Chapter 16
Portugal

16.1 INTRODUCTION

In the past decades, Portugal has had little development of wind power plant installations, mainly due to the low tariffs practised. However, at the end of 2001, the scenario changed with the publication of new legislation and tariffs. By 2003, that change became reflected in the implementation of new wind park projects and a strong increase in the development rate of capacity installed. In the following sections, a synthesis of the past as well as a summary of the current situation is presented with a main focus on the Portuguese current state of development and trends.

16.2 NATIONAL POLICY

Strategy

On 28 April 2003, the Government Journal published the *Resolution of the Council of Ministries* (*RCM 63/2003*), held on 13 March 2003, which approved the main orientations of energy policy defining the objectives and the measures to implement these objectives. This resolution suspended the *Resolution 154/2001*, which created the E4 program. According to *RCM 63/2003*, the Portuguese energy policy is based on three main vectors: I-security of supply; II-sustainable development; and III-promotion of national competitiveness.

Within the first vector, security of supply, the reduction of external dependency on energy gave rise to the establishment of new objectives to attain in 2010 for the electricity produced by renewable energy sources (RES). Within the second vector, sustainable development, the resolution proposes measures to assure the commitment of Portugal in the framework of the Kyoto protocol, namely a commitment to use renewable energies and promote rational use of energy. Within the third vector, promotion of national competitiveness, the main topic is market liberalization and the decrease of energy intensity in the product. It is important to note here the actions to be taken towards the Iberian market of electricity (the MIBEL).

This new resolution, *RCM 63/2003*, follows the legislation already available concerning renewable energy systems and co-generation that was first regulated in Portugal by the *Decree-Law 189/88*, published in the official government journal, *Diário da República*, in May 1988. Since than, the legislation was reviewed several times, the most recent in December 2001 by the *Decree-Law 312/01* and *Decree-Law 339-C/01*. The first law covers the technical and licensing procedures, and the second law covers the tariffs for renewable energy production.

The *Decree-Law 312/2001* concerns renewable energy systems and co-generation. The law "establishes the procedures regulating the awarding and management of the interconnection points with the Public-Service Electrical System (SEP) for the delivery of electricity received from new power plants, in the framework of the Independent Electrical System (SEI)."

In 2002, the *Decree-Law 68/2002* was published, which concerns the micro-power producers. Its mechanism is intended to speedup administrative and technical procedures associated with the interconnection of micro-generators to the low-voltage grid.

For 2002 tax incentives, the Ministry of Finance is directing favorable taxation towards private investors, who get tax credits for investing in renewable energies (personal income tax). The scope of this tax is, therefore, to stimulate investment in renewable energy technologies by making the investment more economically attractive. However, it is important to remind that the lower value-added tax (VAT) rates of 5% applied for renewables in the country are no longer in force due to the European fiscal harmonization of 2002 (12%).

Progress Towards National Targets

Currently, Portugal's bulk of renewable energy production is supplied by hydropower; biomass/waste sources; and, more recently, a steadily growing capacity of wind power. In view of the country's high dependence on imported fuels, the government has established a number of policies to increase the level of renewable energy development.

Recently, *RCM 63/2003* established that the energy policy of Portugal should reduce its external dependency, which gave rise to the establishment of new objectives to attain in 2010 for the electricity produced by RES. These objectives are shown in Table 16.1.

Wind energy capacity has been stimulated by a series of national policies, reaching the level of 289 MW in 2003. The supporting policies include financial incentives and feed-in tariffs (*Decree-Law 312/2001* and *Decree-Law 339-C/2001*) that have been provided to promote an increase of endogenous renewable energy production. In addition, applications for 7,000 MW of new wind capacity were received at the beginning of 2002 after the most recent PRE law was issued.

Resources	2001 [MW]	2010 [MW]
Wind	101	3750
Small hydro	215	400
Biomass	10	150
Biogas 1 50		
Solid waste	66	130
Wave	0	50
Photovoltaic	1	150
Large hydro	4,209	5,000
Total	4,603	9,680

Table 16.1 Endogenous installed and planned capacity (evolution 2001 to 2010)

16.3 COMMERCIAL IMPLEMENTATION

Installed Capacity

Table 16.2 presents the wind capacity and number of turbines installed in Portugal during 2003, and Table 16.3 presents the accumulated values.

Rates and Trends in Deployment

In 2003, an estimated total energy – based on the average capacity factor of different locations – of 720 GWh was produced. Figure 16.2 and Figure 16.3 show the evolution in capacity installation and wind energy production, respectively.

A rate of growth of approximately 50% was verified in 2003, which is slightly lower than 2002. However, a large number of wind park projects reached their final installation phase during 2003 even though they did not begin operation in that year. The rate of development for the past ten years is displayed in Figure 16.4.

Contribution to National Energy Demand

Although only estimates for gross and net energy consumption are available, it

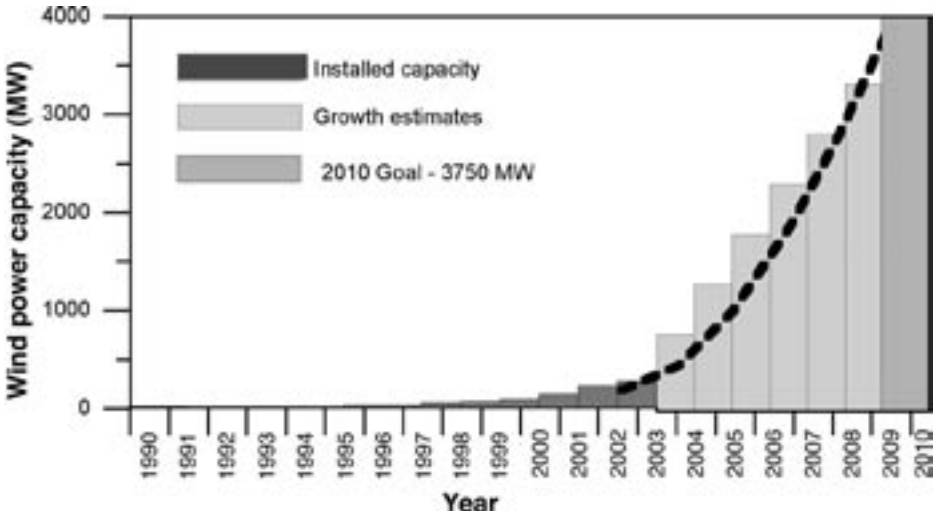


Figure 16.1 National targets for wind power capacity and growth estimates for 2010

is possible to calculate an approximate value for the wind energy contribution to Portuguese demand. Assuming an increase of 4.5% to the 2002 values, the estimated gross demand for 2003 would be 50,166 GWh –therefore, only 1.4% percent of this is wind.

MARKET DEVELOPMENT AND STIMULATION

Main Support Initiatives and Market Stimulation Incentives

The most significant government initiative introduced in the framework of the E4 Programme was the above mentioned 2003 Cabinet Resolution, which re-affirmed the national objective of promoting the installation of 3,750 MW of wind capacity by 2010.

There are also financial incentives under the POE/PRIME program (2000 to 2006), and some tax reductions for renewable energy that also apply to wind energy, as well as a partial support of this program budget on the costs of the transmission network reinforcement requested for the grid integration of further wind capacity in some areas of the country.

Unit Cost Reduction

During 2003, a stable reduction in the unit cost of wind turbines could be noticed – the actual mean cost of installed kilowatt-hours (excluding terrain cost and grid connection) ranged from 750.00 euro/kWh to 950.00 euro/kWh, depending on the country of origin of the turbines and individual capacity. This unit cost reduction has not been as significant as in other countries because the tendency in Portugal, mainly due to the high terrain cost, is to install turbines of more than 1.3 MW/2.0 MW, which have higher individual costs than smaller units.

Project Name	Local	Owner/ Promoter	Power per turbine [kW]	Manufacturer	Model	Installed capacity 2003 [MW]	Installed wind turbines 2003
MAÇÃO_III	Serra Amêndoa	ENERVENTO	900	NEG-MICON		4.5	5
Cabeço Raínha (ampl.)	S. Cabeço Raínha	ENERNOVA	2,000	Enercon	E66/ 2.0-70	6.0	3
VERGÃO	Serra Vergão	GENERG	1,300	Nordex	N60	13.0	10
Srª_CASTELO II	S. Montemuro	FINERGE	2,000	Enercon	E66	4.0	2
Srª_CASTELO III	S. Montemuro	FINERGE/ Catavento	600	Enercon	E40	0.6	1
AGUEIRA	S. Larouco	FINERGE	600	Enercon	E40	0.6	1
ALTO VACA II	Serra Cabreira	FINERGE	600	Enercon	E40	1.2	2
SERRA DO BARROSO	Serra do Barroso	ENERNOVA	2000	Vestas	V80	18.0	9
BOLORES	Loures	TECNEIRA	1,300	Izar Bonus	B62	5.2	4
MEROICINHA	Serra do Alvão - Pena Suar	GRUPO ENERSIS	3@2,000 1@3,000	Vestas	V80, V90	9.0	4
PICOS VERDES II	Vila do Bispo	Unit [E] Portugal	1,500	Fuhrlaender	MD70/ 77	10.5	7
MOINHOS DO OESTE	Oeste	Auditerg	2,000	Enercon	E66/ 70	4.0	2
TRANDEIRAS	Vila Pouca de Aguiar	ENERGIEKONTOR	1,300	Izar Bonus	B62	18.2	14
TOTAL						94.8	64

Table 16.2 Installed number of wind turbines and capacity by wind park and region

	Total operating capacity (Dec. 2003) [MW]	Total operating wind turbines (Dec. 2003)
Continent	**273.55**	**287**
Azores	**5.25**	**22**
Madeira	**9.75**	**43**
TOTAL	**288.55**	**352**

Table 16.3 Operating capacity and wind turbines in Portugal in 2003

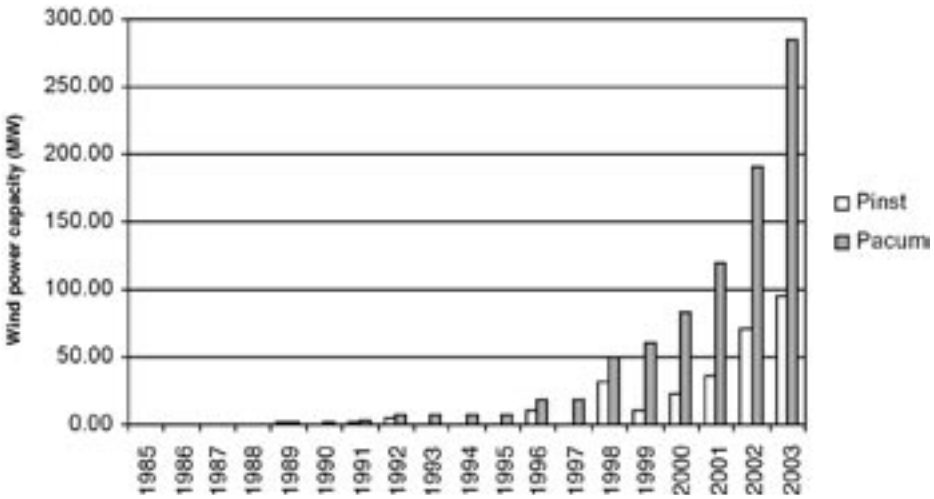


Figure 16.2 Installed and accumulated wind power capacity, 1985 through 2003

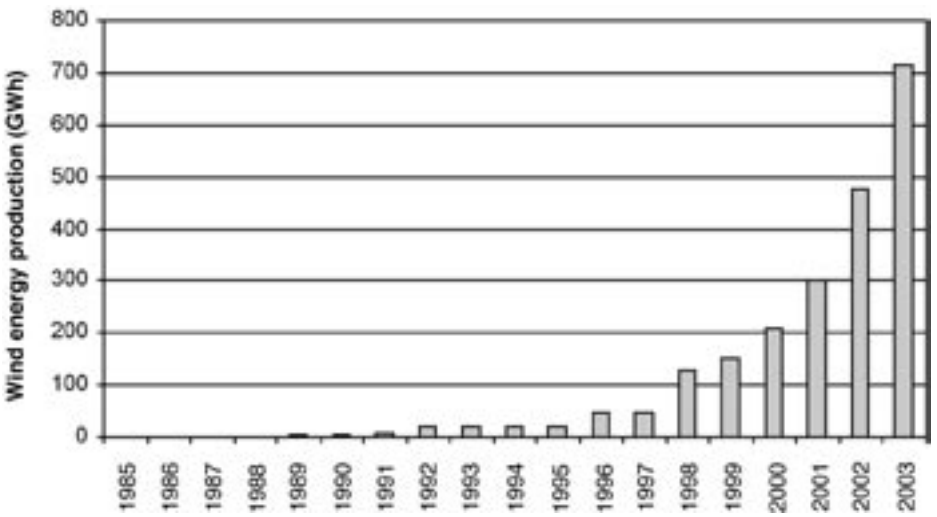


Figure 16.3 Wind energy production, 1985 through 2003 (calculated values)

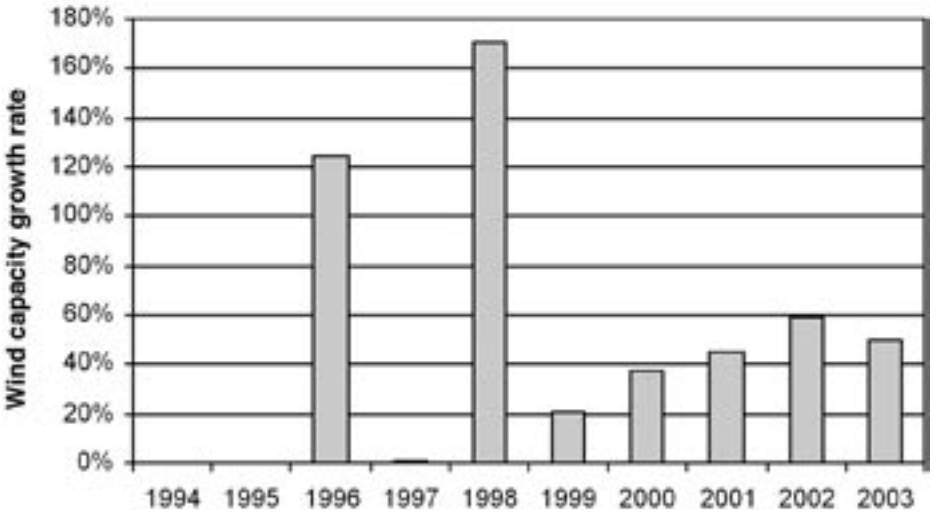


Figure 16.4 Wind capacity growth rate, 1993 through 2003

16.5 DEPLOYMENT AND CONSTRAINTS

Wind Turbines Deployed

In 2003, 64 wind turbines were installed in Portugal with individual capacities ranging from 0.6 MW to 3 MW, all from European manufacturers. The share of installed power by manufacturer is displayed in Figure 16.5.

Operational Experience

During 2003, no major failures of wind turbines were been reported, with the exception of the collapse of one Mitsubishi 500-kW wind turbine in the wind park of Vila do Bispo, Algarve. This was due to a succession of low-probability occurrences, including a loss of grid connection and failure of the two existing over-speed protection systems. The main reason for the wind turbine over speed was attributed to a misinstalled blade that during periodic maintenance was set to a wrong pitch angle.

Main Constraints on Market Development

The market in Portugal had a major burst during 2003, after the legislation published at the end of 2001 and the new projects developed during 2002, which were ready for installation in 2003. The major constraint in Portugal continues to be the excessively bureaucratic and long authorization system in order to obtain all the different permits required to install and operate a wind park. It takes four to five years from initial application to the installation phase. And there is the extreme exigency of the environmental institutions, from which a permit may take up two years to be issued.

16.6 ECONOMICS

Trends in Investment

The trends in investment in the wind sector in Portugal are pronounced towards multi-megawatt wind machines due to the high cost of land. Although the cost structure of

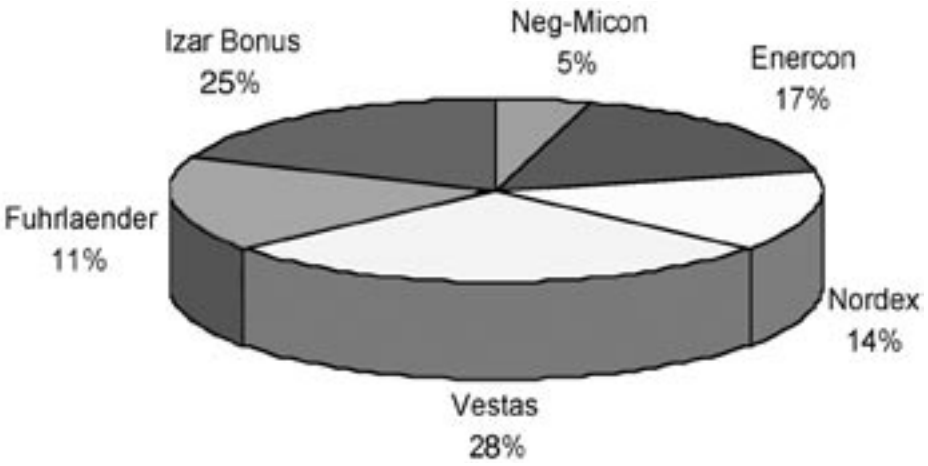


Figure 16.5 Share of installed power by manufacturer

wind park projects is considered a classified subject by all private investors and financial institutions, the total costs in 2003 are in the range of 900.00 euro to 1,200.00 euro. Annual costs for operation and maintenance (O&M) vary between 2% and 4% of the investment cost.

Trends in Unit Costs of Generation and Buy-Back Prices

Although production and trade costs are not yet available for other forms of energy, the tariffs for renewable energy, including wind power-based production, are fixed by the government's decree within *Law 339-C/2001* and are presented in Figure 16.6.

16.7 INDUSTRY

Manufacturing

Wind turbines are not manufactured in Portugal, but there is some incorporation of technology in towers and electrical equipment, such as power transformers and wind park cabling.

Industry Development and Structure

During 2003, the intention to install wind turbine industrial and assembling units in Portugal was announced by three different manufacturers in order to comply with the requirements of the national strategy and the consequent development of the Portuguese wind energy market. These announcements included an investment in two assembling factories in the north and center interior, and an investment in a new production factory in the northern littoral.

16.8 GOVERNMENT-SPONSORED R,D&D

Priorities

Portugal does not currently have a governmental program for sponsoring R,D&D activities related to wind energy. However, the National Institute for Engineering and Industrial Technology (INETI) is a part of the Ministry of Economy, and its activities are partly financed by the government.

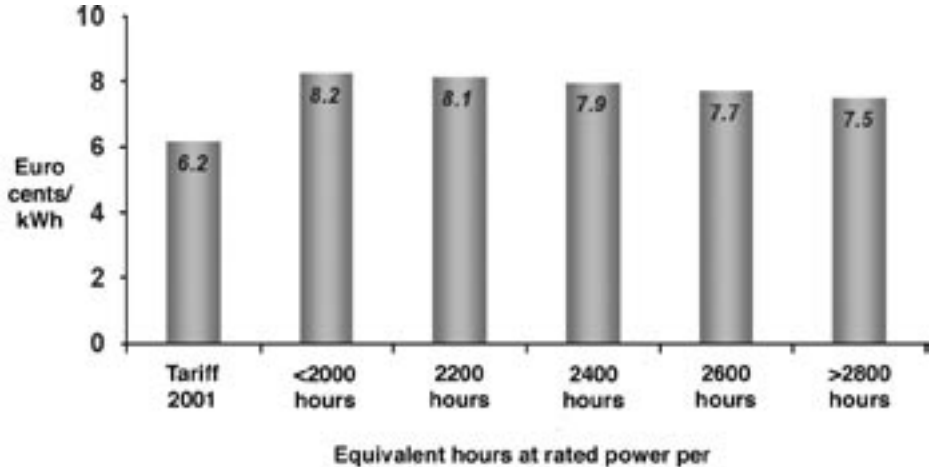
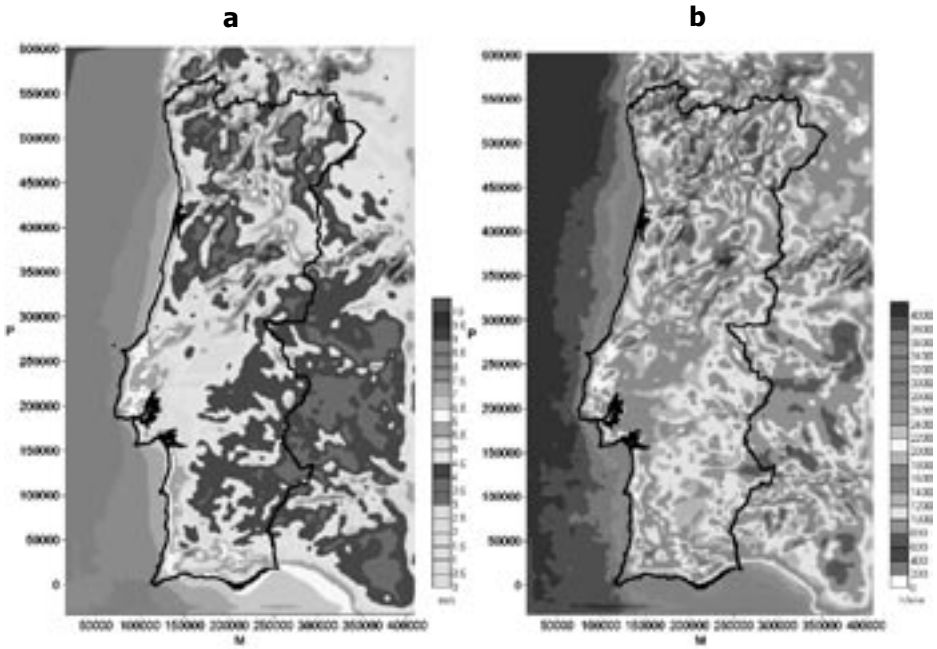


Figure 16.6 Tariffs applied in Portugal versus equivalent hours at rated power per year



Figre 16.7 Wind atlas: a) mean wind speed at 80 meters above ground and b) yearly equivalent full-capacity hours

Figure 16.8 Anemometric stations available in the EOLOS 2.0 database

During 2003, the Portuguese wind atlas, as displayed in Figure 16.7, was developed together with a national database for wind characteristics (EOLOS 2.0) with information of about 50 anemometric stations (Figure 16.8).

The main R,D&D priority for INETI is currently the forecast of wind power production, which INETI intends to carry out with the Portuguese network operation and dispatch company Rede Eléctrica Nacional (REN).

New R,D&D Developments

New trends in what concerns wind energy are oriented to the development of wind/hydro common regulation (e.g., wind for hydro pumping use under excessively high penetration), due to the high hydro capacity installed in this country and the high correlation between availability (and sometimes excess of) hydro resource and wind during the winter months.

Offshore Siting

Although INETI participated in the identification of possible sites for offshore wind park installation, the possibilities are globally low due to the high depth and fast slope of the continental platform, which leads to technical problems or very high costs. So far, there is no consistent plan for offshore wind farms.

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