In 2002, there was approved the wind energy implantation map in Catalonia.

That map, in conjunction with wind resources map, located which areas were usable and environmentally compatible and which ones not.

An extract of that map is presented in the figure 2.

mean wind speed at 80m (m/s)	Total Surface (m^2)	Incompatible Surface (m^2)		Compatible Surface (m^2)	
11,5-12	3,08	2,68	87,01%	0,4	12,99%
11-11,5	8,28	7,2	86,96%	1,08	13,04%
10,5-11	21,68	20,08	92,62%	1,6	7,38%
10-10,5	38,28	33,92	88,61%	4,36	11,39%
9,5-10	61,12	53,76	87,96%	7,36	12,04%
9-9,5	95,48	77,76	81,44%	17,72	18,56%
8,5-9	159,64	121,96	76,40%	37,68	23,60%
8-8,5	284,68	183	64,28%	101,68	35,72%

Fig. 2.- Wind energy resources and compatibility in Catalonia

If the most usable areas are selected between 8 to 12 m/s of annual mean wind speed, only the 2,1% of Catalan territory comply with that requirement.

However, as can be seen in figure 2, the most of this area have environmental incompatibility, so only 25,5% of that surface can be used for wind energy exploitation, and conditioned to environmental impact assessments.

Anyway, all that information was available when Catalan Energy Plan was redacted, so it’s unfair to just blame the environmental compatibility.

Nowadays, finally, wind priority development areas have been defined, and offered to wind energy companies to exploit.

In 2010, apart from the 849,28 MW of installed and fully functional wind farms in Catalonia, there are 168,7 MW of authorised wind farms in construction, and these wind priority development areas include 769 MW to be constructed in the near future.

So Finally, Catalonia, likely will have at least 1.787 MW of wind energy power installed by 2015. This will be enough to accomplish the most conservative wind energy objectives, detailed in the Base scenario in Catalan Energy Plan of 1.400 MW installed in 2015, but very far from the 3.500 MW of the much more optimistic IER scenario.