

PAPER TITLE:

**The public promotion of renewable energies in electricity generation in Spain.
The wind energy in the canary islands.**

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1. **Overview:** This paper describes the evolution of the device to promote the renewable energies (RES) in Spain in electricity generation and the results that have been achieved. We will identify the main features of Spanish institutional environment. Spanish Public support at the national level has been based on a feed in tariff that has been effective in the promotion of certain technologies but not in others where technical and economic potential exist. For this reason, the government passed a new regulation in 2004 involving relevant changes to reduce the risk for the investors and to encourage the participation of RES in the generation wholesale market. Finally, we will analyse the wind energy situation in the Canarian Archipelago characterised by the existence of seven small sized independent electricity generation systems but where exists an abundant supply of renewable energy sources, principally from wind and the sun (Calero and Carta, 2004).
2. **Methods:** The analysis is based on the problematic of New Institutional Economy. Firstly, we use the concepts of the Transaction Costs Theory to explain the essential features that the structure of governance of regulatory contract must manage to promote RES. Secondly, we will study the particular effects of Spanish regional institutional framework for the promotion of RES adopting the perspective developed by North (1990). Finally, we will identify the main determinants of the successful of the actual device in Spain in terms of installation of new units and the stimulation of technological learning and development of an industrial policy in fabrication of RES units.
3. **Results and conclusions:** The Spanish Public support for RES in Spain has been stable but there exists risk of opportunism of the public authority in the revision of tariffs and the regulatory contract. Regional authorities have a complementary but very important role in the deployment of RES in Spain (Finon and Pérez, 2004) but there are certain bureaucracy and administrative coordination problems between national and regional administrations. There are other issues that affect RES promotion like grid access and transmission capacity congestion. We will see that this is a very important barrier for the deployment of wind energy in the Canary Islands.

1.- Introduction

Since the nineties, governments have developed voluntary renewable energy development policies with the aim of preserving a set of collective goods, climate stability, local environment and energy security. The objectives of the policy became ambitious in the field of electric production, which is the main field of their development besides that of biofuels: if we take the case of the European Union members, the share of “new” renewables in the electricity production must increase from 1% to 8% of the total electricity production in average if the voluntary objectives adopted by the 2001 directive on renewable promotion (European commission, 2001) are reached. The adopted policies are based on subsidisation of investments, or of production by these technologies when they are near to commercial maturity, while the These devices are necessary because the units of Renewables Energy Sources in Electricity (RES-E) are not competitive with the large electricity generation units for three reasons: (i) their relative commercial immaturity; (ii) the absence of scale effects on transaction and production costs, due to their small size, which limits savings on preparation and realisation costs, and (iii) the random nature of their intermittent production with difficulty in programming of the production from some of these technologies (wind power, mini-hydraulic).

After learning from the experience of voluntary purchases of green electricity by consumers to frame the RES-E investments according to the market, as well as the experience of direct investment subsidies, the European countries and a several states in the United States and in Australia switched to one of the types of institutional mechanisms by organising indirect subsidisation of production. These devices have a common character: an obligation to purchase RES electricity imposed on clearly specified agents, or a quota to be respected. They are based either on buy-back tariffs guaranteed in the long term, on a system of auctions for the assignment of long-term purchase contracts at the proposed price (pay-as-bid), or on the system of quotas of exchangeable green certificates.

One of the most interesting cases is the Spanish one, because Spain has been one of the countries where major success has had the politics of support and promotion of the RES-E based on a mechanism of “feed in tariffs”. This success, nevertheless, has not taken place equally for the different sources of renewable energies, being the wind energy the one that has presented a major grade of development and the

photovoltaic and mini-hydroelectric those who less have fulfilled the targets of growth. This development of the wind energy has supposed that, in 2003, Spain was the second country of the world (after Germany) in installed power (4838 MW) and one of the first potency in the construction and operation of wind farms. The evolution of the retribution mechanism of RES-E has suffered a significant transformation since it has been passing to a less and less regulated system trying a major participation of the producers of in the spot wholesale-market although subject to a systems of incentives. On the other hand, the different players that take part on the Spanish electricity market and the territorial system of the Spanish State, allows us to do an interesting interpretation of these regulatory mechanisms of the RES-E in the frame of the New Institutional Economic's Tools and veto player theory. Finally, on the determination of institutional arrangements by transaction attributes, it is very significant the weight of some characteristics of the REE-E as the problems of intermittence of supply and the connection to the grid. In this sense, we will see the case of the wind energy in the Canary Islands, where, in spite of his magnificent conditions, it is not developing satisfactorily.

In this work we will analyze the device to promote RES-E in Spain in electricity generation and his evolution in the lens of the New Institutional Economy. To reach our target, the order of this paper will be the following one. In the second section it is analyzed the attributes of transactions associated with the development of RES-E production. There are described the principal actors and the levels that take part in the transactional analysis as well as the importance of the specificity of assets. In the third section we will interpret the evolution of the legislation to promote energy in Spain. This politics, faced finally to the promotion of the RES-E, has been based on a system of "feed in tariffs" that has evolved towards market mechanisms. In the fourth section we will study the factors that have not allowed a satisfactory development of RES-E in the Canary Islands. The paper closes with the main conclusions.

2.- The attributes of transactions associated with development of RES production

The Transaction Cost Theory takes account of the attributes of the transactions to explain and determine the institutional arrangement to adopt. The seminal authors note the different types of assets specific to the transaction (especially specificity of site and competence and temporal specificity), but also the uncertainty, complexity and measurability of the performance levels within the transaction. It is known that the main determining factor of the institutional arrangements in an uncertain environment and with external aspects present is the constitution of specific assets [Williamson 1996, Masten & Saussier 2002]. The empirical studies also show that frequency, complexity and external factors surrounding some transactions condition the choice of institutional arrangement. In generalising the transaction costs analysis to the government's choices of governance structures for leading tutelary policies, Williamson (1999) analyses the characters of political transactions to explain the choice between public bureaucracy and market, while passing by regulation and contract by delegation.

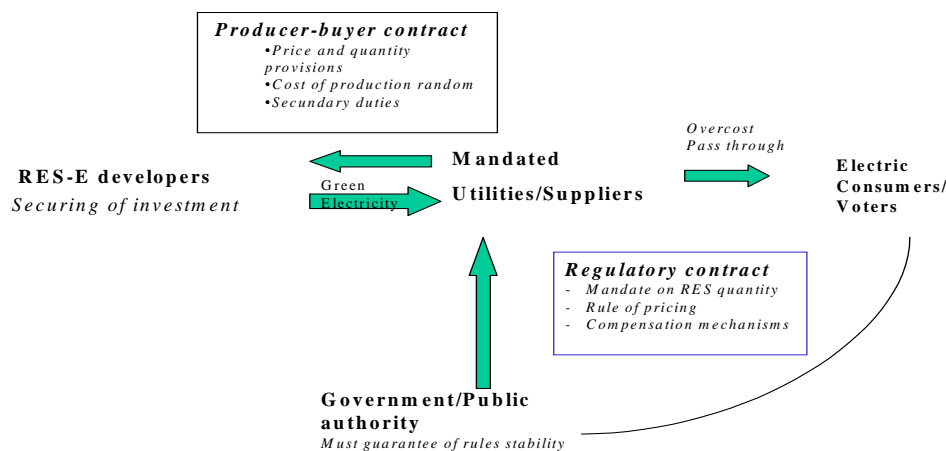
The different methods to promote RES production make up different hybrid governance structures that put together a regulatory contract between the public authority and the mandated purchasers on one hand, and contracts that bind the mandated purchasers and the producers who invest in RES-E units on the other hand. Finon & Perez (2006) have discussed the relative performances of the devices by reference to three criteria: transactional efficiency in relation to protection of investments in renewables in the long term, control of the collective cost and redistributive effects (rents) allowed by these mechanisms, and finally their capacity to stimulate technical progress and to sustain industrial policy in RES equipment manufacture. They have showed that none of the three devices (feed in tariffs, bidding and quotas) offers an optimal solution in each of these dimensions, and that according to the relative importance of the criteria, an adapted mechanism exists. But, "feed in tariff" mechanism has been most used internationally, having as principal advantage, the efficacy in the development of the investments and, thus, in the improvement of national industry in the sector of renewable energies. His worst characteristic is that may suppose an excessive cost for the electrical system and, finally, for the consumers. Next we study with major detail, from the transactional point of view, the main characteristics of this specific mechanism.

2.1- The players

Here, to identify the transactions organised around the RES-E promotion, we distinguish four groups of agents involved in several types of transaction between them around the promotion of the RES-E:

- The public authority that takes on the government's commitment to provide or preserve a set of collective goods through development of RES-E production.
- The electricity consumer citizens who call on the government to act for the preservation of these collective goods through RES-E development.
- The agents who will carry an obligation either to purchase green electricity or to respect a quota of physical RES-E, contractual RES-E and green certificates.
- Applicants for investment in RES-E.

Figure 1: General hybrid governance infrastructure for promotion of RES-E



The transactions associated with RES-E production between these agents are set at two levels. At the level of definition of public policies, political transactions concern the protection of a set of collective goods through RES-E promotion under the supervision of the government elected by the citizens. These transactions lead to the setting up of the device that organises stable indirect subsidisation of RES-E production. It is at this political transaction level that the public authority prefers regulation to market, given the limitations of green tariff programs or direct purchases of green electricity through green marketing to boost investment in RES-E for providing this set of collective goods. Regulation is also

preferable to public bureaucracy because of the institutional environment (in particular, the cultural reluctance of public power companies to develop decentralised generation before the market reforms in the nineties; and incompatibility with the market ruling of the sector after the reforms). It is also at this level that, once the choice of regulation is made between the various modes of governance, the public authority must choose between the three institutional devices that each correspond to a specific regulatory contract between public authority and mandated purchasers.

At the second level, the transactions concern relations between producers who invest in RES-E units and the mandated purchasers of their green electricity. The investors refer to the regulation set to define the contractual arrangements with the mandated purchasers in order to secure their investment and to attract lenders for establishing a project-financing contract. In the case of the quotas system, the transactions are more complex at this level because the system divides the green electricity into two types of goods: electricity that cannot be differentiated, and green certificates, which are property rights on environmental goods that are exchanged between green producers and purchasers subjected to quotas expressed in terms of green certificates that should be owned at the end of the year.

For these two intricate transactions, the specific nature of the assets and other transactional attributes such as uncertainty and external factors also exert a degree of influence.

2.2. - RES-E asset specificity to transactions between producers-investors and purchasers

At the second transactional level, between RES-E producers and mandated RES-E electricity purchasers, asset specificity depends on the institutional rules for mandated electricity purchases arising from the RES-E regulation and the legal rules for network access that condition the geographic specificity of assets.

The geographic specificity of RES-E assets

The regulation of the electric industries conditions the geographic specificity of the RES-E units and determines the rules for safeguarding the investments in RES-E. Thus, in the previous regulated public service monopoly set that does not allow purchasers to access the network and choose their suppliers and therefore differentiate the product according to the character of its production process, there exists a geographic specificity of RES-E asset. Indeed, RES-E producers are forced to sell to the electric utility that is in monopoly in the area where their units are located. They are therefore greatly exposed to the risk

of hold-up, which leads the public authority to impose a purchase obligation and payment of an administered price to the local monopolies in return for the passing of the additional cost of the subsidised green kWh (that is, the difference between this price and the wholesale electricity market price) to their retail tariffs.

The market deregulation rules change the deal. The provision of third party access that fundamentally modifies the property rights over physical network capacities erases the supply monopoly and suppresses the geographic specificity of RES-E assets. RES-E producers can now reach voluntary purchasers. Therefore, a regulatory or legislative decision is necessary so that the RES-E unit's production is removed by the local or regional distributor-supplier and paid according to an administered tariff over a guaranteed period.

The temporal specificity

A second type of asset specificity concerns some RES-E technologies (wind power, mini-hydraulic) that are bound by the intermittence of their production; this means the weakly programmable character, based on meteorological risk, which cannot be managed by storage because of the nature of electricity. The meteorological risk, superimposed on the normal operational risk, compels the RES-E producers engaged in real-time contractual sales to search for compensatory electricity to balance their contractual load as per the provisions of the arrangement. Intermittence of production generates a problem of instantaneous adjustment of physical supply to the quantities that must be contractually provided to the purchasers.

Under the regulated monopoly regime, this problem was settled by the monopoly purchase obligation, which imposed the responsibility of real time balancing due to intermittence. On the deregulated electricity markets, where RES-E production is treated as normal production on the organised wholesale markets, the market players must advise the system operator several hours in advance of the quantities that they will produce or buy. The costs of technical adjustment by the system operator, associated with all physical imbalances in contracts between producers and buyers, are not grouped together anymore and mutualised, as in the old monopoly situation. The market logic leads to real-time individualisation of responsibility of actors involved in bilateral or multilateral transactions, despite the need for general system stability. They therefore bear responsibility for the instantaneous balance between injection of

their production into the electricity grid and off-takes by their purchasers. One level of the organised markets, the intra-day market of balancing, is dedicated to gathering offers of instantaneous increase or reduction of producers' injections (or conversely of purchasers' off-take) in order to allow the system operator to assure balance of the system in quasi-real time. However, the price of balancing does not reflect the marginal cost of adjustment, because the market rules give it the function of deterring producers and purchasers from being in physical unbalance in real time. Moreover, mutualisation of balancing costs due to intermittence of RES-E production becomes impossible if some market rules are not dedicated to RES-E production transactions.

If the priority of RES-E promotion does not balance the electric markets' efficiency objective, the organisation of these markets can be defined in terms of ignorance of the specific features of the ENR units' weakly programmable production, as was evident in the UK in 2001 when the new market rules (NETA) were implemented (Mitchell & Connors, 2004). It depends on two particular rules: the period between gate closure and realisation of the transactions, and the balancing prices that the system operator calculates for balancing the shifts between producer's offer and realisation. In the first place, the gate closure period can be chosen mostly as a precaution (3½ hours in Great Britain in 2001). This creates a recurrent risk of shift between the announced RES-E unit production and the production achieved. In the second place, the general electric market efficiency objective that leads the electricity regulator to limit load unbalances leads the regulator to define price incentives for the producers to self-balance the load in real time between their production and their contractual sales, This explains the difference between the balancing prices and the actual average costs of the adjustments for which RES-E producers are jointly responsible.

Because of the difficulties in forecasting their production three hours in advance, RES-E producers are therefore doubly penalised beyond the reality of the overall balancing costs that they cause. In this case, therefore, the system operator captures the quasi-profit from the RES-E production because of the rule of market closure. Indeed, this market rule can so depress the value of this production that one is deterred from investing in RES-E (Mitchell & Connors, 2004; Menanteau & Finon, 2004).

Temporal specificity which is associated with strong real time externalities therefore generates transactional complexity and creates uncertainty. It obliges one of the other contractual parties to commit to assuming the production risk *ex ante* in order to suppress the risk of hold-up associated with the weakly programmable character of the RES-E production.

How to cope with externalities

Before concluding on the determination of institutional arrangements by transaction attributes, let us note the importance of externalities via the intermittence of supply, and uncertainties. These ones are common or specific to the two transactional levels. They are of various types, at the first level the regulatory risk (changes of rules), at the second level the technological risk on the investment costs and the performances of the plants. These risks can be more easily assumed in a device granting the environmental quasi-rent to the developers of RES-E units.

The hybrid governance structure to be introduced should therefore take account of the original forms of the specific asset features, the uncertainty over how they will affect the transactions, and the management of externalities. They direct the choice of the most efficient institutional arrangement. The definition of transaction attributes now allows analysis of the various governance structures and determination of the most efficient one for offering the guarantees necessary to the investors while limiting the risk of excessive appropriation of quasi-profit by any of the parties. Three elements will influence the efficiency of each device and the level of transaction costs:

- The content of the contractual relations between public authority and mandated purchaser, which can go so far as to determine the relation in quantity and price between producer-investors and purchasers.
- Securing of the investments allowed by each of these arrangements, when at the second level the RES producers and mandated purchasers have the opportunity of choosing between various types of arrangements (this is the case with the quotas system).
- Within these institutional arrangements, the possibility of sharing the balancing costs for the weakly programmable productions in deregulated electric industries.

2.3.- The hybrid structure of governance of the feed-in tariffs

We consider successively the regulatory contract and the contract producers-mandated buyers.

The regulatory contracts

In the feed-in tariffs system, the regulatory contract compels the regional distributors or suppliers to buy the RES-E units' electricity at an administered price much higher than the wholesale price. The guaranteed prices are defined for a given technology and guaranteed for a period of 10-15 years, for every unit installed according to the level of this price signal. This principle allows discrimination between RES-E technologies, the tariff levels being adapted to each one according to their respective degree of maturity.

In the former monopoly regime, the additional cost of a RES-E purchase is compensated when it passes through the tariffs; this ensures the indirect subsidisation by all electricity consumers. In the market regime, in which the suppliers who bear the obligation are in competition, the additional cost compensation is an important provision of the regulatory contract; repayment is made through a special fund financed by a tax on every kWh transported and thus passed mechanically to all consumers.

The contractual arrangement producers-mandated buyers

The second contractual arrangements that govern transactions between developers and purchasers offers clarity and simplicity to developers. It was Langniss [2001] who underlined that these transactions rest completely on the regulatory contract that is the basis for the public authority's commitment when set at the first level. The first allows reduction of all transaction costs for setting up and following up the producer-buyer contract. There is no producer-purchaser co-ordination via prices and quantities, to the extent that frequently there is no explicit contract [Langniss, 2001], as the German and Spanish experiences show. In terms of governance structure, the mandated agent acts as an agent of the public authority assigned to remove green electricity produced in its area while repaying itself by passing the cost to the tariffs or by subsidies financed by a general tax on transported kWh.

So the producer-buyer contract is thus defined by advance in price. With regard to volumes, the purchase obligation means the mandated companies do not know *a priori* the quantities that they should take in future. In real time, they must assume adjustments of delivery in relation to the random nature of the

production (wind, mini-hydraulic) by the RES-E units concerning them. The producer-buyer relation is therefore codified by the regulatory contract, so that the purchases need not be formalised in a formal contract, except for technical conditions and method of settlement.

In this governance structure, the risk of opportunism by the public authority exists, consisting mainly of discretionary decisions to review tariffs for existing facilities or those in construction. There could also be a risk of opportunism in complete revision of the regulatory contract, but this change will not affect the former investors if it maintains the former arrangement for them in terms of guarantees over off-take and prices relating to RES units. This change only affects investments by RES-E unit constructors when the units are dimensioned in relation to optimistic market development predictions directly linked to the level of incentives created by the feed-in tariff system.

Finally in this governance structure, the risk of hold-up lies only in the regulatory contract. The risk is placed either on the level of the purchase tariffs, which can be changed on a discretionary basis, or on the device itself, which can be replaced by another device. In cases of radical change, the stability of the second contract, that is, feed-in tariffs and off-take, is called into question for the RES-E assets. There is therefore a need to guarantee upholding of the previous rules for these units when institutional change occurs.

3.- The Spanish case from 1986 to 2004: Constant Legislative incentives for RES promotion via generous “feed-in tariff”.

Spain political support to promotion of energy sources development is not very new. National Energy Programs (PEN) are a classical tool in Spain to define the energy policy from the energy crisis of the seventies. The emphasis has changed from a policy directed to the implantation of the nuclear energy in the eighties, to other one whose target is the promotion of the renewable energies in the horizon of the year 2010. In appendix 1 we can see the evolution of nuclear energy in Spain.

The PEN, approved by the parliament, are institutional productions approved by the Parliament and they stipulate the anticipated demand, the sources of the production and the nature of the investments which will have to be carried out to face the demand. These PEN faced many problems with the private and public operators coordination because macro-economic planning carried out, included heavy errors of in

demand forecast, and because they are mandatory. The PEN generally forecast demand rises too important, which proved to be financial pits for the regulated companies held to achieve the goals laid down by the plans. This profitability crisis was then transformed thereafter into financial crisis for the regulated electricity operators¹.

<i>Tableau : la présentation des Plans Energétiques Nationaux</i>			
	Premier plan	Deuxième plan	Troisième plan
<i>Adoption</i>	24-janv-75	03-mai-78	09-avr-91
<i>Période</i>	1975-1985	1979-1992	1991-2000
<i>Hausse de la demande anticipée</i>	10% par an	4,7% par an	50% sur les 10 ans
<i>Investissements prévus</i>	23 centrales nucléaires	Orientation vers nucléaire 10 centrales et production au charbon	Energies renouvelables
<i>Date de l'échec</i>	Vers juin 1975	1984	
<i>D'après Cross [1996]</i>			

From Nuke to RES

This and a new 1989 plan focused on demonstration and application projects (European Renewable Energy Council, 2004, Renewable Energy Policy Review Spain, May 2004). By an early start continuous & generous feed in tariff policy in RES promotion, Spain is showed as a RES politic success story. The introduction of feed-in tariffs for various classes and capacities of technologies followed a period of planning that had started out back in 1986. In 1986, the 'First Renewable Energy Plan' presented targets for production from renewable energy and targets for private and public investments in renewable energy systems. This change of orientation in the Spanish national energy policy will be the reasons for the requests of the operators to be compensated and they have received large amount of money according to costs for transition to competition policies.

The last PEN is different and emphasis the renewable promotion according to new public concern about environmental issues. In 1991, the new National Energy Plan (PEN) included a 1991–2000 Energy Saving and Efficiency Plan, setting overall targets for energy production from renewable energy sources to 1.1 Mtoe/year by 2000, increasing renewable electricity production to 4.2 TWh/year and thermal

¹ This situation is also accentuated by the presence of two exogenous financial phenomena. Investments financing was done by the emission of debts in foreign currencies (dollars & DM increases value) and the rise of the national interest rates (increasing also).

energy to 0.5 tMtoe, comprising 35 % increase from biomass, 9 % from small hydro, a planned target for solar collector area for 2000 of 400,000 m²/year and installed wind capacity of 168 MW.

On the economic ground, the far more generous and stable governmental support for renewable energy in Spain is connected to the feed-in tariff system that was made the major pillar of its renewable energy policy. Between 1980 and 1994, the market introduction of RES-S, was supported for governmentally guaranteed purchase for individual projects (only a specified target group defined in the RD 82/1980 Energy Conservation Law) a third-party financing by IDAE and investment subsidies. From 1994, through the so-called 'Royal Decree 2366, the RES-E device was set up in the definition on the mandated contractual purchase of electricity by the companies and of the rules of buy-back tariffs definition. The average tariff to be paid by distribution companies was based on avoided costs of generation, transport and distribution. Average feed-in rates to be paid for electricity from biomass were around 6.5 Eurocents/kWh, 7.4 eurocents/kWh for wind power, PV and small hydroprojects.

Motivated by the liberalization of the sector from the LSE 97, the politics of RES-S promotion faces something more towards market rules but trying to support certain regulative stability. RD 2818/98 enabled renewable energy producers to choose either high fixed feed-in tariffs or a system of lower premium price on top of the market price². Reformulation in 1997 ensured a payment equivalent to 80%–90% of the retail rate (almost 8 US cents/kWh), to wind energy producers; price support was to be revised periodically. In 1999, the Spanish government adopted the Promotion Plan of Renewable Energies ('Plan de Fomento de las Energías Renovables en España'), calling for a doubling of the share of renewable energy in the primary energy supply quota from 6 to 12%. The main areas considered by the plan were biomass, wind, hydropower, solar and urban solid waste. By 2000, the premium tariff amounted to about 3 Eurocents /kWh for most renewable sources and even 36 Eurocents/kWh for small-scale solar plants (Sijm, 2002:12). The fixed feed-in tariffs were in the range 6.05-6.85 Eurocents/kWh for technologies

² Thus, the RES-E device was integrated by the law of liberalization of the electric industry of 1997. It is integrated in the particular regulatory niche of the "system of independent production" created beside the new regulatory system of "ordinary" electricity competition. This RD supported the obligation of purchase of decentralised production by the large regional producer-distributors that can be reinforced by direct subsidies on the investment and tax subsidies at the central and provincial level (for example the Galice Region where more half of the capacity of windpower is developed).

other than solar PV, which received 39.6 for installations below 5kW and 21.6 for larger installations.

Tariffs were specified for plants < 50 MW.

In March 2004, new feed-in tariffs regulations were adopted (RD 436/2004), giving renewable energy producers two remuneration options: sell output to the distributor at regulated (feed-in) tariff; or sell output directly in the market at the market price plus an incentive and premium, as well as a capacity payment. The changes from 1997, in which renewable energy producers could voluntarily choose a support system related to market prices, must be seen in connection with Spain's gradual turn to less government intervention in the market mechanism, in the mood of the new electricity directive imposed by the EU. This RD tries to reach also another two targets. Firstable, the stability of the system of compensation from a lasting and transparent regulation, indexing the system of premiums to the new methodology of calculation of the of reference electricity fee that the RD 1432/2002 has provided. Secondly, to increase the profitability of those renewable energies that have not been developed since it was foreseen such as the photovoltaic or the biomass.

The 2004 changes have given new incentives for using the option of offering wind power directly to the spot market, with the clear intention to 'reduce administrative intervention in the setting of the prices as well as to allocate better and more efficiently the costs of the system' (EWEA, 2005:). Until this change in policy, most producers had chosen the fixed tariff system, simply because it provided a better deal and less uncertainty over future income. The higher spot prices in Spain by 2005, due to low precipitation and reduced hydropower in the market, led many producers to accept higher risks and choose the spot-market option instead. Nevertheless, by keeping the fixed feed-in tariff option intact, Spanish policymakers showed that they would not surrender to policies that could jeopardise rapid market diffusion.

We propose here to interpret this continuous legislative production according to New Institutional Economics' Tools and veto player theory.

The Spanish case of a hybrid multi-veto player: the stability of the costly device based on a generous rent sharing policy³

³ The Spanish case study is based here on the evaluation of the Spanish device carried out by Del Rio P. et Gual M.A (2005) . in « An integrated assessment of the feed-in tariffs system in Spain », Working Paper, Universitat de Castilla (Toledo), forthcoming in *Energy Policy* (2006).

The 1978 Spanish Constitution, while reserving for the state exclusive rights over general economic planning and legislation governing the energy system, gave the country's 17 Autonomous Regions far larger leeway than before in developing administrative procedures and planning provisions related to, among other matters, the environment (IDAE, 1999). The Constitution recognises the right of the autonomous communities to have financial autonomy 'for the development and enforcement of their authority'. These communities receive revenues directly and indirectly from central government sources as well as from their own local taxes, special levies and loans. Several of Spain's Autonomous Regions have been highly aware of the opportunities of wind power in terms of regional industry policy and employment. According to Del Guayo [2001], there exists a tension between the local authorities and the central government aiming to the increase in the delegations of sovereignty towards the local level. Article 149 of the Spanish Constitution of 1978 establishes a framework of 32 exclusive competences of the central government⁴.

<i>Tableau : les compétences exclusives de l'Etat espagnol en terme économique.</i>
Art. 149.1.10 : Les environnements douaniers et tarifaires. Le commerce extérieur.
Art, 149.1.11 : Le système monétaire, les devises, le change et la convertibilité. Les bases de l'organisation du crédit, des banques et des assurances.
Art. 149.1,13 : Les bases et la coordination de la planification économique générale.
Art. 149.1.14 : Les dettes et les finances de l'état.
Art. 149.1.21 : Les chemins de fer et les transports terrestres qui traversent le territoire de plus d'une Communauté Autonome ; l'environnement général des communications, des postes et des télécommunications. Les câbles aériens, maritimes et la radiocommunication.
Art. 149.1.22 : Les autorisations d'effectuer des installations électriques lorsque l'approvisionnement en électricité en affecte une autre communauté ou lorsque le transport de l'énergie excède les limites du territoire d'une communauté.
Art, 149.1.23 : La législation fondamentale sur la protection de l'environnement sans préjudices des facultés qu'ont les communautés autonomes de définir des règles additionnelles.
Art. 14.1.25 : L'environnement des mines et de l'énergie.
Source : Moderne - Bon [1981].

This article results in to leave only little place to the autonomous communities in the management of Spanish electricity sector. Those have a competence only in three cases: the management of the complaints of the consumers at the local level; the introduction of additional local taxes relating to provisions of environmental protection; and finally, right to follow a regional policy of energy promotion

⁴ : This framework seems to be very favourable in terms economic and electricity regulation to the central government.

in agreement with the national energy plan (PEN). For RES promotion the later point is crucial, because it leave option open to local authorities to build and operate a RES strategy.

Basically in term of institutional environment in the Northian sens, Spain has a hybrid system of government centralization and a sort of limited federalism (Weingast, 1995), the government has important means in industrial policies and decision making in regulatory design in strategic sectors such as the whole regulation of electricity industry and regulation; it can legislate by decree. The regionalization of the political institutions acts in an asymmetrical way onto the reinforcement of public policies defined at the central level: it does not allow the reduction of policies initiated by the central level, but authorizes the increase in public commitment and regulatory support by the Provinces (Perez, 2002). It is the case of production of the environmental policies and thus of the promotion of renewables and decentralized production by cogeneration are characterised by moderate multi-veto player. Note that Sector regulators for electricity have only an advising function to the ministry of industry.

The RES-E system has got a significant efficiency in terms of installation (with 8000 MW installed in windpower between 1995 and 2004). It is expensive and dispenser of rents because of high tariffs of purchase. It was occasionally criticized like too expensive by electric industry (Del Rio and Gual, 2005 and Libro Blanco de la Energía Eléctrica en España), but it is stable. It did not attract real hostility from the electric companies because the mode of regulation allows the pass-through of all the overcosts on the electric prices and tariffs. It was not called in question during the right-wing government period between 1996 and 2004. This stability is based on the agreement of the large companies and their principal ally, the Ministry for industry.

The agreement of large companies is explained for two reasons. Firstly the policy of RES-E promotion compensates for the impossibility of carrying out nuclear investments since the end of eighties, and is perceived as recourse to respect the objectives of the Spanish climate policy. Secondly the device is coherent with the usual rent mechanisms in the Spanish electric market: indeed the revenues are collected by the RES-E producers who are mainly the subsidiaries of the 4 major electricity operators, which themselves benefit from considerable rents of the electric system (stranded costs, price making on the wholesale electric market). In other words the stability of the device is ensured by the attribution of rents

to the incumbents⁵. An internal characteristic ensures also its credibility by getting flexible from a rule of annual adjustment of the premiums of feed-in tariffs compared to the wholesale price and by the relatively short duration of purchase obligation (5 years instead of 12 or 15 years in other countries), which facilitates the flexibility of the device. The arrival of a new government in 2004 also led to a revision of the device to improve its foreseeability for the RES-E investors.

It should be noted that the Spanish Provinces have a role of veto player to any change of policy of RES-E promotion to ensure by a right registered in the Spanish constitution of 1978. Their powers on economic and industrial issues allow them to animate local economic activities. It was the case of the Galice and Navarre for the development of a local manufacturing industry of windmills, which have use subsidies conditioned to the development of local employment.

The veto player which emerges from the creation of a RES-E manufacturing industry limits the possibility of change of the device towards a new one which would leave less rent and create less opportunities of industrial development, as it is also the case in Germany⁶. It is followed from there that the passage to the device of the quotas which was discussed in Germany in 2000 and will be again is not discussed in Spain, despite the European procedure of harmonization which aims at a unification of the RES-E devices between country. The Spanish institutional environment thus creates an effective incentive structure for the developers of RES-E by insuring a stability corrected by an adaptability of the device in place.

4.- Why not the high potential wind power is exploited in Canarian Island?

The energy system in the Canaries presents significant singularities derived from a limited self-sufficiency, isolation from other systems, and territorial fragmentation which imply a greater energy

⁵ According to Eikeland & Sæverud (2006), among incumbent energy producers, both major national companies Endesa and Iberdrola are now investing intensively in renewable energy. Iberdrola, Spain's second largest energy company, has become the biggest owner of wind farms in the world (more than 3,000 MW), with the Navarre Company EHN wind-power developer currently taking third place (IEA, 2005:113). Endesa, with its installed capacity of more than 1,100 MW, was by June 2005 the owner of around 20% of total installed wind-power capacity in Spain. Hence, Spain's renewable policies seem to be more about additional opportunities than the redistribution of resources among national actors. This is of course connected to the gap between growing energy demands (nearly 6% growth per year in recent years) and poor domestic supply situation (OECD 2004:45). Unlike the UK, Spain does not have a strong domestic fossil fuels industry that might feel threatened by strong support schemes for competing energy sources. Spain's small oil and gas industry contributes less than 1% to domestic demand for each of these fuels (IEA, 2005:22).

⁶ However it is not a sufficient condition so that this veto player prevents a change of policy. In Denmark where a significant industry of construction of wind mills was developed under the effect of a generous policy combining buyback tariffs and defiscalisation of green electricity, the right wing government arrived in 2002 decided to stop the subsidization for new projects

vulnerability than the rest of the state and the European Union (EU). The energy system in the Canaries comprises 7 main islands off the Moroccan coast, with 6 systems isolated by more than 2000km from the Spanish mainland, and which supplies a population of 1.9 million inhabitants, mainly concentrated on the islands of Gran Canaria and Tenerife. The degree of energy dependence on outside sources in the Canaries is almost as absolute as the diversity of said sources is scarce, with petroleum and its derivatives representing 99.56% of the total primary energy usage. These values are conditioned by the structure of the electrical generation sector, which relies almost completely on the use of petroleum-derived fuels.

Likewise, the energy policy of the archipelago is shaped by the worldwide energy situation, characterized by medium and long term petroleum and natural gas shortages, as well as by the impact of measures designed to avoid climate change. The agreements reached in the Kyoto Protocol to reduce the emission of greenhouse gases (GHG) will have a decisive influence on the energy policies of the signatory countries, as is the case for the EU. In Spain, the National Plan for the Assignment of Emissions Credits 2005-2007 (RD 1866/44 of 6 September) outlines the efforts that various economic sectors must undertake in order to comply with the Protocol limits specified for each country in EC Directive 2003/87. This directive also establishes a framework for the trading of GHG emissions credits.

In the case of the Canaries, the effects of these regulations are under moratorium until natural gas is introduced for electricity generation. All of these elements are reflected in the Energy Policy of the archipelago as expressed in the Canaries Energy Plan 2002 (PECAN 2002) which considers, among others, the objectives which affect the medium and long term planning of the electricity sector.

Year	OIL	NATURAL GAS	RENEW.	WASTE (BIOGAS)	Total
2003	5.135.474	0	41.123	8.808	5.185.405
2004	5.215.310	0	42.340	11.718	5.269.368
2005	4.985.454	0	139.558	14.112	5.139.124
2006	4.956.337	0	184.606	17.781	5.158.724
2007	4.610.243	397.644	186.616	26.291	5.220.795
2008	4.605.268	395.760	217.976	28.567	5.247.570
2009	4.196.343	833.568	221.098	34.455	5.285.465
2010	4.283.213	878.276	224.265	34.358	5.420.113
2011	4.323.723	881.047	255.291	34.023	5.494.084

PECAN 2002

To this end the plan emphasizes the diversification of supply sources, energy savings through efficient use, and a boost from endogenous energy sources. The main elements provided for in the PECAN 2002 which affect the electricity sector are the introduction of natural gas and the increase of generation by renewable energies. The use of natural gas will take place through the use of combined cycle plants until it represents 15% of the balance of primary energy in the year 2011, which would mean 64% of thermal electrical production. This fact implicitly acknowledges that the substitution of fuel in the Canaries by alternatives such as coal or nuclear is not possible for size reason. As for renewable energies, it is thought that they will represent 26% of electrical production, with installed wind generation growing from 134,565 kW in 2003 to 892,780 kW in 2011 because canarias enjoys a capacity factor of 32.37% that represents 2836 hours in 2004.

Although this is an alarming energetic situation, Archipelago enjoys an abundant supply of renewable energy sources, principally from the wind and the sun. The wind resources are particularly high, both in terms of their intensity and constancy. The programme named *Canarias Eólica* was formulated in 1987 for the large-scale exploitation of wind energy in the Islands. As a result of the work that was carried out within this programme suitable areas for the exploitation of wind energy were selected like is shown in the following table.

Table X: data on the Canarian Islands ability to have wind power energy						
	Suitable areas for wind energy exploitation	Exploitations areas as a percentage of island areas	Average long wind speed V(m/s)	Average obtained energy (MW)	Maximum exploitable wind power (GWh)	Maximum power that can be fed into the island's power Grid (MW)
Lanzarote	8	0,94	5,5 - 7,0	74	169	15
Fuerteventura	7,5	0,45	7,0 - 8,0	70	178	13
Gran Canaria	25	1,63	6,0 -8,0	232	530	106
Tenerife	8,5	0,42	6,0 - 8,0	79	192	90
La Palma	4,5	0,64	5,5 - 7,0	41	100	5,5
La Gomera	1	0,37		8	20	0,66
El Hierro	2,2	0,6	7,5 - 8,5	19	66	0,28
Total	56,7	0,72	5,5 - 8,5	523	1255	230,44
source: Calero & Carta (2004)						

In the areas proposed, the average long term wind speeds varied between 5.5 and 8 ms; the intensity, regularity and constancy of the recorded winds place these areas among the best in Europe from a

practicable point of view. The electrical stability restricted the amount of wind power that could be connected to the grid on the various islands to the values shown in last column.

The conclusion was that wind energy, through the exploitation of wind farms connected to the island's grid, could satisfy (in the year 2000) more than 8% of the energy consumption for the islands as a whole. The wind energy penetration could be increased to 35% of total electricity demand using isolated wind farms to replace all conventional potable water production of the islands in the year 2000. The economic analysis, using life-cycle costing methods concluded that the cost per kWh of wind source energy was extremely sensitive to the average wind speed and was reliant on the technology employed and other related parameters (discount rate, operation and maintenance cost, subsidies, etc.). Without subsidies, the estimated cost was between 0.04 and 0.06 Euros per kWh.

The continues and detailed communication of the technical and economics results obtained with this plan together with the purchase obligation all the non storable wind energy generated for the distribution company, turned out to be the first incentive for the private business sector to involve in the exploitation of this energy source. Another incentive for the implementation of wind farms was the provision of investment subsidies from the VALOREM programme (30%) and the Autonomous Canarian Community (25%). Electrical energy from wind sources was 0.008% of total electrical energy in 1990, while in the year 2000 was 3.53% with an installed power of 105.6 MW and a total production of 243 GWh. In 1994, Canary Islands was the second among the 17 Autonomous Spanish Communities in total installed wind power, and the proportion of total installed wind power for all Spanish territory was 34.66% (only 4.73% in 2000).

Nevertheless, this favourable tendency has not been supported from the year 2000 in Canaries in spite of the ambitious plans fixed by the PECAN 2002. The *Plan of Renewable Energies 2005-2010* (PER) places a target of increase for Spain of 12.000 additional MW between 2005 and 2010. This would suppose finishing the decade with an installed entire power of 20155 MW. The realisation of these targets in Archipelago supposes an increase of 494 MW going on from current 136 MW to 630 MW in 2010. As consequence of the competences of the regions on the arrangement and energy planning in his ground, some of them have prepared their own Energy Plans, being, in all the cases, more important than the

realized ones in the PER. The sum of these regional plans, complemented with the regional PER. who has not proper planning, supposes an entire installed wind power of 37.000 MW about 2012. Especially ambitious are the targets raised by some regions as Canaries which target is to reach 893 MW in 2010. Nevertheless, the targets of the PECAN 2002 are not fulfilled. In the year 2005 a wind power installed of 506 MW was foreseen, which supposed an increase of 370 MW in the year 2004. Nevertheless, the reality indicates that practically the same capacity has been supported from the year 2002 (136 MW). For this reason, Canary Islands have lost relative weight in the development of the wind energy with regard to the national average.

What factors explain this non-performance?

The Canarian Islands problem is interesting to understand deeply because it reveals the necessary conditions of success for the development of the promotion of renewable energies within Spain. Because, the Spanish model is often seen as an example, it is interesting to study its internal limits. To account for the difficulties of the wind development, we will distinguish four axes which are proposed in the economic literature to explain the failures of the mechanisms of promotion of renewable energies: first is the problems of incentive, second the problem of bad designed regulation and the induced lack of transparency, third the technical problems caused by massive wind power introduction into the grids, and finally, the problem arising with a fully integrated industrial structures and of lack of unbundling in Canarian industrial structures.

Is it a problem of bad incentive mechanism?

Like the rest of Spain, Canarias enjoy a very generous and stable feed in tariff mechanism to promote RES-E. As we have already quoted, by 2000, the fixed feed-in tariffs were in the range 6.05-6.85 Eurocents/kWh for technologies other than solar PV, which received 39.6 for installations below 5kW and 21.6 for larger installations⁷. In March 2004, new feed-in tariffs regulations were adopted, giving renewable energy producers two remuneration options: sell output to the distributor at regulated (feed-in) tariff; or sell output directly in the market at the market price plus an incentive and premium, as well as a capacity payment. This market option is not relevant for Canarias wind production and the ability to

⁷ : Tariffs were specified for plants < 50 MW.

'reduce administrative intervention in the setting of the prices as well as to allocate better and more efficiently the costs of the system' (EWEA, 2005) is not possible, according to the geographical constraints. The continues and detailed communication of the technical and economics results obtained together with the purchase obligation all the non storable wind energy generated for the distribution company UNELCO, turned out to be the first incentive for the private business sector to involve in the exploitation of this energy source.

As a partial conclusion, in our view, we can conclude, as **the high number of potential investors in wind energy clearly shows also**⁸, that there are no incentive problems for investment in RES-E in Canarias.

Is it a problem of bad designed regulation and the induced lack of transparency?

We can distinguish two problematic dimensions in the scheme introduced to support the mechanisms of promotion of the RES-E which illustrates the lack of transparency on the real conditions of effectiveness of the Spanish model: the first level relates a problem of coordination between national and local economic rules; the second problem relates to the "had hoc" character of the safety requirements elected by the incumbent company to manage the renewable energy insertion within the networks.

The problem of coordination between national & local or regional rule makers is a classical problem.

Moe (1990), Levy and Spiller (1994), Weingast (1995) on the one hand, have showed the condition that good local and national coordination between different rule makers can lead to economic stability (if properly suited). On the other hand, Perez (2002) and Macintyre (2003) have showed the extreme case of rule making within two levels of governments leading to institutional paralysis. Here as noted by Finon and Pérez, (2006), regional and national authorities play a complex role in the promotion of RES-E technologies in Spain. Region and Nation have important role in the deployment of RES-E in Spain but there are certain bureaucratic and administrative coordination problems between national and regional administrations as the Canarian example illustrate well that lead to a lack of economic transparency for the support of RES-E technologies.

⁸ : The auction for the first round of 2005 wind installation have been raised by about 4 000 MW. Privates investors willing to invest is clearly not the main problem. At the end of this auction process, nothing happen concretely. The whole process has been cancelled according to a corruption problem raised by police investigation.

In Canarias a conflict of competences has taken place after the approval of the LSE 97, between the State and the Autonomous Region, still not completely solved by the Constitutional Court, as regards the planning and collaboration in the management of the energy sectors. Equally, a delay has taken place in the development of the state laws in his adaptation to the extra peninsular territories as regards the functioning of the electrical system and the compensation of the activity of generation. As there indicates the “*Libro Blanco de la Energía Eléctrica*”, the development of the RD 1747/2003 has not done fully and must be done in accordance with the affected CC.AA as the LSE 97 indicates.

This regulatory uncertainty faced in all Spain, is a bigger problem in Canarias, because of the isolated and independent network characteristics. Without the automatic solidarity provided by the UCTE networks, technical problems arise more frequently in small systems and the lack of a specific Canarian Law of Energy and the absence of an Independent Canarian Energy Agency⁹ able to deal with this specific problems can also be noted¹⁰.

Safety requirements and RES-E technologies in small electric systems

The insular nature of the electrical supply networks makes them more difficult to manage for two reasons. First, as the size of these networks is limited, they are weaker to impacts and risks. Indeed, each element constituting its small networks is very significant for the entire grid. So the loss of a group or the loss of a single element of the network is felled in a much stronger way than on a network of more significant size. So the first adjustment between “power and frequency” is thus more difficult there to achieve. Moreover, as the electric distances are small, the voltage drops have an effect on the all network (Weisser 2004a & b, Ramos-Réal & Perez 2004).

The second problem of these networks is that they must be managed in an autonomous way, with technical rules adapted individually, and that they do not profit from the immediate solidarity offered by the size effect of the producers connected on the large continental network. As each island is a very specific network (function of the surface, number of inhabitants, economic activities, climate...) it is very hard to define transparent management rules or even clear safety rule according to the network

⁹ : Thus there never has a local public body specialized in energy planning which could carry out a control of the achievement, gives adapted objectives and then propose correct measurements.

¹⁰ : Note also that, the PECAN 2002 was not even approved by the local Parliament.

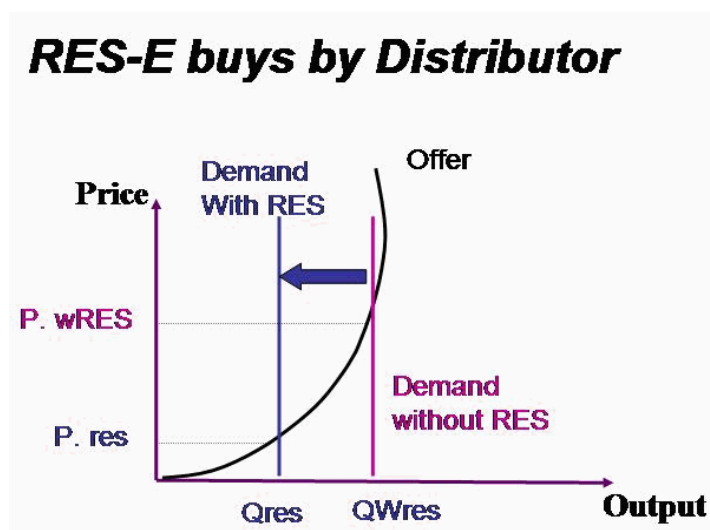
specificities. The comparison of the ongoing safety requirements of some isolated electric systems shows a high diversity which is very difficult to determine how the rules are really in adequacy with the sole security problem. See table:

	Installed capacity in MW	Pick of demand in MW	Security margin in %	Transmission grid	Distribution grid in kv	Rules for primary reserve
Guadeloupe	358	218	61	63 kv 385 km	20	modular rule of delestage according to the lost group
Cyprus	990,2	775	78	66kv 324 km 132 kv 711 km	11	2nd group in reserve or 10% of the total
Crete	703,9	471	67	66kv 15,5 km 150 kv 501,3 km	20 and 15	The largest group or all the wind production presents at time T
Mallorca-Menorca	1098,2	914	83	66kv 690km 132kv 158 km 220kv 163 km	15	50% of the largest connected group
Ibiza Formentera	197	169	86	66kv 51km 30kv 59km	15	
Lanzarote-Fuerteventura	345,89	212	61	220kv 162 km 66kv 905 km	20	50% of the largest connected group
Gran Canaria	860	552	64		20	
Tenerife	774,5	540	70		20	

The principal insight of this comparison is to reinforce the opinion of "*Libro Blanco of Energía Eléctrica (2005)*" which estimates that the safety margins required in the Spanish islands are too restrictive. The opinions expressed seem to be robust to the comparison we made, and if we are right, we can then interpret the safety requirement as a barrier to entry to wind technologies in the network.

It is advisable here to stress that the introduction of massive wind energy on insular networks is not easy matter to achieve, because that increases the difficulty of management of these fragile networks. These problems are related to the intermittent character of the wind production which is not easily foreseeable in a horizon of a few hours. Moreover, this type of production is known as "fatal", because it is necessary to use it at the time produced or to lose it. Taking into account these characteristics, this type of technology cannot be mobilized for the adjustments of power and frequency or to provide reactive energy to the network. Moreover having priority on the network, the wind power producers modify the rules of operation of the whole network. The conventional producers must adapt their production curve to the real times fluctuations of wind energy production. So the rules used to call the power stations are modified to come after this priority energy.

This modification of the merit order does not go without over costs and redistribution effect because certain power stations previously being called will not be so often call, or being call under more stressed pattern of use. So the incumbent producer faces an incomes dropping and its costs of operation are increasing (ratio fixed costs/variable costs increases). For incumbent producer, wind energy introduction is like a drop in demand, and have the same basic economic effects see next figure.



Source Maupas F. (2006)

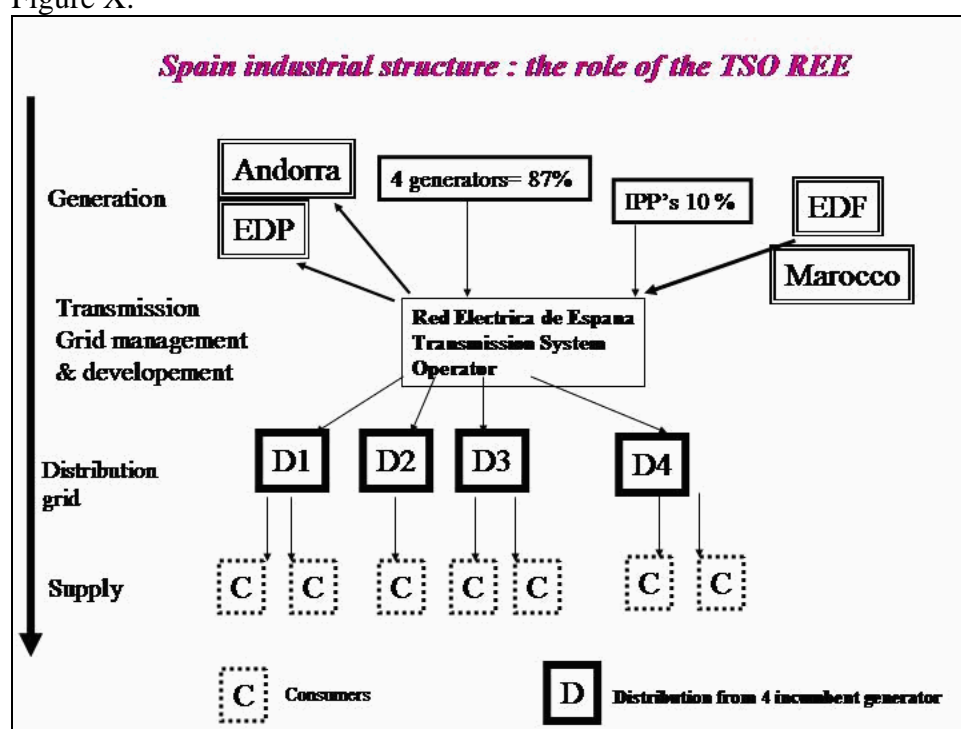
In a very simplified description, for incumbent company, the RES-E technologies increase the uncertainties in operating the networks and when wind energy is functioning well, it means a decrease in quantities served to consumers with inelastic demand. The price reduction effect is more difficult to determine in the real world, because, the price paid by consumer is regulated in Canarian Island. So the price effect show in the figure doesn't play an immediate role.

As a partial conclusion, we note that the lack of transparency is twofold: first the problem of coordination between local and national authorities has helped to maintain a constant "*provisional state of regulation*" in energy matter within the archipelago. Second, the lack of clear rules & technical support to assess the safety requirements needed induce an impression of over defence of the network as a way to introduce barrier to entry in the Canarian islands.

Is it a problem of lack of unbundling in Canarian industrial structure?

In Spain, the totality of the high voltage grid system (440kV) belongs to *Red Electrica de Espana* which holds the techniques of data-processing control of flows of electricity and information necessary to the centralized management of the electricity transmission on the whole national network. This company plays the role of TSO for the whole of the Spanish peninsula, assuming at the same time the current management of flows on the network in real time, and doing the necessary increase in the capacity of the network¹¹. It should be noted that the principal electricity operators in production and distribution – supply remain the Spanish incumbent companies namely, Endesa, Iberdrola, Union-Fenosa and Hidro-Cantabrico see next figure.

Figure X:

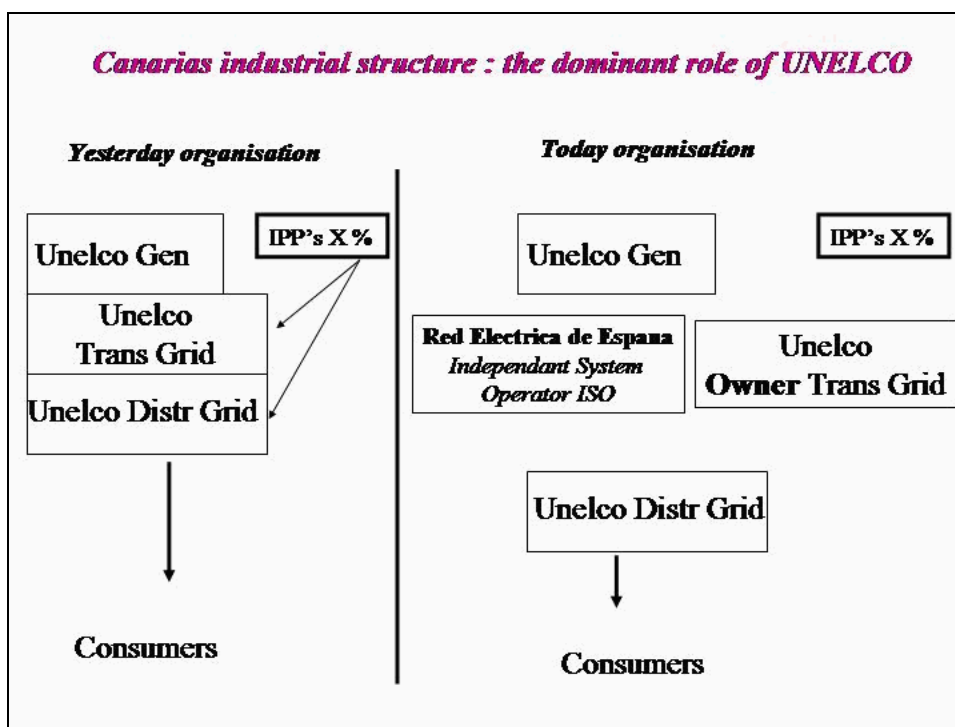


This situation goes with recurring problems of competition in the Spanish electricity market. This point has been widely noted (Fabra & ... (2005), Glachant & co 2006). However, with regard to the problems of management of flows and investment plans to upgrade the connection capacities, the Spanish TSO acts efficiently in supporting the introduction of the wind power. The global performances of Spanish installation underline it without any doubt.

¹¹ : As a regulated company, REE needs the agreement of the economy Ministry and the Spanish regulator.

The unbundling situation is different for the Canarian Islands. Indeed, on the isolated systems the industrial structure is less strictly separated between regulated activities (transmission – distribution grids) and the activities being subjected to competition (production - supply). Until lately, the production structure in the islands was concentrated, the dominant company Unelco-Endesa controlling X % of the production, transmission and distribution networks and the all supply of electricity. The wind producers thus must, to by connect on the networks, to “negotiate” with Unelco transmission grid, if the wind farms were of size higher than 6 MW, or Unelco-Distribution, if they were smaller.

Conscious of the problems which this situation could produce (lack of co-operation between the dominant company and new entering a new technology with the complex design features) the Canarian government has try to introduce a moderate form of unbundling asking REE to become an Independent System Operator (ISO) for the Canary Islands. The ISO’s have common characteristic to manage only the problems of short-term flow on the networks. The increase in capacities is still remaining in the hands of the owner of the network (Unelco transmission). So according to the Canarian law, the new 2005 industrial structure in Canarian Islands is the following.



The problem with this structure is its only formal characteristic. Until mid-2006, REE doesn't really operate the grids.

Conclusion

To sum up, in Spain the diffusion of renewable energy technologies has increasingly come to serve as a convergent solution for a range of energy-related problem areas: security of energy supply, fostering a viable national industry segment, and regional concerns like employment and the environment.

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Appendix 1.

The nuke story

To acquire the bases of the civil nuclear engineering, the government charged Instituto Nacional de Industria (INI)¹² with achieving this goal [Romero Balmas, 1992 ; Segreto, 1992 ; Sudria, 1987 ; Serrano-Martinez, et Calmes, 1998]. The INI set up Junta de Energia Nuclear which it then supplemented by the law on the nuclear energy of 1963. This preliminary work involved the operational startup of a first generation of nuclear thermal power stations, Zorita in 1969 (153 MW stopped in 1989), Garona in 1971 (460 MW) and Vandellos in 1972 (507 MW) with user licences and design of construction of American power stations.

The strategy was to benefit from technology transfers by buying power stations to the tested design which it got in the United States (General Electrics, Westinghouse) and in Germany (Siemens). To fight against this strong initial dependence with respect to the nuclear engineering, the strategy of the INI led to the reduction of this dependence gradually by the creation of the companies Equipos Nucleares SA¹³ and by the national uranium company the ENUSA¹⁴. These two companies controlled by the INI, supported the development of this technology by international exchanges, where technology was exchanged against the access and the enrichment of uranium by the United States and France¹⁵. If the technological control were the work of the INI, it is mainly by an alliance between the private and public capital that the nuclear investments were carried out as indicates it the following table.

Centrales	Type de réacteur	Capacité installée	Date de mise en fonctionnement	Structure de Propriété
<i>Jose Cabrerias</i>	PWR (W)	160	1969	UEF 100%
<i>Garona</i>	BWR (GE)	460	1971	Endesa 50% Iberdrola 50%
<i>Almaraz I</i>	PWR (W)	930	1980	Iberdrola 53% Endesa 36% UEF 11%
<i>Asco I</i>	PWR (W)	930	1983	Endesa 100%
<i>Almaraz II</i>	PWR (W)	930	1983	Iberdrola 53% Endesa 36% UEF 11%

¹²: L'Institut National de l'Industrie a officiellement disparut par la loi du 10 janvier 1996 pour lui remplacer la structure de la *Sociedad Estatal de Participaciones Industriales*. L'objectif initial de l'INI était de prendre le contrôle des industries liées à la défense nationale. En injectant des capitaux dans les secteurs industriels prioritaires, son champ d'action se développa. L'institut pris le contrôle des entreprises de charbonnages, d'extractions de minerais, de sidérurgie, d'aluminium, de construction navale et de transports. De plus, il créa des entreprises quand celles ci n'existaient pas ou n'étaient pas présentes en nombre suffisant.

¹³: Elle a pour objet la maîtrise, la réalisation et la maintenance des équipements nucléaires.

¹⁴: Elle a pour objet de mettre en valeur les deux gisements d'uranium nationaux.

¹⁵: La production de minerai enrichi a atteint 294 tonnes en 1996 et ENUSA s'est alliée avec la General Electrics pour la commercialisation de son combustible.

<i>Cofrentes</i>	BWR (GE)	990	1984	Iberdrola 100%
<i>Asco II</i>	PWR (W)	930	1985	Endesa 85% Iberdrola 15%
<i>Valdellos II</i>	PWR (W)	992	1987	Endesa 72% Iberdrola 28%
<i>Trillo</i>	PWR (S)	1043	1988	Iberdrola 48% UEF 34,5% HC 15,5% Nucleonor 2%

Notes : PWR Pressured Water Reactor, BWR Boiling Water Reactor
GE General Electric design, W Westinghouse design, Siemens Design.
UEF Union Electrica Fenosa HCG Hidro Cantabrico Grupo
Source : ATOM [1999] : L'évaluation des performances des industries de service public en Europe, le secteur de l'électricité, Commissariat Général du Plan.

However, this initial success induced a disproportionate nuclear passion behalf of the public authorities which will launch in a series of constructions via the National Energy Programs (PEN). It will result from it a development of the nuclear excessive leading to closing from nuclear thermal power stations before their completion¹⁶.

Tableau : les fermetures de centrales nucléaires

Centrale	Capacité MW	Type de réacteur	Propriétaire	% de propriété	Degré d'achèvement des travaux en %
<i>Lemoniz 1</i>	930	PWR (W)	Iberdrola	100	97
<i>Lemoniz 2</i>	930	PWR (W)	Iberdrola	100	57
<i>Valdecabelleros 1</i>	975	BWR (GE)	Endesa et Iberdrola	50 / 50	60
<i>Valdecabelleros 2</i>	975	BWR (GE)	Endesa et Iberdrola	50/50	60
<i>Trillo 2</i>	1040	PWR (GE)	Endesa et Union Fenosa	80/20	5

Note : PWR Pressured Water Reactor, BWR Boiling Water Reactor; GE General Electric design, W Westinghouse design, Siemens Design.
Source : Financial Times Energy 1999

Appendix 2

The Navarra example

The Navarra example is striking; more than 45% of total energy production in 2003 came from wind power. In return for authorisation of wind-farm projects, local governments have often required that developers keep a large share of investments in the local economy and contribute to local employment (see American Wind Energy Association, 2004; FT.com, 2005); OECD, 2004). The success of Navarra in coupling environmental and industrial affairs serves as an example to yet other regions seeking to emulate the model in order to attract industrial investments based on wind power. Aggregated to the national level, the sum of regional success stories had by 2003 created a sizeable wind-power industry with more than 47,000 jobs (12,000 direct and 35,000 indirect) (OECD 2004:49). Spain is now home to the world's second-largest manufacturer of wind turbines, Gamesa; and is the currently largest wind-park developer and constructor in the world (EHN, incorporated in 2004 into the Acciona Group), with up to 500 smaller companies supplying components (FT.com 2005, EWEA, 2005).

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¹⁶ : Si ces nouvelles centrales avaient vu le jour, la capacité de production nucléaire espagnole aurait été augmentée de près de 66%.