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# Initiating a sustained diffusion of wind power: The role of public–private partnerships in Spain

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ABSTRACT

The literature on policy approaches for the market support of renewable electricity is dominated by narrow conceptualizations of policy, referring mostly to direct instruments for economic feasibility. Such approaches often led to unsatisfactory explanations of diffusion results. This is the case of wind power diffusion in Spain, the success of which is typically credited to the 'feed-in-tariff' instrument. This paper offers an alternative explanatory account for wind power diffusion in Spain. It is argued that diffusion can be explained by a less obvious policy of stimulating investments by means of public–private partnerships (PPPs). The three legal frameworks for economic feasibility applicable up to 2004 harbored high economic risks. Although projects could have high profitability because of generous investment subsidies, up to mid 1990s most investments were based on PPPs, to address the risk perceptions of early investors. Fully-private partnerships now dominate investments, though PPPs have not disappeared. Next to winning investors' confidence, the PPP policy led to an investment culture whereby partnership investments dominate. By 2000, 95.7% of the installed wind capacity was owned by partnerships, and only 4.3% by individual companies. Partnerships invest in larger projects, have ambitious investment plans, and these lead to a high diffusion tempo.



## 1. Introduction

The political drivers for the support of renewable electricity technologies (RET) have diversified over the past decade. Concerns regarding increases in fossil-fuels' prices and procurement insecurity overlap nowadays with concerns for climate change. However, since the environmental impacts of electricity generation are not internalized in production costs, technologies using renewable resources are more expensive than fossil-fuels-based technologies. Numerous countries have decided to support RET market adoption by means of economic instruments; but as the number of countries introducing such policy instruments increased, so did the diversity in the instruments used. With the liberalization of electricity industries in many countries, since early 1990s, this diversity increased even further.

The debate has started as to which policy instruments for economic support could lead to more substantial adoption of RETs and ensure continuity in diffusion. The debate was similarly strong in the policy—political arena and the academic arena. However, the question that guided this debate was not such a good question, as it shaped the assumption that the design of economic support instruments can, on its own, explain the 'fate' of RETs in energy systems. The intensity of political debates—regarding the consequences of various policy instrument' designs and combinations—distracted academics towards this aspect of policy. This has had important negative consequences for the quality and richness of policy-oriented research, and for the policy lessons offered by academic work.

A narrow conceptualization of policy for RET support emerged, whereby the policy instruments meant to help RETs overcome the economic barriers received most attention, such as price support systems, subsidy schemes, fiscal incentives and soft loans. Numerous publications consist chiefly of detailed descriptions of such instruments, especially in terms of the extent of financing offered (price/kWh; % subsidies); descriptions are typically followed by data on diffusion results, in the form of MW installed capacity, or RETs' market share. The general conclusion has been that the described instruments led to the observed diffusion results, as if there was little to nothing in between.[1] Under this narrow-policy-descriptive research style, diffusion patterns were ignored and no attention was given to other, non-economic policy

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[1] The number of such studies is very large; here are few examples: Agnolucci (2006), Reiche (2002), Lipp (2007), Valle Costa et al. (2008), Blok (2006), Martínez Montes et al. (2007), Gan et al. (2007), Menz and Vachon (2006), Ackermann et al. (2001), Haas et al. (2004) and Brunt and Spooner (1998).

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instruments and strategies of public authorities for RET market support. Too often, the assessments of various economic policy instruments as successful hanged in the air. This has been the case with numerous 'explanations' for the success of wind power in Spain.

The Spanish approach to RET market support has always been described as 'feed-in-tariff'. Though numerous authors do not use an explicit definition of feed-in-tariffs, these are generally implicitly conceived as legal guarantees for long-term purchase contracts with grid companies, at a fixed attractive price. Feed-in-tariffs have been therefore for a long time equated with investor certainty on the economics of RET projects. The feed-in-tariff was given a 'thumbs-up sign' already in mid 1990s, as successful policy instrument leading to the high installed capacity of wind power in Germany and Denmark. Few market observers noted, later, *some* similarities between the German, Danish and Spanish economic support systems. In the same time, they also observed a steadily increasing wind power capacity in Spain, towards the end of the 1990s, and the years thereafter. This led many to swiftly show the 'thumbs-up sign' to the 'successful Spanish feed-in-tariff', too (e.g. Coenraads. and de Vos, 2005; Held and Ragwitz, 2006; Mulder, in press; Meyer, 2003; Peters and Wiess, 2008; Reiche, 2002; Söderholm, 2008).[2]

However, empirical proof has never been provided for the hypothesis that the Spanish feed-in-tariff is responsible for the large wind power capacity. For example Bechberger and Reiche (2004, p. 7) easily write about the "great successes of EU countries like Germany, Spain or Denmark—which all used REFITs" and about "the (long-term) security given for potential investors if REFITs are designed accordingly (like in Germany or Spain)", where REFIT stands for renewable energy feed-in tariff. Like with so many other articles, the empirical evidence and convincing analyses—linking the Spanish feed-in tariff design with discussions on diffusion patterns, and with the observed diffusion results—are missing. Observing a correlation does not mean that there is necessarily a cause–effect relationship between the dependent and independent variables.

Most authors turn a blind eye to the fact (or perhaps are not informed) that the so-called 'Spanish feed-in-tariff' had a very unattractive design for investors up to mid 1990s in terms of economic risks. An attractive, low-risk feed-in-tariff was introduced in Spain only in 2004, with the adoption of the 436/Royal Decree; this guarantees that RET will receive price support for the entire economic lifetime of the projects. Between 1994 and 2004, the two applicable economic instruments also harbored risks; they guaranteed minimum 5-year purchase contracts, but did not give life-time guarantees on price support, or at least contract renewal guarantee—when contracts were shorter than the economic lifetime of projects. By 2004, when a lower-risk feed-in-tariff instrument was adopted, the rush for wind power investments was already high, and 8.155 MW capacity was already installed (IDAE, 2005); therefore, there must be a different explanation for wind power success in Spain. Besides, four feed-in-tariff designs can be differentiated between 1980 and 2008, as Section 2 explains; thus, which one(s) do researchers cheer as successful? The excessive focus of researchers on the economic instruments for RET support generated sometimes inadequate explanations of diffusion, as in the case of wind power in Spain.

Besides, a focus on narrowly defined policy instruments runs the risk of missing an adequate understanding of the way various non-economic policy instruments and contextual factors influence diffusion results. Some authors, adopting a broader conceptualization of policy, revealed for example the role of environmental/social movements, the institutional context, and spatial planning policies in wind power diffusion (Toke et al., 2008; Nadaï, 2007; Christensen and Lund, 1998). Therefore, it is important to understand *how* diffusion takes place, in order to illuminate diffusion results.

A narrow conceptualization of policy may also miss the chance to underpin the existence and consequences of unwritten or less obvious policies of public authorities, which may also influence diffusion patterns and the prospects of sustained investments. Diffusion may not always be a matter of 'hard-paper policies' only. This is the case of wind power diffusion in Spain, as this paper will argue. In general, by focusing on narrowly defined policy instruments, important policy lessons that could be drawn to enhance the prospects for RET market success may also be missed.

### 1.1. Research focus and methodology

This papers aims to explain the diffusion results of wind power in Spain, characterized by high investment interest among a wide diversity of actors; this is done by focusing on the analysis of diffusion patterns. The paper departs from the idea that it is misleading to think that the feed-in tariff system is the 'hero of wind power diffusion' in Spain, as often so easily suggested in the literature. It is argued the diffusion results we currently observe can be explained by a policy—implemented at all governmental levels[3]—of stimulating investments by means of public–private partnerships (PPPs).

PPPs are understood in this paper as legal partnerships between public actors (agencies or departments of local/regional/national governments) and private actors, for joint equity investments in wind/RET projects. The diffusion of wind power in Spain was initiated, and has been sustained for a long time by means of PPPs. Public authorities' interest in PPPs was generated by a diversity of objectives and motivations, which are analyzed in the paper; one of the most powerful motivations was the desire of the involved public authorities to contribute to the reduction of the risks perceived by private investors in relation to wind power projects.

The early investors in RETs typically need to consider a wide range of risks: resource quality, spatial planning, technological, economic, administrative approval, local and environmental acceptance, quality and price of maintenance services and so on. The reduction or elimination of economic risks is often a precondition for attracting potential investors' interest. As Section 2 explains, this certainty on long-term predictable returns was not offered in the legal framework before the adoption of the 436/2004 Royal Decree. PPPs were seen as an adequate mechanism to hedge against the economic risks in the legal framework. In time, PPPs led to confidence in a basically poorly designed economical support instrument, and a reduction in the perception of other types of risks, as well. Investments driven entirely by fully-private partnerships have started to emerge in the second half of the 1990s; since the 1990s, fully-private partnerships have been playing the main role in diffusion.

Diffusion results for wind technology were large by 2007, with 11.630 MW in operation. The empirical data for the period 1980–2000 show that investments based on partnerships are responsible for an overwhelming share of the 2.977 MW capacity

[2] For a very large number of such studies and reports see the website of WindWorks at http://wind-works.org/articles/feed_laws.html.

[3] The governmental levels can be differentiated in Spain: national, regional, and local. The 1978 Spanish Constitution started process of decentralization that led to the creation of 19 Autonomous Communities, referred to in this paper as regions. They represent an intermediate level of government between the state and the local authorities. The current state organization resembles federal models, but national sovereignty resides over the whole Spanish population.

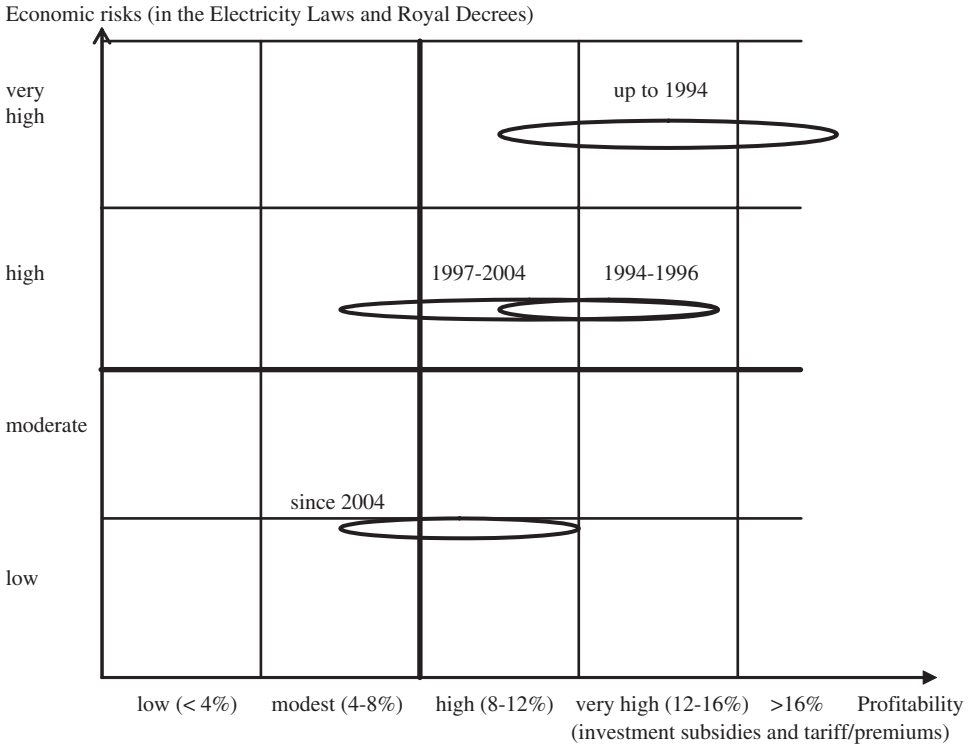


**Fig. 1.** The risk–profitability profile of the economic support instruments for wind power in Spain 1980–2008. (*Source*: Update based on Dinica, 2003, 230pp.).

put into operation during these years: 95.7% (Dinica, 2003, pp. 248, 264). Up to mid 1990s, most of these partnerships were PPPs; but PPPs remained a popular investment mechanism throughout the second half of the 1990s as well. Up to early 1990s, the national Institute for Energy Saving and Diversification (IDAE[4]) was the main or only 'public element' in PPPs. Later, regional and local authorities started to take a growing position in PPPs, while IDAE slowly withdrew. The business culture of economic actors with regard to risks is a very important factor that made the use of PPPs in the early stages of diffusion so important. However, a series of other factors can also be identified as driving partnerships' emergence and dominance. In order to understand the role of both public–private or fully-private partnerships in diffusion, it is important to look at the dynamics of actor structures; but this also needs an investigation into the partnership types that can be differentiated during the diffusion process, in terms of other aspects such as: financing modes, scope of investments and the key aims of the projects.

Two sources of information were used to underpin the types and dynamics of partnerships, and the changes in the main drivers behind their formation: (a) written material including: the direct analysis of Spanish laws, decrees and policies for renewable energy support; market reports of IDAE and of investors; articles published in professional journals, such as Wind Power Monthly, Las Energias Renovables, Era Solar and Energia; (b) 40 interviews with experts from investment companies and public authorities (listed in Dinica, 2003, pp. 633–634).

The empirical data used in this paper regard the diffusion period 1980–2000. The diffusion analysis focuses on these two decades because the main aim is to explain diffusion by looking at how diffusion started, and how a wide investment interest was generated in spite of high risks being embedded in the policy instruments for economic support. Research also aims to unveil how changes in the types of partnerships contributed to the speeding-up of wind power diffusion. For this reason, a historical perspective is crucial. Section 2 presents, shortly, the economic support instruments applicable to wind electricity production. Section 3 discusses the dynamics of partnership types, their actor structures, and the drivers behind partnership formation. Section 4 concludes the paper with some reflections on the role of PPPs in wind power diffusion in Spain.

## 2. Instruments supporting the economics of wind power production

Four legal frameworks can be differentiated since 1980, which were applicable to all RETs in terms of contractual relations and price design; the difference among RETs has always been only in terms of the price levels offered.

*The first legal framework*, applicable between *1980 and 1994*, was defined by the 82/1980 Energy Conservation Law. Parliament failed to specify any price design in the law. It only mentioned that contractual prices are to be decided by the Ministry of Energy and Industry, based on annually revised Orders. These provisions were assessed by developers as posing high price risks (Dinica, 2003, pp. 191–192). Besides, although there was a legal guarantee for grid connection, contracts' length was also not mentioned. This was interpreted by financing agents and potential equity investors as posing high contract risks. Overall, the investment risks associated with this first economic support instrument (or first 'feed-in-tariff') were assessed as very high, as illustrated in Fig. 1. Besides, the price per kWh offered by the Ministry was quite low, compared with the production costs at that time.

However, this highly unattractive feed-in-tariff was used in parallel with generous investment subsidies; during these years investment subsidies were in the range of 50–90% of the total investment costs. Investment subsidies were making wind projects highly profitable, with profitability ranges between 10%

[4] IDAE was established in 1984; one of its main tasks is to draft, implement and monitor the national renewable energy plans.

and 20%. There were no projects developed without an investment subsidy, in this period. Subsidies had a national origin, and were typically approved by IDAE; subsidies from European and regional agencies were rare and less meaningful financially.

*The second legal framework: 1995–1996.* In 1994, a new electricity law was adopted (40/1994), strengthening slightly the special protection regime for renewable electricity. For the first time, the guarantee on sale contracts was specified for a minimum period of 5 years. However, contract risks were still present as the economic lifetime of wind projects is typically 15–20 years, and the terms of contact' renewal were not clear. The new law envisaged that prices were to be set by means of governmental Royal Decree (2366/1994) and price levels were to be revised every 4 years, also by means of Royal Decrees; these provisions reduced somewhat the price risks perceived by prospective investors; not only were price formulas specified this time, but the frequency of their revision lowered to 4 years, instead of annually, and revision was to be approved by the government. In Spain, the perception dominates that instruments approved by the government are exposed to lower political risks as compared with instruments approved by a ministry, as in the government there are more actors that have institutional power and could oppose that decisions unattractive for RET investors are taken.

Price design improved also because higher price levels were offered per kWh. This was viewed as necessary in order to maintain an attractive profitability of wind projects, since a process of phasing-out the investment subsidies for wind power started in 1994/1995. However, because the price formula was only specified for the following 4 years, price risk perceptions remained high among investors, who could not calculate their return on investments in the long term. The investment risks associated with this second legal instrument were assessed, overall, as still high, as illustrated in Fig. 1. Project profitability lowered a bit during these years but was still attractive, with ranges between 10% and 15%.

*The third legal framework*: *1997–2004.* The main legal instruments during these years were the 54/1997 Electricity Law and the 2818/1998 Royal Decree. The main change they introduced was that two price designs became available at the choice of generators, if RET projects were smaller than 50 MW. The first was a 'market-based' option, and the second a 'revisable tariff' option. For wind technology, investment subsidies were phased-out for projects larger than 5 MW; but, still, the average profitability potential remained attractive, in the range of 6–15%, with most of the projects managing to get 10–12% profitability (Dinica, 2003, pp. 229–230).

*The fourth legal framework: 2004–present.* The economic support for renewable electricity changed more significantly with the adoption of the 436/2004 Royal Decree. Although sale contracts are still guaranteed for 'minimum 5 years', based on Art. 17,[5] contract risks are now perceived as low because of some important changes in the price design (Bustos, 2004). The Decree specifies for the first time the price formulas for the entire lifetime of a project, as shown in Table 1. Contractual prices must be annually updated according to the latest Royal Decree applicable, in which the government revises the average electricity tariff (AET). Both tariffs and premiums depend now on the annually revised AET levels.

The government promises that the tariff/premiums received by wind power generators will enable profitability of projects of around 7%. In order to ensure this, a 10% AET incentive was added on top of the tariff/premium level for wind power. Therefore, this fourth instrument is characterized by lower investment risks, but also lower profitability, as suggested in Fig. 1. An important reason why the projects installed between mid 1990s and early 2000 had higher profitability than those developed later is that the early projects had wider choices on good locations, picking-up sites with excellent wind resources.

**Table 1**
Price support based on the 436/2004 Royal Decree

| Onshore wind power | Tariff (%AET) | Premium (%AET) | Incentive (%AET) |
|---|---|---|---|
| <5 MW | 90% first 15 years; 80% onwards | 40 | 10 |
| >5 MW | 90% first 5 years; 85% from year 6 to 15; 80% onwards | 40 | 10 |

*Source*: Bustos (2004).

This short account indicates that the investment risks embedded in the legal instruments for economic support have been initially very high and lowered in time, gradually. The risks associated with them can be described as 'low' only after the adoption of the 436/2004 Royal Decree. An important cultural factor to consider in the analysis of wind power diffusion in Spain is the high risk-adversity of Spanish companies. Energy companies, industrial corporations and financing agents in Spain are in general highly reluctant to accept risks—technological, administrative, legal (in the price support system). They need strong clear signals for long-term political commitment for renewable energy; but above-all they require the involvement of one or more public agencies/authorities in investments—be it very small (like 2–5% ownership), which is clearly a national contextual factor. Some companies are even more risk-adverse than others and do not dare to invest unless they see other influential corporations investing—especially corporations viewed by them as opinion-makers in business. This risk-adversity of the business culture in Spain was known to IDAE, who also realized that the risky legal design was not going to raise much interest among private actors.

Up to 2000, IDAE was subordinated to the Ministry of Industry and Energy and received from it generous budgets to implement the political goal of increasing the production of renewable electricity. The institutional framework gave IDAE two important freedoms. Firstly, IDAE could choose which RETs should be supported with priority for market diffusion. Of all RETs considered, IDAE assessed the wind technology as sufficiently technically mature for generous financial support. Secondly, IDAE had the freedom to choose the policy instruments by means of which governmental budgets for RET diffusion were to be spent. Based on these freedoms, IDAE decided to attempt altering the investment appetite of Spanish corporations by contributing financially—with equity—to investments in wind power projects.

Direct capital investments were eligible as policy instruments for RET market support. The agency also used traditional policy instruments for wind power, such as investment subsidies and soft loans, used by most European national energy agencies. IDAE was, however, original and effective by investing equity into partnerships that had the involvement of various types of actors, whose investment interest had to be raised: energy companies, industrial corporations, banks, insurance corporations, and institutional investors. As two IDAE experts explained, "IDAE tried to find out a replicability effect to speed-up private investments to obtain an economically sustainable renewable energy market" (Concha and Cayetano, 1996). Given the high political commitment to domestic renewable energy, the political support in the Parliament for generous budgets to IDAE remained high

[5] The 436/2004 Royal Decree can be found at the website: http://noticias.juridicas.com/base_datos/Admin/rd436-2004.html#a17.

throughout the 1980s and 1990s. This was necessary in order to fuel the policy of the agency for PPP formation. Therefore, by engaging into PPPs, IDAE took upon itself the role of diffusion catalyst by providing not only subsidies to investors, but also *trust* in the legal support instrument and in wind technology.

## 3. The dynamics and drivers of partnerships for wind power investments

This section presents the empirical findings in terms of the types of partnerships that can be differentiated, their dynamics, actor structures, and the main drivers for partnership formation, as diffusion progressed.

### 3.1. Types of partnerships for wind power investments and their dynamics

Several types of partnerships can be differentiated along three dimensions: the type of financing, the type of activity, and the scope of investments. From the standpoint of the *type of financing* one can differentiate between: internally financed partnerships and externally financed partnerships. The difference is that bank loans are used only in the second case, when the wind power project and its output are accepted by banks as loan guarantee. Partnerships can also be differentiated according to their *types of activities*: technology-development and demonstration; early-stage commercialization and large-scale commercialization of wind technology.

Further, differences can also be observed in terms of the *scope of investments*. Some companies join forces only for the commissioning and operation of a single wind project; others develop together, in the same partnership formula, a large number of wind project; while others decide to expand their scope of activity to other RET types. The following terms are used in this paper to differentiate among partnerships based on the scope of investments:

- 'project-vehicle partnerships', which means that the investment is made by a group of actors investing in one wind project only; those actors have no other wind/RET projects together under the same actor formula;
- 'wind-specialized partnerships', which implies that a group of actors invest in more wind projects, under the same actor formula;
- 'renewables-specialized partnerships', meaning that a group of actors invest not only on wind projects, but also in other RETs, under the same actor formula.

Table 2 shows the changes in the market shares of partnerships characterized according to their scope of investments.

The differentiation of three dimensions implies that a single partnership can be described based on all three criteria mentioned above. Fig. 2 illustrates the connections among the three dimensions. Fig. 2 should be read as follows, by taking the second row from above as central to the discussion. *Up to 1994*, technological-demonstration was a key driver for most partnerships, which were conceived as project-vehicle partnerships, in terms of their scope of investments. The project-vehicle partnerships developed up to 1994 had a market share larger than 90% in the total wind power capacity. All project-vehicle partnerships in these years can be classified, in the same time, as internally financed partnerships, taking into consideration their type of financing.[6] These relationships are shown in continuous arrows, on the left side of Fig. 2.

**Table 2**
The market share of PPPs differentiated according to their scope of activities

| Diffusion period | Installed capacity (MW) | Project-vehicle partnership (%) | Wind-specialized and RET partnership (%) | Individual companies (%) |
|---|---|---|---|---|
| 1980–1990 | 7 | 100 | – | – |
| 1990–1994 | 70 | 80 | 4 | 16 |
| 1995–2000 | 2.900 | 36 | 60 | 4 |

*Source*: Dinica (2003, pp. 248, 264).

The early-commercialization partnerships dominating the investment picture *in mid 1990s* were to large extent project-vehicle partnerships (continuous arrow, left side of Fig. 2); of the 112 MW installed in 1995 and 1996, the projects developed by project-vehicle partnerships accounted for 41.5% of the capacity; they were followed by manufacturers—investing as individual companies—with 31% of the installed capacity, and by wind-specialized partnerships with 26% of the capacity (continuous arrows). In the same time, the overwhelming share of the projects developed in mid 1990s were still based on internally financed partnerships (continuous arrow), with only a small share of projects being characterized as externally financed partnerships (dashed arrow). The available empirical data show that of the 18 projects that entered into operation in 1995 and 1996, only three projects benefited of project finance (Dinica, 2003, pp. 304–308).

The partnerships that emerged towards *the end of the 1990s* were overwhelmingly concerned with the large-scale commercialization of wind technology. However, as technological innovation was still taking place, the new turbine models were tested in the framework of technology-demonstration partnerships, or even by individual companies. After testing them, early-commercialization partnerships were being developed to prove the commercial viability of the new technological designs. The partnerships for technological-demonstration and early-stage commercialization initiated towards the end of the 1990s can be generally described also as internally financed partnerships, having in view their type of financing. These relationships were not shown in Fig. 2 to avoid further complicating the picture.

The partnerships initiated after 1997/1998 under the objective of large-scale commercialization of wind technology can be in the same time characterized as externally financed partnerships (continuous arrow, right side of Fig. 2). Between 1997 and 2000, 87% of the projects that entered into operation were developed by externally financed partnerships. In terms of scope of investments, they were renewables-specialized partnerships—49.5% of the projects, and project-vehicle partnerships—33% of projects (Dinica, 2003, pp. 308–311; (continuous arrows, right side of Fig. 2). A much smaller number of partnerships were conceived as wind-specialized partnerships—3.5% of the projects; the rest 14% of the projects were built by individual companies (dashed arrows, right side of Fig. 2).

This data suggest that after a long period of dominance of project-vehicle partnerships, investors gain trust in not only in wind power and other RETs, but also in their business partners, and in the economic support instruments. Numerous investors decided to move away from the rather experimental project-vehicle partnerships. This resulted in the emergence of wind-specialized partnerships in mid 1990s, and the dominance of

[6] The most used approaches were third-party finance by IDAE, multi-contribution finance (several actors pooling equity/cash), in-house corporate finance (the available cash of a single company), and debt-corporate finance (loan guaranteed with the marketable assets of a company).

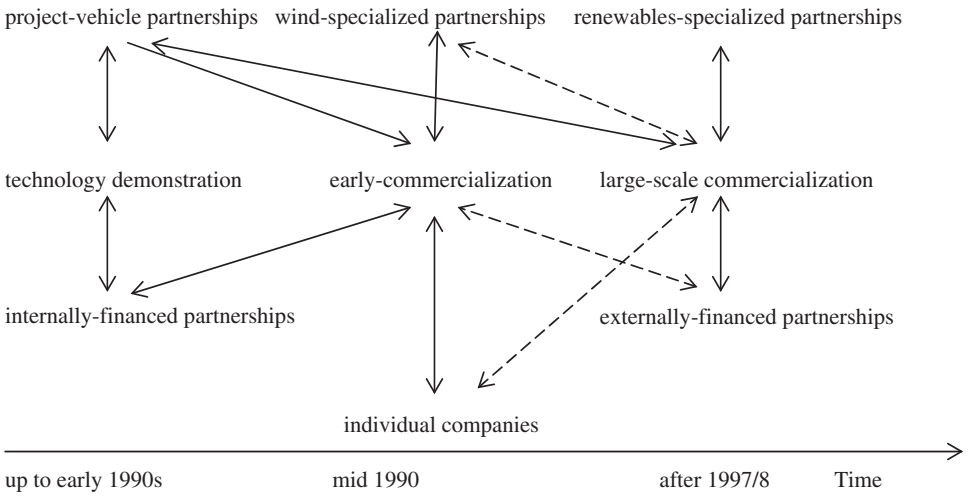


**Fig. 2.** The evolution of partnerships for wind power in Spain, 1980–2000.

renewables-specialized partnerships, since mid 1990s. In these later types of partnerships, investors allocate substantially more financial and human resources, which result in long-term ambitious investments plans. These kinds of partnerships develop more projects and their projects are typically larger; these contribute to an exponential growth in the total installed capacity observed towards, and after, 2000. The dominance of these two types of partnerships, as shown in Table 2, is a strong indicator of the fact wind electricity production has become a mature business sector.

The other type of transition these data show, from internally financed towards externally financed partnerships, is another strong indicator of market maturity. After few years of testing the economic risks of wind technology by means of providing project finance loans to project-vehicle partnerships, banks and other financing agents gain trust in wind technology and the economic support instruments. This was reflected by the making available of project finance loans also to wind-specialized partnerships and to RET-specialized partnerships. The availability of project finance loans means that the financial pool on which the diffusion of wind technology can draw has become substantially larger, and a more significant progress in diffusion may be expected.

### 3.2. Actor dynamics in partnerships

Up to mid 1990s almost all partnerships had the involvement of IDAE. Since early 1990s, more actors started to join the partnerships as equity investors. The actors involved in the '*project-vehicle partnership*' *initiated up to mid 1990s* can be divided into five groups:

1. the governmental agency IDAE;
2. manufacturers of wind technology (Made and Ecotecnia);
3. energy companies (Endesa and Union Fenosa);
4. regional and local authorities;
5. to a lesser extent water utilities (in areas with water desalinization challenges).

However, not all actors were involved simultaneously in each partnership. This started only later, in mid 1990s, when the number of actors forming a partnership increased.

A striking characteristic of the *project-vehicle partnerships related to early-commercialization* activities is their actor structure: almost the same types of actors in each partnership, each fulfilling a clear role:

- IDAE offering political support;
- a regional/local authority, strengthening the political commitment and securing the necessary administrative permits and social approvals;
- a manufacturer supplying the technology with guarantee for technical quality, and typically at costs lower than offered to others on the market;
- an energy company offering technical guarantee of grid connection and other network-related advantages; importantly, energy companies were often also the electricity buyers, which helped eliminating the contract risks induced by the legal framework; IDAE was stimulating their presence in partnerships so that private actors could reduce their economic risk perceptions;
- sometimes also the land owner (local authority or private owner) had also an ownership share in the wind project, which is preferred by financing agents to reduce project risks; this is again an important cultural factor influencing the actor structure of partnerships;
- eventually another local/regional public agency or development company that could bring extra benefits to the project.

Almost all project-vehicle partnerships in Spain, initiated in mid 1990s, have this actor formula. This emphasizes *the crucial role of resource complementarity* in the formation of partnerships for the early-stage commercialization of wind technology.

When wind-specialized partnerships and renewables-specialized partnerships emerged, they displayed largely the same actor formula with *three main differences*. Firstly, IDAE was not involved in such partnerships anymore. IDAE can function as a commercial company, but cannot have renewable electricity production as its core activity. IDAE was always involved in project-vehicle partnerships only, which predominantly used internal financing schemes and were aimed at either technology-demonstration or early-market commercialization. The partners of IDAE were rarely the same, as the agency was aiming to increase the number and diversity of private actors interested in wind power generation. This objective could not have been followed if IDAE was contributing to wind-specialized or RET-specialized partnerships, where the partners remain the same in the development of a large number of projects. According to a policy expert of IDAE, by

becoming a permanent commercial generator, the agency would have overreacted to its goals (Avellaner Lacal, 2001). After 2000, projects with IDAE's equity involvement disappeared.

Secondly, large industrial corporations from a wide variety of sectors entered the wind power business and there was almost no such partnership without an industrial corporation. Industrial corporations were coming from industrial branches such as infrastructure works, construction, engineering, naval-construction, aeronautics, ammunition, mining, textile production, chemical industry, metal and agricultural equipment production. Some industrial groups also expanded their activities in the areas of turbine manufacturing, and services for project development/construction and maintenance.

Thirdly, starting with 1998, banks and other types of financing agents were also joining partnerships with equity investments. After few years of 'checking' the wind technology by enabling project-finance loans, between 1995 and 1997, some financing agents experienced such an abrupt reduction in the perception of economic and technological risks that they decided to invest equity not only in wind projects, but also in wind technology manufacturing companies. For example, by 2000, the bank Bilbao Vizcaya Argentaria had ownership shares in the manufacturer Gamesa Eolica, together with energy company Iberdola, and therefore it became interested to finance projects developed using Gamesa technology, either by project loans or by direct equity investments.

Local and regional public actors remained present in numerous wind-specialized and renewables-specialized partnerships. Some public actors even intensified their investment activities (e.g. in Navarra, Galicia, Aragon, the Basque Country and Andalucia) and few decided also to invest equity in companies manufacturing wind turbines and technology components (e.g. in Navarra). Section 3.3 explains the key drivers for the emergence of this policy of PPP formation among regional and local authorities. Towards the end of the 1990s, all three types of partnerships differentiated according to their scope of investment started to be also developed as fully-private partnerships. In time, their contribution to diffusion has steadily increased, in comparison to PPPs.

### 3.3. Factors underlying the formation of partnerships for wind power

Three categories of drivers can be differentiated based on the empirical data collected from written documentation and interviews: motivational, knowledge generation, and resource-related factors. To understand them better, it is useful to discuss the drivers by differentiating partnerships in terms of the type of activity followed, and by focusing on the motivations of some of their key actors.

By initiating and stimulating the use of PPPs, IDAE was striving to help implement the following political goals:

- the emergence of a national manufacturing industry for wind technology that should be competitive internationally (goal shared by industrial and energy companies);
- the creation of jobs for regional and local economic regeneration (goal shared by industrial and energy companies; and by local and regional authorities);
- the use of endogenous energy resources to reduce the political risks associated with imported fossil-fuels (goal shared by industrial and energy companies; and by local and regional authorities);
- the reduction of the environmental and health impacts of fossil-fuels and nuclear energy technologies.

However, none of these goals could have been realized without the reduction of the risk perceptions that private investors and (former) energy utilities had in relation to wind projects. This was a key driver for IDAE to join PPPs.

#### 3.3.1. PPPs for wind technology-development and demonstration

Three main drivers can be differentiated for PPP formation in the period 1980–1994: motivational factors (such as institutional goals), resource complementarity, and knowledge development.

First, in terms of *motivational* factors, IDAE was interested in raising investment interest among private actors, by giving a political signal that governmental support for wind energy was reliable and long-term oriented, in spite of the hick-ups regarding the poor price and contract guarantees in the law. Besides, IDAE was interested in speeding-up national technological development of high quality; IDAE had the vision of a future with a high international demand for wind technology supply, due to expected fossil-fuels crises.

Few energy and industrial companies had interests in joining PPPs, because they believed in the vision of IDAE. For example, the engineering groups Ecotechnia, Acsa and Desa, and the energy utilities Endesa and Union Fenosa realized early that the market introduction of RET was soon to become a 'sink or swim' issue; they, and other industrial prime-movers wanted to grasp the chance to develop wind turbine manufacturing companies/subsidiaries and experience with the installation and operation of wind projects, using state financial support for wind power production. But other energy companies such as Iberdrola and Hidrocantabrica were still skeptical about wind power. Local authorities were also investing equity in areas with difficult access to grid-electricity and rich wind resources, such as Canary Islands and Andalucia. For them, raising investor interest in any locally available renewable energy resource was very important.

With regard to the uncertainties in the economic support instrument, IDAE also organized workshops with potential investors and political actors to explain to the latter why the design of the legal price support system would need to be changed. However, changing the law immediately proved to be quite complicated politically, and it had to wait until more general reforms in the energy system were introduced due to the EU goal to liberalize energy production markets. This happened in 1994 and 1997, with the adoption of the new electricity laws.

Secondly, *resource complementarity* was also an important driver for PPP formation during these years. Prospective investors were looking for partners with sufficient internally available financial resources (own capital or corporate/private finance loans). In early 1980s, banks were not willing to approve project finance loans for wind power and capital investments were still very high per kW installed capacity. The management of many energy companies was also not sufficiently enthusiastic about wind energy, at that time, and limits were place on the investments that could be made with company equity. IDAE was willing to compensate for the important absence of project finance loans and limitations on companies' equity. A third driver for PPP formation can be referred to as *knowledge development*. PPP actors were interested in pooling technical expertise and strengthening the basis of technology-related information; of importance was also acquiring knowledge on the location, quality and estimation of wind energy resources.

#### 3.3.2. Partnerships for the early-stage commercialization of wind technology

Three main drivers for the partnerships developed between 1995 and 1996 can be described as: resource complementarity, motivational, and knowledge development. Firstly, *resource*

*complementarity* played an important role in partnership formation, in order to overcome the financing obstacle. Some companies became willing to invest, but did not have the financial resources to do so. Banks were (still) reluctant to give loans to actors who did not have a track record in electricity generation, or who had not used wind technology before. Banks would agree to give loans only to public companies or for projects where a public agency such as IDAE—or another public authority—was involved financially. The wider importance of resource complementarity in this period was already mentioned in Section 3.2, arguing that all actors forming a partnership were expected to contribute in a way or another to the resources—tangible or non-tangible—needed to make the wind project a success.

Secondly, in order to *motivate more investors*, IDAE was, again, a frequently recurring actor in early-stage commercialization partnerships. The agency was still struggling to reduce the perception of risks with regard to the legal price and contract support system. Although the second legal framework brought some reductions in the economic risks (see Fig. 1), many companies were still skeptical about the political reliability of the price design and contractual provisions. In mid 1990s, several other motivational factors began to play a role in partnership formation as well.

Regional and local public authorities started to see the socio-economic benefits of wind power diffusion. They were interested in attracting companies in the region for industrial development, not only for wind technology manufacturing and plant maintenance, but also for other spin-off industrial investments. However, next to supporting wind power diffusion by means of traditional policy instruments, such as additional investment subsidies, regional and local authorities realized that they can become direct capital investors in wind power plants, just like IDAE. The laws regulating electricity production in Spain allowed them this role of direct investors. This was seen by regional and local authorities also as an ideal way of complementing the public administration budgets with income from legally allowed activities.

Besides, regional governments also have responsibilities in the field of energy policy and have been striving for energy independence; between 1995 and 2000 most Autonomous Communities adopted policies aiming to maximize the use of all forms of energy resources available on their territory and to minimize the import of electricity not only from abroad but also from other Communities. Regional authorities were frequently contributing to PPPs by means of equity investments; but some regional authorities and most local authorities were (also) involved in PPPs as a result of owning the land on which the wind projects were to be located, generating this way additional income for the public budgets. Consequently, starting with mid 1990s, regional governments and municipalities engaged in policies of PPP investments, inspired by the actions of IDAE.

Thirdly, *knowledge needs played* also a role in partnership formation by helping private actors to learn more about the new technology, especially with regard to the resource quality management and permitting procedures. Overcoming the obstacle of limited expertise by potential investors, both in terms of project development and project operation, was an important driver. There were yet very few companies offering technical expertise for wind power. When IDAE was participating in partnerships, knowledge diffusion was also among its objectives. IDAE was interested in improving technology perception among potential investors and stakeholders, showing that wind power projects are functional, blades do not break and do not destroy houses, and projects give constant profit that can be estimated beforehand within acceptable levels of uncertainty. In the support of PPP formation, IDAE also often organized workshops to discuss the technical and resource risk perceptions of potential investors and financing agents.

### 3.3.3. *Partnerships for the large-scale commercialization of wind technology*

The key role in the formation of large-scale commercialization partnerships was played by *resource synergies*. Motivational and knowledge factors became less important as the diffusion tempo picked up significant speed. It is important to note that since around 1996/1997, 'resource synergies' replaced the resource complementarity dominant in the previous period. This is especially the case with financial resources, which stopped being a problem when project finance by banks became widely available. Actors were pooling resources not because of resource shortage, but because of the added value of having certain partners in their partnership. For example, there was a strong interest to increase the financial pool underlying the increasingly ambitions investment plans of actors, in order to maximize their share in the wind power capacity the government was still willing to support by means of the economic support instrument.[7]

Resources of other types were also important: land, labor, low-cost technology, lobby potential, etc. For example, manufacturing companies that already achieved large economies of scale in technology production could contribute to projects' success by bringing-in their technological brand at lower costs than those offered to competing investors. This helped directly improve project profitability compared with competing partnerships where manufacturing companies were not part of. Further, when regional/local authorities were co-owners this could make administrative permitting easier, reducing the costs associated with long waiting times.[8]

The involvement of energy companies has been also highly desirable for all types of prospective investors, to overcome the growing technical problems related to grid connection. The wind power capacity increased fast and the remaining resources are generally located in remote rural areas with weak grids. The presence of an energy company could assure the other partners of a high-quality grid connection executed in shorter time, and perhaps at lower costs too, given the in-house technical expertise of energy companies. In principle, interested investors were accepted as partners for large-scale investments when they could bring a significant benefit to the project or the general investment strategy of the partnership.

The fact that many of the projects developed since 1997 are large projects (usually $>20$ MW) can also be explained by the increasingly popular culture of multi-dimensional resource synergies. In late 1990s, wind power diffusion speeded up and it even accelerated after 2000. By 2007 there were 11,630 MW of wind power in operation in Spain. But a sustained diffusion is not guaranteed by a number in itself. It is guaranteed by investment confidence, the availability of resources that condition the realization of investments, and reliable business partners. The emergence of corporations dedicated to investments in wind power or renewable energy in general is an important sign of potentially sustained diffusion.

[7] The governmental target for 2011 is 13,000 MW and many partnerships were making investment plans for thousands of MW; by 2002 the competent permitting authorities received investment plans that totaled 40,000 MW capacity at national level (Bustos, 2002).The grid integration ceiling is considered to be 30,025 MW.

[8] However, since around 1997–1998, when competition for good resource sites increased, municipalities not taking part in PPPs have started to require project initiators to include in the business plan certain royalties and/or non-financial benefits for the local community, often as pre-requisite for the needed administrative permits (for details on these, see Dinica, 2003, pp. 289–293).

## 4. Summary and reflections—from public–private partnerships to confident investors

This paper argued that the diffusion results of wind power in Spain can be explained by taking a wider conceptualization of policy, and looking at the diffusion patterns of the technology. An obsessive preoccupation of numerous academics with a narrow conceptualization of policy, studying only the so-called 'successful Spanish feed-in-tariff system', obscured the importance of a less obvious but very powerful policy, which assumed building trust in wind power investments by means of public–private partnerships. By now it has become clear that the policy initiated by IDAE—and later embraced and carried on by regional and local authorities and agencies—has been successful.

Next to winning investors' confidence, the PPP policy led to an investment culture whereby private companies prefer to invest in wind power by means of partnerships with others, rather on than their own. This way projects have became larger, investment plans more ambitions and the tempo of diffusion increased. By 2000, 95.7% of the installed capacity of wind power was owned by partnerships—both PPPs and fully-private partnerships. A brief market analysis of partnerships use after 2000 indicates that the types of partnerships and the drivers behind their formation have not changed much, compared with the post 1995/1996 period, if at all. However, the number of projects increased tremendously, since at least 8.630 MW wind power were added in Spain between 2000 and 2007.

The interactions between IDAE, other public authorities and business actors during the formation and operation of PPPs contributed to a joint definition of the philosophy behind the economic support instruments, and the reduction of the risk perceptions associated with them. This 'price philosophy' was communicated to, and endorsed, by political authorities. As a hybrid actor, IDAE permanently mediated between the political community and the business community. In mid 1990s, the idea emerged that the legal premium/tariff received by RET investors is not to be interpreted as a 'subsidy'—which could have been challenged with withdrawal due to 'competition rules', therefore attracting high risk perceptions; but it should be interpreted as an internalization of the environmental benefits and energy system benefits of RET projects. The success of this joint interpretation of economic support has culminated with its explicit incorporation in the introductions of the Royal Decrees adopted in 1998 and 2004. Consequently, PPPs helped with the reduction of economic risks not only directly—by lowering the risks for the private actors involved in those specific wind projects, but also indirectly and more broadly—by creating a political climate willing to reduce the risks embedded in the economic support instruments for all RETs, as suggested in Fig. 1. This way, it could be argued that, in the case of wind power in Spain, diffusion patterns (initiated by PPPs) led to the emergence of a low-risk feed-in-tariff system, and not that an attractive feed-in-tariff led to impressive diffusion results—as typically argued in the literature. Trust in policy continuity has proved to be more important than high profitability, since the reduction of the projects' profitability—from very high to modest levels, as shown in Fig. 1—did scared investors off. This illustrates the importance of political science and institutional perspectives for the analysis of RET diffusion—which emphasize values such as trust and price philosophy, in contrast to the so far dominant narrow-policy and econometric perspectives—which focus on price levels and the modeling of projects' returns.

PPPs have served investors, however, even beyond the issue of economic risk perceptions. As mentioned in Section 1.1, wind power investors have to face a wide range of risks and obstacles. The analysis of the drivers to form PPPs reveals the importance of technical knowledge development and resource complementarity in the first stages of diffusion. PPPs proved excellent policy instruments to generate and sustain private actors' interest in wind power even in the absence of project financing by banks. Without PPPs many important types of actors, such as energy companies, would perhaps not have entered the market; and the fact that the largest manufacturers of wind technology in Spain—such as Gamesa and Desa—have/had an ownership link with an energy company indicates the importance of this group of actors. Several regional public authorities have also acquired ownership shares in some important manufacturers, such as Gamesa, which is a strong indicator that the economic support for wind power is likely to remain attractive for a long time. PPPs were also helpful in generating knowledge related to project development and permitting procedures; investors needed to learn mastering these aspects, in the process of becoming mature market players. PPPs also helped overcoming other obstacles, such as related to spatial planning, administrative permitting and local opposition; the involvement of public actors ensured shorted waiting times for permits and lower risks that projects would be rejected.

The usefulness of PPPs will differ, however, from country to country. Institutional, cultural and other contextual factors may play important roles in the usefulness of this policy. This paper shows that in countries where highly risk-adverse commercial actors dominate, PPPs can be an effective way to raise interest in sustainable energy investments. The empirical data on this case study showed that, during the technology-development and early-commercialization stages, public authorities and private actors with an energy/industrial technology track record (electricity companies; manufacturers of technology) were in the 'front-line' of partnership formation; they had the most substantial financial contribution to projects. During the transition phase, public authorities moved to the background, while specialized financing agents came to the fore in partnerships; public authorities gradually diminish their financial contribution, while banks and specialized investors increased their investments either by means of equity or by enabling project finance loans. Almost all interviewees underlined that, in Spain, the involvement of IDAE as capital investor was crucial for winning the trust of banks and insurance companies in wind power (Dinica, 2003). As a result of PPPs' use, during the later phase of diffusion, new business relations have been formed that no longer needed the presence of public authorities to hold-together a partnership. This signals the transition towards new fully-private partnerships with sustained investment interest in a renewable electricity industry.

For academics, a focus on diffusion patterns is important to help explain diffusion results across countries. Next to the details of price support design, other aspects are also of crucial importance in diffusion; for example: who is behind the investments being made, and why? Who is actually legally allowed to invest in renewable energy technology? It makes a difference if investors such as energy companies and public authorities may be (co-)owners of projects. This is not in all countries the case. In Spain, all kinds of actors were allowed to invest; and this resulted in the competition that emerged to submit project proposals in since late 1990s. Most importantly, public authorities and agencies are allowed to invest to a significant extent. The uniqueness of the Spanish support system lies in the institutional and cultural context, and in the policy of PPP, and not in the feed-in tariff.

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