Analysis of future scenarios relating population and installed wind power in Spain
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Abstract

The future of the electric power demand is unpredictable. Even though it has an increasing trend, the economic crisis (2008-2015) proofs that the situation may be upside down. However, what is undoubted is that the power demand is strictly related with the population. On the other hand, the installed wind power in Spain does not grow always at the same pace, it depends mainly on the in force legislation.

Considering the above facts, it can be useful to analyse several possible scenarios that may happen in the future in order to take the suitable decisions in advance. These possible scenarios include any crossing between a situation of population, plus or minus different percentages and a situation of installed wind power plus different percentages.

In order to assess each scenario, one possibility is to obtain the probability of wasting wind power, considering that value as information related with the closeness of having been installed more wind power than needed. With this information in mind, the installed wind power can be developed properly.

Objectives

The two main objectives are:

• The limit to the installed wind power may be closer than expected due to population issues.

• To establish a method to assess the closeness to that limit may be helpful in order to properly develop this industry.

Methods

The data of the last years were used to obtain the corresponding models. First, the power demand and its relationship with the population were analysed to establish a spline model that may simulate power demand for different sizes of population. Second, the wind power and the corresponding installed wind power were used in the same way.

Both models provide the mean and the standard deviation to consider each specific case as Normal distributed and, as it has been said, obtain the probability to waste wind power from the subtraction of two Normal variables.

Results

The results obtained said, general speaking, that if the population decreases, or the installed wind power increases, then the probability increases and, in the opposite cases, the probability decreases. Obviously, the intermediate scenarios depend on each situation. In all cases, specific values of the probability of wasting wind power were obtained.

Following, two graphs are showed to provide examples of the results obtained. Both graphs represents the probabilities of waste wind power along the Sundays for several months.

If these graphs are compared, it can be distinguished a different measure of probabilities, around 100 times higher in the second case. In addition, it can be stated two apparent behaviors: one for winter months and other for spring ones.

Graph 1

Sunday Probabilities
Actual past (1 GW Wind Installed Power, 45 Million of Inhabitants)

Graph 2

Sunday Probabilities
Greatest possible past (29 GW Wind Installed Power, 45 Million of Inhabitants)

Conclusions

In order to properly develop the installed wind power in Spain, to consider the possibility to be close to the limit may be something to take into account in the future and it depends, mainly, in the population of the country.

Two interesting models are provided: One that relates power demand and population and another that relates wind power and installed wind power.

Their use makes it possible to establish the proximity of the maximum installed wind power, which can be useful for future developments in the country.

References