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Renewable Energies in Spain and Portugal: A Strategic Challenge for the Sustainability

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***Abstract*—**Directive 2009/28/CE establishes, as obligatory objective, a share of renewable energies on energetic consumption of 20%, in European Union, in 2020 However, such European normative gives freedom to member states in the selection of the renewable promotion mechanism that allows them to obtain that objective.

In this paper, we analyze the main characteristics of the promotion mechanisms of renewable energy used in the countries that shape the Electricity Iberian Market (Spain and Portugal) and the results in employment. The importance of these countries is given by the great increasing of the renewable energies which suppose a share higher than 30% of the overall generation in 2010. Therefore, this research paper can serve as the basis for the learning of other countries with regard to the main advantages that entail the use of a feed-in tariff system.

***Keywords*—**Employment, Energy policy, Professional profiles, Renewable energies, Professional profiles.

I. Introduction

THE promotion of renewable energy is a key concept in European Union (EU) by both environmental and economic reasons. In this context, the involvement of national governments in the diffusion of renewable energy is necessary in the initial phases of the integration of green energy in the economy. It can be justified by the following motives: the stimulation of the technical change and the promotion of the innovation [1].

The stimulation of technical change: renewable energies have to compete with other production technologies established in the system and, therefore, they have an unfavorable position. When renewable energies enter the market, they have not reached their optimum capacity in terms of cost and reliability but these characteristics will be obtained gradually as the result of the process of learning by doing [2]. Hence the necessity of establishing a system of incentives that allows to solve such questions.

The promotion of the innovation: action to implement green energy requires governmental mechanisms that incentive the development of innovative technological solutions that are economically viable [3].

Therefore, the development of mechanisms that promote renewable energy is required. In this context, the objective of this paper is to determine the success factors of such mechanisms in the countries that shape the Iberian Electricity Market. The importance of these countries is given by the great increasing of the renewable energies where a demand supply of 45% is expected with this type of technologies in 2020 (it could suppose a duplication of the requirements established by EU) [4].

With this aim, this paper is structured in the following way: in the first section, we study the main characteristics of the different renewable energy promotion policies of the EU; after that we analyze such policies in the cases of Spain and Portugal; in the third section we make a comparison of such policies in wind and solar renewable energy and we show their results in employment and, in the last section, we draw the main conclusions of the paper.

II. The Renewable Energy Policy in the EU

European Commission establishes a measurement pack of environmental and energetic policies with the aim of obtaining an energetic consumption from renewable energies of 20% in 2020 [5]. In this context, an institutional support mechanism to renewable energies is developed although Directive 2009/28/EC [6] (and previously Directive 2001/77/EC [7]) gives freedom to each member state to choose the more suitable policy in function of its characteristics. There are different support mechanisms but mainly three types are used: feed-in tariffs, competitive auctions and quotas of negotiable green certificates [8], [9] (see Table I).

By means of the *feed-in tariffs*, renewable energy generators have right to sell all their production in the electricity network and to obtain, in exchange, a retribution based on a fixed price or in the daily price of electricity market plus an incentive that compensates the environmental value. This system establishes legally the prices or incentives of each renewable production technology (wind, solar, biomass, mini-hydraulic, etc.). This reward is set for a specific time period that oscillates, generally, between ten and twenty years from the starting of the installation.

For a suitable functioning of this mechanism, a high reward is required to guarantee an attractive profitability. When this condition is fulfilled, feed-in tariff systems have shown that they are the most effective to promote the expansion of renewable energy [10], [11].

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TABLE I
CHARACTERISTICS OF THE RENEWABLE ENERGY SUPPORT POLICY IN DIFFERENT MEMBER STATES

Country / System	F	Q	A	T / I	System change	System adaptation
Austria	1998-2012	x	x	x	x	2002-2006-2010
Belgium	1997-2002	2002-2012	x	x	2002	2009
Bulgaria	2003-2012	x	x	x	2003	x
Cyprus	x	x	x	2004- 2006	2004	2006
Czech Republic	2002-2012	x	x	x	2002	2006
Denmark	1997-2012	x	x	x	2001	2009
Estonia	2003-2012	x	x	x	2003- 2010	2005-2008
Finland	2011-2012	x	x	1997- 2012	2011	x
France	1997-2012	x	1997-2000 2003-2006	x	2001- 2003	2001-2006-2010
Germany	1997-2012	x	x	x		2000-2004-2009-2011
Hungary	2002-2012	x	x	x	2002- 2012	2005
Greece	1997-2012	x	x	x		2006
Ireland	2006-2012	x	1997-2006	x	2006	x
Italy	1997-1999	1999-2012	x	x	1999	2005-2008-2009-2011
Lithuania	20022012	x	x	x	2002	x
Luxemb.	1997-2012	x	x	x		2008-2009
Latvia	2001-2006-2009-2012	x	2006-2009	x	2001	2003-2006-2009-2010
Malta	x	x	x	2006-2012	2006	x
Holland	2003-2006-2009-2012	1997-2000	x	2004-2012	2000-2003-2004-2006-2009	2011
Poland	x	2000-2012	x	2000-2012	2000	x
Portugal	1997-2012	x	2005-2008	x	2005-2008	2001-2005-2007-2009-2010
Romania	x	2004-2012	x	x	2004	2009-2011
Slovakia	1997-2012	x	x	x	x	1998- 2004-2007-2008-2010
Slovenia	x	2003-2012	x	1997-2003	2003	2011
Spain	2004-2012	x	x	x	2004	2009
Sweden	2005-2012	x	x	2003-2012	2003- 2005	2010
United Kingdom	x	2002-2012	1997-2002	x	2002- 2010	2009

F: Feed-in tariff; Q: Quota; A: Auctions; T/I : Tax/Investment incentives
Note: For various technologies (wind, bioenergy and photovoltaic)
Source: Own elaboration from Ragwitz (2011) [23]

This mechanism has been used in different member states, such as Germany, Spain, Portugal or Denmark.

In the case of *competitive auction system*, competition is centered on the price due to the production offers are sorted in an increasing order of prices until the proposal quantity was reached. So, the regulator reserves a proportion of market for the production of renewable energy and develops the competition between generators that use these resources. Distributors have the obligation of acquiring the total of produced quantity in that reserved market.

This mechanism has been used mainly in United Kingdom, Italy, France or Sweden.

The objective of the *quotas of negotiable green certificates* is that the produced energy from renewable sources can be converted in an integral part of the electricity market. For it, the government establishes the obligation for distributors to acquire a certain percentage of their supply from renewable energy (fixed quota of electricity). At the end of every period, distributors have to prove their performance of the quota by means of the virtual delivery to the corresponding National Regulatory Authority. This system has been applied in the Netherlands, France or Latvia.

There is not a consensus about which instrument is the most suitable. However, the experience shows that the development of a feed-in tariff system, that allows investors to guarantee an attractive profitability of the renewable installations, is effective in the promotion of the renewable energies [12], [13]. It is the case of Spain or Portugal which introduced this renewable energy policy from the first phases of the promotion in this type of production technologies, and it has allowed them to obtain the first places in installed capacity and production of renewable energy (in the case of Spain) and in renewable energetic consumption (in the case of Portugal).

III. ANALYSIS OF THE PROMOTION POLICIES OF RENEWABLE ENERGY IN SPAIN AND PORTUGAL

Spain is the second European country with higher installed power and production in renewable energy (after Germany). Its success in the promotion of these production technologies is given, in a great measurement, by the regulatory framework used.

In the case of *Portugal*, the development of renewable production technologies is a key concept because of its high exterior energetic dependence (more than 80% in 2010) [14]. The introduction of this type of technologies allows this member state to increase the consumption of national resources and to obtain an environmental improvement.

The main characteristic of the regulatory frameworks of

both member states are given in Table II (for wind energy) and in Table III (for solar energy).

In the case of wind energy, Fig. 1 shows that Spain was characterized by the development of a stable regulatory framework until 2011. The recent Royal Decree-Law 1/2012 entails an abolition of all renewable energy promotion system in Spain because of this member state has achieved the foreseeable expectations.

TABLE II
CHARACTERISTICS OF THE REGULATORY FRAMEWORK OF WIND ENERGY PROMOTION IN SPAIN AND PORTUGAL

Member States	Characteristics of the Regulatory Framework
Spain	*Law 54/1997* entails the liberalization of the Spanish electricity industry. It aims to achieve the guarantee of electricity supply at low prices and the reduction of the environmental impact. With this aim, the new regulation establishes the possibility for renewable energy producers to incorporate their surplus energy. *Royal Decrees 436/2004 and 661/2007* allow producers of renewable energy to choose between two possibilities: a) to sell their surplus of electricity energy to a distributor in exchange for an amount equal to the feed-in tariff calculated as a percentage of the medium or reference electricity tariff every year or b) to sell their production surplus in the electricity production market plus an incentive for their participation and a fixed premium. Likewise, a reference premium (2.92 Euro cents/kWh) and the upper (8.49 Euro cents/kWh) and lower limits (7.12 Euro cents/kWh) are established for wind energy. *Royal Decree 1614/2010* establishes a restriction of the equivalent hours of functioning in wind production with the right to receive the premium (2589 hours/year). Besides, it involves a reduction of the reference premium of 35% that has recourse to Royal-Decree 661/2007 and those installations with more than 50 MW. *Decree-Law 1/2012* entails an abolition of the renewable energy promotion system. This indicates that Spain achieved the foreseeable expectations.
Portugal	*Policies of renewable energy promotion*: feed-in tariff system, subsidies (up to 40%), fiscal incentives and tenders. In the case of renewable energy systems with great size, feed-in tariffs and tenders have been the basic support mechanisms used. On the other hand, renewable energy systems with small size have been promoted mainly by the use of subsidies and fiscal incentives. *Royal Decree 168/99* which establishes its calculation as a function of the avoided costs of the public energy system and the environmental profit that this type of production technologies entails (EREC, 2004). *Royal Decree 33/2005* modifies the amount of premiums and considers the specific type of technology, the environmental aspects and the inflation rate. In the case of wind energy the feed-in tariff is established at 7.40 Euro cents/kWh for a time period of fifteen years. Likewise, the *regulatory framework* establishes in Portugal limits to the local opposition in the development of new windfarms. In this sense, regulation determines that municipalities that have wind plants will benefit automatically with the reward of the windfarm operator (they will obtain the 2.5% of the amount received by the operator monthly).

Source: Own elaboration

Such regulatory framework involved an intense and constant growth between 1997 and 2009 of wind energy installations because of the development of a favorable feed-in tariff [15] (See Fig. 2).

Regarding Portugal, in spite of establishing a feed-in tariff system of a substantial amount, it seems that this has not been sufficient to attract investors in terms of profitability and security. So, in Fig. 3, we can observe that this member state has experimented important increases in wind installed capacity recently (from 2005 to 2009) although these values are lower that the Spanish case. The answer to this situation may be given by the long periods for the authorizations of this type of production technologies.

TABLE III
CHARACTERISTICS OF THE REGULATORY FRAMEWORK OF SOLAR ENERGY PROMOTION IN SPAIN AND PORTUGAL

Member States	Characteristics of the Regulatory Framework
Spain	*Royal Decrees 436/2004 and 661/2007* establish regulatory price-driven mechanisms as renewable promotion incentives in this member state. Its value varies with respect to the size of the solar installations. It fluctuates between 41 and 44 Euro cents/kWh for solar installations with installed power below 100 kW, and between 21 and 41 for solar installations with installed power beyond 100 kW. *Royal Decree 1578/2008 and 1614/2010* establishes a limitation in the number of functioning hours of this renewable production technology. *Decree-Law 1/2012* entails an abolition of the renewable energy promotion system. This indicates that Spain achieved the foreseeable expectations.
Portugal	*Royal Decree 168/99* introduces feed-in tariff as a solar energy promotion mechanism. *Royal Decree 33/2005* modifies the amount of premiums and considers the specific type of technology, the environmental aspects and the inflation rate. In the case of solar energy, the feed-in tariff is established at 31-45 Euro cents/kWh for photovoltaic solar installations and at 26.30-27.30 for thermal solar installations. *Royal Decree 80/2006* determines the obligation of solar collectors in all new building constructions. Increase of feed-in tariff of photovoltaic solar installations in 2010 (up to 61.80 Euro cents/kWh).

Source: Own elaboration

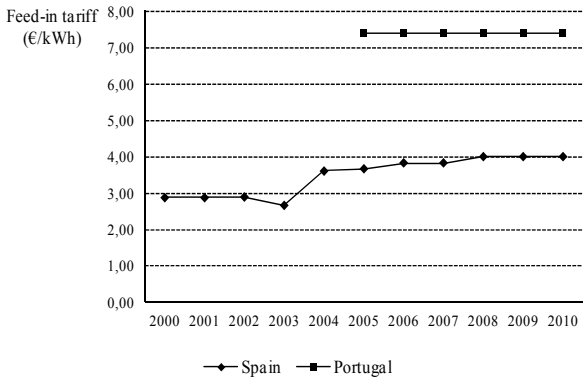

Fig. 1 Evolution of the feed-in tariffs for wind power in Spain and Portugal (source: [16])

These characteristics are present at the solar renewable energy too whose effects on installed capacity are shown in Fig. 4. We can observe an important increase of this variable in Spain from 2006 as a consequence of the establishment of an attractive investment incentive. However, the long administrative procedures have involver lower installed capacity in Portugal.

The great development of renewable energies in Spain has involved positive economic-social implications. In this context, a positive contribution of renewable energies to Gross

Domestic Product is observed. This industry gets a contribution of 0.94% of GDP with a positive contribution of 10000 millions of Euros in 2010 [17]. Besides, there has been an important development of the research, development and innovation activity that involves the creation of a relevant industry of equipment and fabrication components. Finally, this emergent industry entailed a reduction of the emissions of CO2 in 145 millions of tons and a saving of 2483 millions of Euros [18].

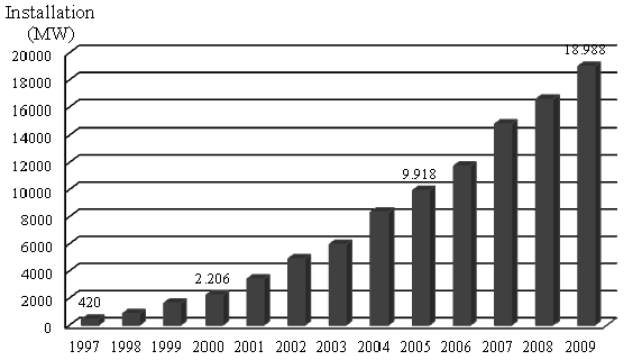

Fig. 2 Development of wind energy installations in (source: [16])

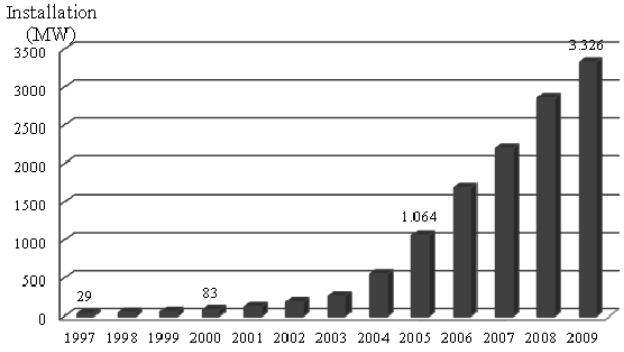

Fig. 3 Development of wind energy installations in Portugal (source: [16])

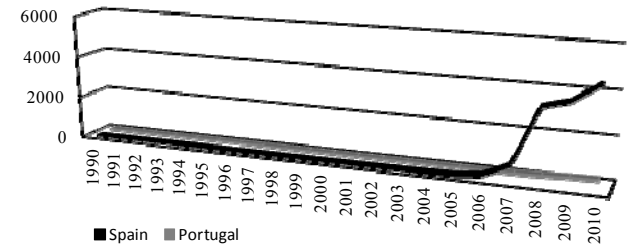

Fig. 4 Development of installed solar capacity in Portugal and Spain (source: [16])

In Portugal, positive implications in the economy are shown too as a consequence of the development of that industry. The use of renewable energies in this member state has allowed it to obtain a renewable energy quota in the electricity consumption of 23.2% in 2008 (exceeding the objectives established in the European Directives for 2020) [19]. So, Portugal is between the leading countries in the green energy consumption (besides Sweden and Finland). Besides, a greater efficiency and improvements in quality is observed by means of the technological development that entails the creation of more efficient and reliable renewable energy technologies.

IV. Analysis of the Impact of Wind and Solar Renewable Energy on Employment in Spain and Portugal

In this section, we analyze one of the most important social implications of the development of renewable energies in the present context of economic and financial crisis. This variable is the creation of employment.

With the aim of analyzing the effects of the renewable energy subsector on employment in Spain and Portugal, it is necessary to consider that this industry is characterized by distinctive characteristics compared to traditional extractive industries. Besides, this subsector entails a "dragging effect" on employment of other industries of the economy, such as the machinery production industry, the chemical industry or the machinery of electrical components [20].

In Fig. 5, we can observe the evolution of the employment developed by wind energy industry in the analyzed member states with respect to the type of promotion policy applied to this clean production technology.

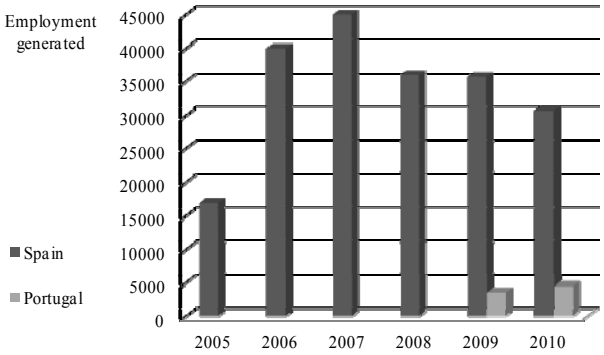

Fig. 5 Evolution of employment generated by the wind energy industry in Spain and Portugal (source: [21])

The case of Spain is outstanding. However, in the last years, a decrease in the number of jobs can be observed in this member state due to the regulatory uncertainty regarding the feed-in tariff. Portugal is at quite a distance where the information is limited and rather reduced (only available from 2008). Nevertheless, maintenance of employment increases in this subsector is observed too.

Fig. 6 shows that Spain maintains a greater quota in employment generated from photovoltaic solar energy industry too. However, we can observe a reduction of employment in this member state as a consequence of the financial and economic crisis. This also involves a reduction of financial capacity. In the case of Portugal, an increase of employment is observed in the analyzed years although it is lower.

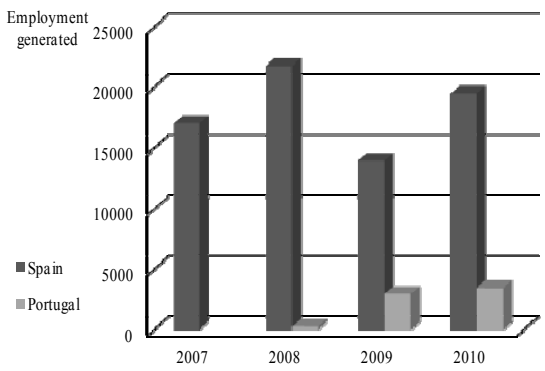

Fig. 6 Evolution of employment generated by the photovoltaic energy industry in Spain and Portugal (source: [21])

Regarding the type of activity that employees develop in the analyzed member states, we can observe Figs. 7 and 8.

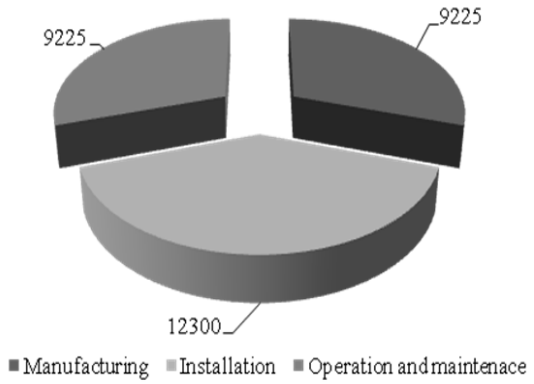

Fig. 7 Employment created in wind energy by activity type (Spain 2010)

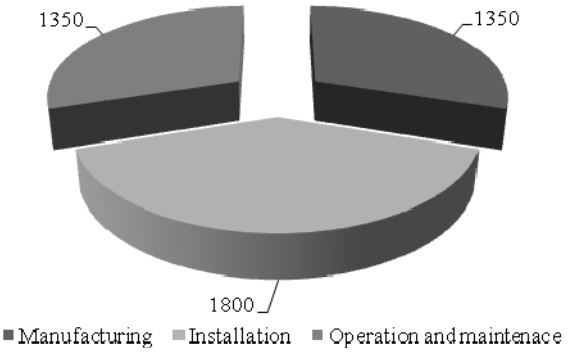

Fig. 8 Employment created in wind energy by activity type (Portugal 2010)

All of these activities have a similar quota where installation activity in wind energy has a slight greater percentage. In this industry, professional profiles of construction industry have been contracted and show that they are suitable to do this work because of the scale economies. With regard to the installation and maintenance activities, that will be likely to be the most demanded, a specific professional formation is required for developing the necessary competences (based on industrial engineering and professional training with electricity and plumbing profiles) [22]. Therefore, the formation of future employees in such topics could be an important element to consider in the present context of economic and financial crisis.

V. Conclusions

Over the last years, a development process of renewable energies in Europe has been happening with the aim of taking advantage of their environmental profits [23]. Between them, lower carbon emissions and the sustainability are emphasized with regard to the energy from fossil sources.

In this context, the participation of governments is necessary in the initial phase of clean production technologies in order to secure development and protection from the direct competition that conventional technologies entail. However, there is not unanimity about what renewable promotion mechanism is the most suitable.

In this paper, we analyze the main characteristics and the obtained results with policies based on feed-in tariffs in Spain and Portugal. This mechanism allows producers of this type of energy to obtain, with the electricity market price, an incentive that compensates the environmental value that entails. The selection of these member states is due to they are between the European leading countries in installed power and production in renewable energy (in the case of Spain) and in terms of energetic consumption of this type of technologies (in the case of Portugal).

Results in such countries show positive economic-social implications, such as a positive contribution to Gross Domestic Product, lower emission contaminants and a great technological development. A key concept has been the creation of employment where the professional profiles have been identified. The formation of future employees in such topics (industrial engineering and professional training) could be an important element to consider in the present context of economic and financial crisis.

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