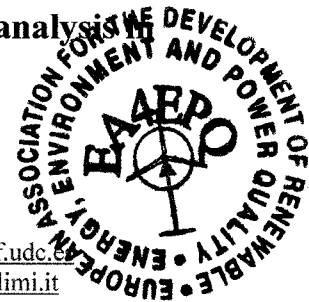
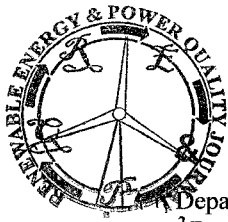


Is it economically possible repowering Wind Farms. A general analysis of Spain



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Abstract— Protecting the environment is becoming a major concern; people are beginning to realise that their living conditions may worsen if they do not rationalise energy use and habits. Environmental pollution and emissions from greenhouse gases caused by fossil fuel use are a threat to sustainable development. With renewable energy sources, no polluting emissions are released into the atmosphere. Therefore, using these sources on a large-scale is a key to reducing emissions and meeting the commitments established by the Kyoto Protocol. At the same time, renewable energy contributes to sustainable development. This study describes economic aspects of the repowering process for the wind farms. This process was the result of a growing demand for renewable energies, facilitated by the great potential of wind energy in the north of Spain. The wind farms studied in this work were set up before 1998 and they have obsolete machinery with low power.

Key words— repowering, viability study, wind farms, sensibility analysis.

I. INTRODUCTION

Repowering a wind farm entails revamping its installations with the aim of extending its service life and/or increasing its power, performance or availability and increasing, modifying and /or updating the equipment for optimum capacity or efficiency.

Given the constant advances made in wind and generator technology, it is now possible for the same site to have a much higher energy production with new machines. They are quieter, their efficiency is higher (2 or 3 MW), and their start-up speed (winds of 2.5 – 3 m/s) are much lower when compared with older turbines (0.1-0.65 MW, with start-up wind speeds of 5 m/s).

Moreover, higher hubs on the new machines make it easier to exploit the wind at great heights. For this reason, repowering a wind farm leads to a noticeable increase in farm production, although the number of generators installed is reduced.

With repowering it is possible to generate considerably more electric current with fewer installations. On the other hand, as the new installations work at lower speeds, their appearance is more calming. It is easier to connect them to the electric grid given that their connection behaviour is similar to that of conventional power plants. This makes their utilisation more feasible.

Therefore, repowered sites are:

- More productive with fewer machines.
- Less difficult to integrate into the grid.
- Easier on the ear and eye.
- The maintenance costs for air generators with over ten years of service increase by 25%. Replacing machines after ten years, once initial costs have been recovered, makes it possible to have newer and more advanced equipment for a significant number of years.
- The first wind farms used the highest wind measurements; nowadays production can be greater.

II. REPOWERING THE WIND FARMS

STUDYING THE ALTERNATIVES

Parks under study have a similar power because are those built as late in the year 1998.

A technical and economic feasibility study on the repowering process is carried out and various alternatives are considered: A, B, C, D, E, F, G, H and I (see Table 1). For the second step, the relevant Spanish legislation-RD 661/2007 of 25 May- must be taken into account; this regulates the activity of energy production within a special regime. It establishes that, for an increase of up to 40%, a new license is not needed, providing that the transmission power cited in the original permit is not exceeded. At first it might be thought that increasing the power by 100% is very profitable, and rightly so. Nevertheless, with the current system for issuing permits, it is extremely difficult to get a new one, despite the fact that repowering takes precedence.

Consequently, these are the options:

- **OPTION 1:** $\Delta P < 40\%$ and the power does not exceed the electric power authorised
- **OPTION 2:** $\Delta P = 40\%$ and the power exceeds the authorised electric power so that a new licence is needed.
- **OPTION 3:** $\Delta P > 40\%$, specifically $P = 50$ MW (maximum production limit in the special regime), and the power exceeds the authorised limit, so that a new transmission limit is needed.