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Costs and benefits of the renewable production of electricity in Spain

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HIGHLIGHTS

- An overview of the current production of electricity from renewable sources in Spain is offered.
- The costs of integrating renewable energy and the downward effect on the market is reviewed.
- Other economic, social and environmental positive effects are also covered.

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ABSTRACT

The reduction of pollutant emissions and greenhouse gases, as well as the strong energy dependence on fossil fuels (gas and fuel oil), have, among other reasons, led many countries in recent years to develop policies to promote and encourage the use of alternative, sustainable, clean and predictable sources of energy. This paper presents an overview of the production of electricity from renewable sources (PE-RES) in Spain, and offers an outline of the current level of development of renewable energy. It also reviews the current support system, the costs of integrating renewable energy into the electric system as well as the effects of this type of energy on the electricity wholesale market price, the Gross Domestic Product (GDP), the environment, human health and employment.

1. Introduction

Recent events, as diverse in nature as the riots of the Arab spring, the uncontrolled spill from the accident at the oil platform in the Gulf of Mexico and or the Fukushima nuclear accident, clearly illustrate some of the adverse consequences of using fossil fuels as a source of energy: supply uncertainty and price volatility of the oil and its derivatives, severe and long-lasting environmental degradation and risks to the human health, as well as huge expenditures (mainly from public funds) which must be spent on efforts to try to control and/or alleviate consequent damage. However, the use of fossil fuels produces low intensity damages on a daily basis, although those fail to attract the attention of the media. Conventional thermal power stations daily emit tons of toxic and greenhouse gases that accelerate global warming and cause damage to human health and the environment. Current nuclear plants produce radioactive waste that must be stored, controlled and kept under guard for tens or even hundreds of years. Armed or diplomatic conflicts and speculative activities in the wholesale markets continuously lead to shortages and price volatility of oil and its derivatives (at the beginning of February 2012 there were interruptions to the gas supply to Europe during a mid-winter cold snap, and by the end of February 2012 the price of Brent exceeded USA$ 120/barrel). All over the world, most people are aware of these harmful consequences and are concerned by the negative consequences of global warming and climatic change. As a result, social pressure is driving most parliaments to promote the use of renewable energy.

PE-RES present clear environmental benefits, and also offer significant socioeconomic advantages, such as the improvement in the diversification of energy supply, security of supply in the long term, promotion of the creation of a domestic industry, enhancement of opportunities for regional and rural development, and promotion of new job creation opportunities. Nevertheless, as the support for PE-RES is paid by electricity consumers via their bills, it is sometimes claimed that renewable energy, due to its subsidies and time-variable characteristics, is expensive. However, the influence that a growing share of PE-RES on the electricity mix has on the consumer costs (bills) is less evident, as there are other effects to be considered. One of the main

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repercussions is the downward pressure that the presence of PE-RES puts on the wholesale price of electricity.

Jensen and Skytte (2003) were probably the first to point out that a greater share of PE-RES (wind power in their work) in the electricity mix could lead to a reduction in the wholesale price of electricity. Sensfuss et al. (2008) examined the case of wind-powered generation in Germany, and Saénz de Miera et al. (2008) the case of Spain. They found heuristically that more wind-powered generation integration results in a reduction of the electricity wholesale price. In both cases, the authors concluded that the cost of supporting PE-RES is roughly balanced by the downward impact on wholesale market prices. In addition, those authors took into account that PE-RES (wind) reduce the number of CO_2 allowances needed by the electricity generation sector to cover their greenhouse emissions. This additional effect puts a net supplementary downward pressure on the wholesale electricity price.

This paper discusses the case of the effects of the integration of PE-RES in Spain. The work empirically reviews Spanish PE-RES support schemes and the balance between the cost increase for the system and the reduction in wholesale prices, while including the effect of the cost of CO_2 allowances needed to cover the greenhouse emissions, as given in Sensfuss et al. (2008) and Saénz de Miera et al. (2008). In this review, the approach is broader since the paper assesses the main renewable sources of energy (not only wind) and other economic and social aspects, such as the amount of toxic gas emissions and greenhouse gases avoided, the health costs avoided, the avoided fuel imports, the impact of the renewable sector on the Spanish GDP, and the potential for new job creation.

The content of the paper is as follows. First the current situation of Spanish electricity production and the renewable promotion scheme is reviewed. The cost of integration of PE-RES into the electricity market and the downward effect on the wholesale electricity market are covered. Other positive economic and social effects such as the reduction of fuel imports, the effect on the environment, the health and job creation are also covered. The article closes with a summary of the main findings resulting from the review.

2. The current situation

Currently, energy consumption is the main source of greenhouse gas emissions. According to forecasts by the International Energy Agency (IEA, 2006), global energy consumption will increase by approximately 30% between 2010 and 2040, mainly due to the growing demand from emerging economies. In this scenario, fossil fuels will continue to account for 80% of global energy demand. Forecasts of rising energy demand will deplete fossil fuel reserves and will push up their prices, as a result of the increasing supply/demand imbalance. The greater the energy consumption from fossil fuels, the greater the growing of greenhouse gas emissions and the greater the adverse environmental impact.

The upward trend in energy consumption, energy imports and emissions of greenhouse gases are a regional concern in the European Union (EU). In Spain, the presence of oil and its derivatives in domestic consumption accounted for 79.4% in 2009, which was significantly higher than the 53.9% of the EU average (Eurostat, 2011). This high dependence on fossil importation is mainly due to a very low production of domestic energy, which is almost totally limited to renewable energy resources.

Within this scenario, the EU has developed policies to control energy consumption and promoting the use of energy from renewable sources, along with policies to encourage energy saving and greater energy efficiency. These policies are an important component of the package of measures to reduce emissions of greenhouse gases needed to meet the Kyoto Protocol of the Convention on the United Nations Framework on Climate Change and other EU and international commitments. All these measures are located within a framework of coordinated progress which includes the liberalization of markets, security of supply, development of the infrastructure of interconnection and emissions reduction.

Table 1
Spanish wind promotion scheme according to the Royal Decree 661/2007. *Source*: (MITC, 2007).

Feed-in tariff (€/MWh)	**Premium option** (first 20 years)		
	Reference premium (€/MWh)	**Upper limit** (€/MWh)	**Lower limit** (€/MWh)
73.228 (first 20 years)	29.291	84.944	71.275
61.200 (after 20 years)	(20.13)[a]		

[a] According to the agreement between the wind power sector and the Spanish Ministry of Industry (MITC, 2010b), the reference premium for those wind farms which chose the premium option will be temporarily reduced to 65% (20.13 €/MWh), from 1 January, 2011 to 1 January, 2013.

Within this policy, the Directive 2009/28/EC of 23 April, 2009 currently presents the European framework on the promotion of the use of energy from renewable sources (The European Parliament and the Council of the European Union, 2009). This Directive sets mandatory national targets for the share of energy from renewable sources in the total final energy consumption. This Directive sets a target, for 2020, of a minimum share of 20% of energy from renewable sources in the total final energy consumption of the EU. Individual minimum targets are also set for each state member, which in the case of Spain, is the same 20% quota.

Mechanisms to promote or support elements covered by the Directive include the establishment of an attractive remuneration framework. For the Spanish case, this promotion scheme is based on one of two mechanisms (MITC, 2007): the fixed feed-in tariffs (tariff + fixed bonus = feed-in tariff) or the premium option (market price + premium) which is the more common preference (85% of wind capacity in 2010). In the latter mechanism, current regulation introduces maximum and minimum premium thresholds for certain technologies, including wind power. The upper threshold limits the premium profits for PE-RES and prevents consumers from being overburdened with overly expensive PE-RES promotion. The minimum threshold limits the risks for PE-RES investors, thereby encouraging new investments in PE-RES. Table 1 shows the support levels for wind power (onshore) under each option, according to the Royal Decree 661/2007 (MITC, 2007)[1] .

The current scheme guarantees the payment of a fee higher than the price of the wholesale market, by establishing a system of tariffs and special bonuses, depending on the technology. These premiums are considered as an internalization of environmental benefits, security of supply and diversification. The amounts derived from the framework of support are included in the structure of the electricity costs with the remaining costs of the electrical system.

[1] At the time of completion of this paper, the Spanish Government, through RDL 1/2012 (JE, 2012), enacted a temporary suspension of premiums for new facilities, but maintained the support system for the previously existing facilities.