

**Research
Article**



How to Prepare a Power System for 15% Wind Energy Penetration: the Portuguese Case Study

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The 2001/77/CE Renewable Energies European Directive together with Kyoto Protocol ratification supported by a government vision and strong objective on the reduction of external oil dependence put Portugal in the front line to achieve one of the highest wind energy penetrations within 10 years' time. This paper gives a summarized overview of the Portuguese technical approaches and methodologies followed in order to plan and accommodate the ambitious wind power goals to 2010/2013, preserving the overall quality of the power system. Copyright © 2007 John Wiley & Sons, Ltd.

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Introduction

One may say that, these days, one of the most relevant difficulties the wind sector faces is caused by this technology's own extreme success. The high capacity installed in the last decade in some European power systems or grid areas has introduced a brand new set of technological issues that has recently become one of the more quoted subjects among developers, network planners and system operators.¹ These concerns are not anymore a negligible distribution grid integration issue (e.g. voltage regulation problem, poor quality of the energy injected in grid) that experts tend not to give too much relevance since they have been easily solved and even more easily avoided through good design and planning, but this being a real power system operation and planning issue:² is the system capable to cope with the specificities of the wind power production in large quantities (also known as 'high penetration') without requiring new wind park models, system operation tools, increased performance of the wind turbines or even a change in the transmission system operators' (TSOs') conventional mode of operation?

The recent concern of the TSOs is very legitimate, since it is their responsibility to design and manage the power system global production and its adjustment to the consumer loads as well as to assure the technical quality of the overall service, both in steady state and under transient occurrences.

The wind power capacity has reached such a dimension in some European power systems that obliged the TSOs not to neglect the typical behaviour of these spatially distributed renewable power plants, that being a situation that must be addressed by the wind park developers, the wind manufacturers, the TSO planners and regulators together with the experts in this technology grid integration behaviour.

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