

THE SOTAVENTO EXPERIMENTAL WIND PARK

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ABSTRACT: In 1997 Galician regional government, *Xunta de Galicia*, promoted an experimental wind park, with the goals of contributing to the development of wind energy technology and spreading the knowledge and use of renewable energies. In 2000 Sotavento wind park started working as an experimental energy plant, constituted by 24 wind turbines from five different manufacturers. They include three prototypes, which are still at a development stage.

1 INTRODUCTION

The region of Galicia is located in the northwest of Spain. It is an area with a large capacity of primary energy transformation (10% of the total amount of Spain) [1]. Only 23% of the energy transformed in Galicia corresponds to its own resources, the other 77% being imported. Generation in Galicia is:

- 14% of the electric energy consumed in Spain.
- 16% of the conventional thermoelectric energy (no nuclear power stations exist in Galicia).
- 27% of the hydroelectric energy.
- 24% of the renewable energy.

In recent years, the Galician regional government, *Xunta de Galicia*, has seriously taken renewables into account, particularly wind energy. As a consequence, an ambitious project for wind energy implementation, the *Plan Eólico Estratégico de Galicia* [2] was developed. This plan assumes that Galicia will have approximately 3500 MW of installed power in 141 different locations in the near future, with a total investment of more than 3,000 million euros, and creating more than 2,000 jobs. There is also a white paper [3] where the energy strategies for the future of Galicia are explained.

The *Consellería de Industria e Comercio* (Department for Industry and Trade), one of the departments of the *Xunta de Galicia*, conceived the idea of obtaining not only economic, but also scientific and technical benefits from the *Plan Eólico Estratégico*, and promoted a new project. This project, called *Sotavento Galicia S. A.*, was born in 1997 as a consequence of the different circumstances explained above.

Three public institutions are taking part in this project, with a total amount of 51% of its capital; they are the *Instituto Enerxético de Galicia (INEGA)*, *Sodiga Galicia SCR S. A.* and the *Instituto para la Diversificación y el Ahorro de la Energía (IDAE)*. The rest of the participation belongs to companies of the electrical sector of Galicia, such as *Unión Fenosa Energías Especiales, S. A.*, *Endesa*, *Iberdrola Energías Renovables II, S. A.* and *Energía de Galicia, S. A.* A breakdown of the different shares can be seen in Fig. 1.

2 DESCRIPTION OF THE SOTAVENTO EXPERIMENTAL WIND PARK

In this section a description of all aspects involved in the project of the Sotavento experimental wind park are explained.

2.1 Location and characteristics

Sotavento wind park is located in an area called *Serra da Loba*, in the north of Galicia, between the provinces of A Coruña and Lugo and approximately at 600 m altitude. The high wind potential of this area has already been reflected in the European Wind Atlas [4]. In this well reputed source, a mean wind speed of 6.5 to 7.5 m/s is recognised for open plain terrain in this area, which agrees with the real mean wind speed, although the landscape in Sotavento can be considered more as a combination of plains and hills than as an open plain terrain.

A map of the location of Sotavento wind park can be seen in Fig. 2.

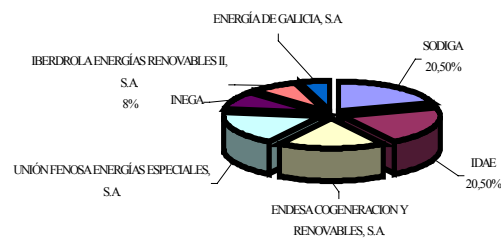


Fig 1: Participation of companies in Sotavento wind park



Fig. 2 Location of Sotavento wind park

Sotavento wind park is constituted by 24 aligned wind turbines with a total installed power of 17.56 MW. In Fig. 3 a scheme with the layout of the wind turbines can be seen. Its north to south orientation can be appreciated, which is a compromise between the points of maximum altitude of the hills and a direction almost perpendicular to the predominant wind speed direction.

It is expected to produce yearly about 38,500 MWh This production saves the combustion of 68,000 barrels of crude oil and avoids emitting 36,000 Tm CO₂ per year into the atmosphere.

The mean wind speed in Sotavento is 7 m/s, measured at a height of 40 m. More than 60% of the total energy corresponds to the third quadrant. The wind speed is higher in winter and, in general, during the day. In Fig. 4 a rose of winds of Sotavento can be seen.

The total investment was 16.22 million euros.



Fig. 3: Location of wind turbines in Sotavento wind park

2.2 Main objectives

As expressed in the title of this paper, Sotavento wind park is an experimental wind park, where the different technologies existing in Galicia are represented, and where manufacturers can place their modern wind turbines and prototypes in order to test them.

This means that this wind park is a good place for investigation and for comparing the behaviour of different types of wind turbines.

As mentioned above, this wind park contains generators from the five different technologies implemented in Galicia, which are Bazán Bonus, Ecotècnia, Neg Micon, Made and Gamesa. There are 21 commercial machines and 3 prototypes. The different wind turbines of Sotavento wind park are those shown in Table 1.

These wind turbines produce their energy with values of voltage between 690 and 1,000 V. This energy is converted in low voltage substations in each wind turbine to the level of 20 kV. There is a high voltage substation for the wind park, which collects all the energy produced (except for losses, of course) and elevates the voltage level to 132 kV.

The connection point for the wind park is located 9 km away from it, and the energy is transported to this point by means of a 132 kV overhead line.

So, the first objective of Sotavento is to provide the manufacturers a place for testing their own technologies in a real wind park.

Table 1: Wind turbines in Sotavento wind park

Number	Wind turbine	Power in kW
4	Neg Micon Multipower 48	750
4	Gamesa G-47	660
4	Ecotècnia 44/640	2x230
4	Bazán Bonus MK IV	600
4	Made AE 46 I	660
4	Neg Micon 900	900
1	Made 1,32	1320
1	Bazán Bonus 1,3	1300
1	Made 800	800

2.3 Other activities

The activities of manufacturers are not the only ones for which this wind park has been designed.

The wind park has additional spaces where educational projects will be developed, such as demonstrative renewables related projects and environmental actions.

There is a central building operating as control centre, as well as the following spaces:

- Classroom: the classroom is a room intended for explaining renewables to different social groups interested in them. In this room a large amount of information about renewables from different points of views can be obtained.
- Energy efficiency room: a place for explaining advantages of energy saving in a modern society.
- Energy workshop: a place where renewables can be studied more in-depth than in the other rooms. Renewables are here studied from a more technical point of view.
- Auditorium: a space with the ability of hosting technical meetings, seminars or working groups about energy-related subjects. It is also used for giving classes and conferences.
- Additionally there is a guided route through the grounds of the wind park, intended to show how the wind has influenced human activities through the ages. Different tools have been set out along this path. They have been recovered from some remains of the thermal power station of As Pontes de García Rodríguez.

With all these installations the following objectives are pursued:

- To convert the wind park into an attractive place for receiving visitors of different social sectors, such as Industry or Education.
- To use its potential for education and research, as it is a very interesting technological place containing well conditioned installations.
- To make the wind park accessible for all kind of institutions interested in renewables.
- To create social awareness of the need for clean energy.
- To make people take part actively in actions in favour of environmental protection.
- To show the effort that is being made in Galicia for renewables and, in particular, for wind energy.

All these activities are intended for the following groups:

- Primary and Secondary Schools: offering information to teachers about activities that can be done in the wind park.

- University: making visits possible with a technical content at a higher level than in the previous case. Also the possibility of reaching agreements for research into wind energy is of importance.
- Public in general: offering the possibility of being visited by lay people.

The activities that can be done are guided visits, classes, projection of videos about renewables and workshops. In Figs. 5 and 6 both overviews of Sotavento wind park can be seen.

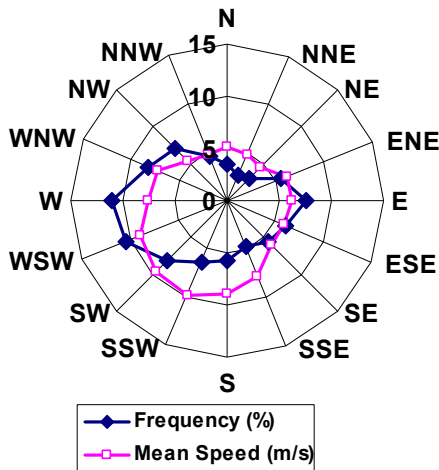


Fig. 4: Rose of winds in Sotavento wind park



Fig. 5: Sotavento control building

3. CONCLUSIONS

The following results are expected from Sotavento wind park:

1. The wind park should produce about 38,500 MWh per year, which correspond to the typical consumption of some 12,000 families or 3,300 Tep/year.
2. From the environmental point of view, the emission into the atmosphere of about 36,000 Tm CO₂ is avoided.



Fig. 6: View of Sotavento wind park

3. Some employment was created during the construction of the wind park. In 20 years, 4 people will have stable employment due to the maintenance operations of the wind park.
4. Nowadays, the wind power considered to be technically obtainable is about 3,500 MW in Galicia. The *Plan de Fomento de las Energías Renovables*, a plan for introducing renewables in Spain considers that Galicia should have 2,500 MW installed power in 2010. The experience of Sotavento wind park can be of interest for helping to reach such ambitious figures.
5. Finally, as explained above, it has a clearly explained educational objective for all groups in the Society and, overall, for the University.

Finally, as a general conclusion we can say that the Sotavento experimental wind park is an open space for those who want to gain more knowledge about wind energy and a place for research, which will be very useful for opening possible investigation lines which can be made in coordination with the University.

4. REFERENCES

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