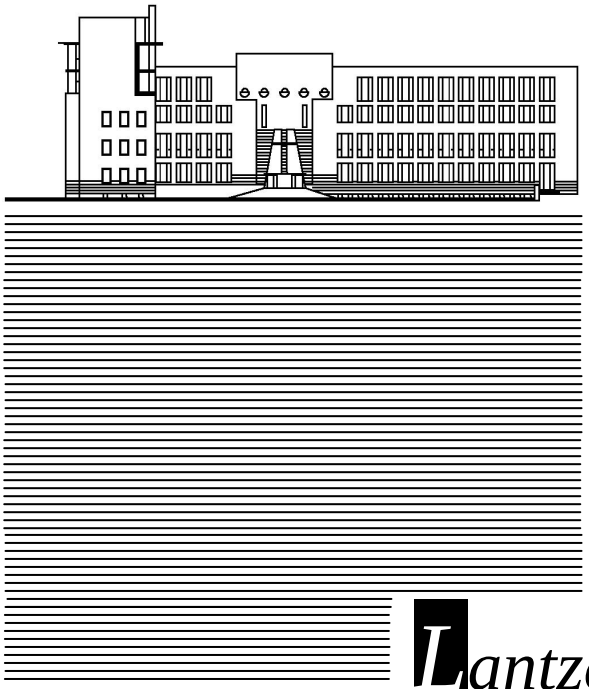


Lantze-bidean
Documentos de trabajo
Documents de travail
Working Papers

2011/02

eman ta zabal zazu

Universidad del País Vasco
Euskal Herriko Unibertsitatea

www.enpresa-donostia.ehu.es

Documento de Trabajo 2011-02 *Lantze-bidean*
E.U.E. Empresariales – Enpresa Ikasketen U.E.
Donostia-San Sebastián
Euskal Herriko Unibertsitatea – Universidad del País Vasco

A GREEN BUBBLE?

AN ECONOMIC ANALYSIS OF THE RECENT EVOLUTION OF THE SPANISH RENEWABLE ENERGY SECTOR

Iñaki Heras Saizarbitoria
Dpto. de Organización de Empresas / Enpresen Antolakuntza Saila
Universidad del País Vasco / Euskal Herriko Unibertsitatea
iheras@ehu.es

Ernesto Cilleruelo Carrasco
Dpto. de Organización de Empresas / Enpresen Antolakuntza Saila
Universidad del País Vasco / Euskal Herriko Unibertsitatea
ernesto.cilleruelo@ehu.es

Ibon Zamanillo Elguezabal
Dpto. de Organización de Empresas / Enpresen Antolakuntza Saila
Universidad del País Vasco / Euskal Herriko Unibertsitatea
ibon.zamanillo@ehu.es

Research Group on the Socio-economic impact of Green Technologies (SiGT)
Department of Business Management
The University of the Basque Country
Spain

A GREEN BUBBLE?

AN ECONOMIC ANALYSIS OF THE RECENT EVOLUTION OF THE SPANISH RENEWABLE ENERGY SECTOR

ABSTRACT

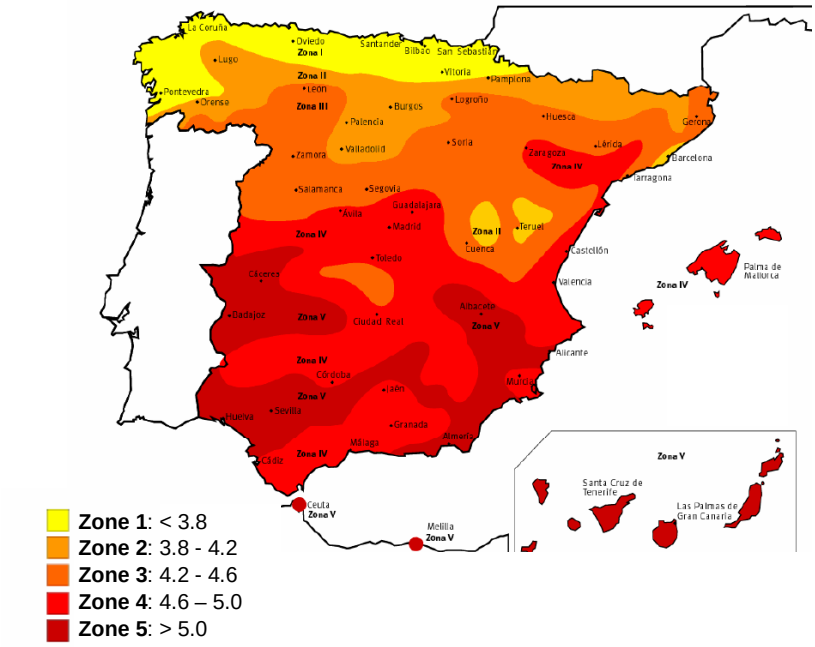
Within a few years the Spanish renewable energy sector has become well-known throughout the world, owing to the sharp increase experienced in its installed capacity. Regarding the sector of photovoltaic solar energy, a single datum clearly illustrates the boom period experienced by the renewables: during 2008, Spain almost quadrupled its potential of installed photovoltaic solar energy, a genuine world record. This article addresses the extraordinary development of the Spanish photovoltaic sector during the period 2004-2010, a case that has gained international momentum. This working paper establishes groundwork for further empirical economic research.

1. Introduction

Spain, owing to its location and climate, is one of the countries in Europe with the most abundant solar resources [1]. Global solar irradiation on a horizontal plane is estimated as being at between 1.48 and 3.56 kW/m2 day in Spain. It also has the advantage of being distributed relatively evenly throughout the territory, to the extent that variations in solar irradiation seldom occur (see figure 1).

Paradoxically, until a few years ago, installed per capita photovoltaic solar energy was much lower than the European average [2]. Indeed, its impact on the total percentage of electricity production is still minor (see figure 2). Nonetheless, a huge growth has been experienced in the installed capacity of the Spanish photovoltaic (PV) sector in the last years. As will be analyzed in the following section of the article, it would seem clear that public intervention in the sector has played an essential role in its development.

Figure 1. Average irradiation in Spain according to climate zones



Source: Spanish National Meteorological Institute. Note: Average daily irradiation in kWh/m^2 generated from annual global solar radiation isolines on horizontal surface.

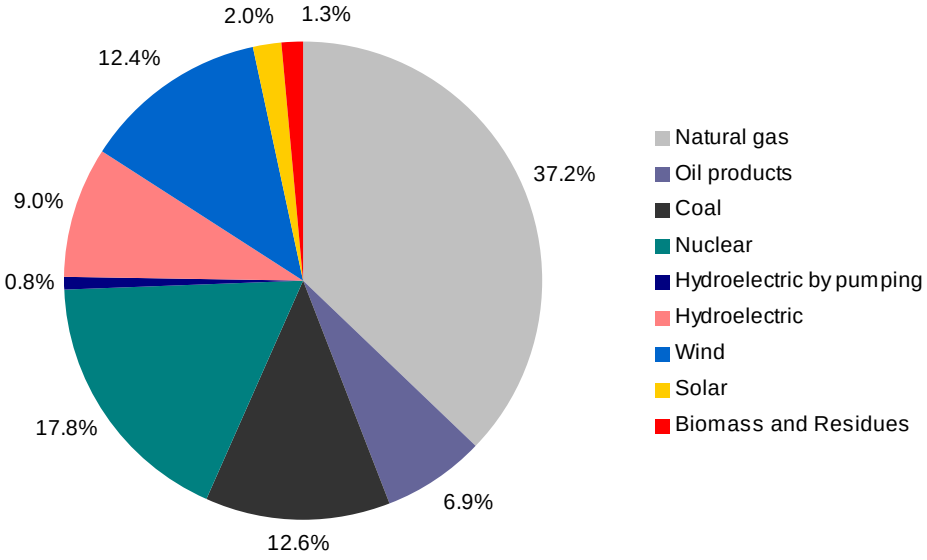
In effect and despite the fact that since the early 1980s, Spain has seen an important increase in the number of industries that manufacture the equipment necessary for the production of photovoltaic electrical energy [3], it was only with the coming into force of the Plan for the Promotion of Renewable Energies in 2004, that a programme for the extensive establishment of photovoltaic solar energy was included. This gave the sector the push needed to develop it.

This growth in production capacity has also been accompanied by a vertical integration process on the part of companies in the sector that have tried to reduce their dependency on suppliers —above all international manufacturers of polysilicon and ingots [4]. As in other leading

countries, the development of PV technology plays a crucial role in Spain in order to reach the expected reduction in prices and, secondly, to achieve grid parity as soon as possible.

Spain has some of the most important R&D centres in Europe with over 20 years' experience in this field. The Solar Energy Institute at the Polytechnic University of Madrid, Ciemat and two Catalan Universities (Polytechnic University of Catalonia and University of Barcelona) have developed lines of research aimed at improving cell efficiencies by using new concepts, e.g. the intermediate bandgap concept introduced by the Solar Energy Institute. Furthermore, new players in photovoltaic research are bringing fresh and new ideas to the scientific community, exploiting the expertise in related fields; an example of this is the Nanophotonics Technology Centre at the Polytechnic University of Valencia [5].

Figure 2. Structure of electricity production in Spain (2009)

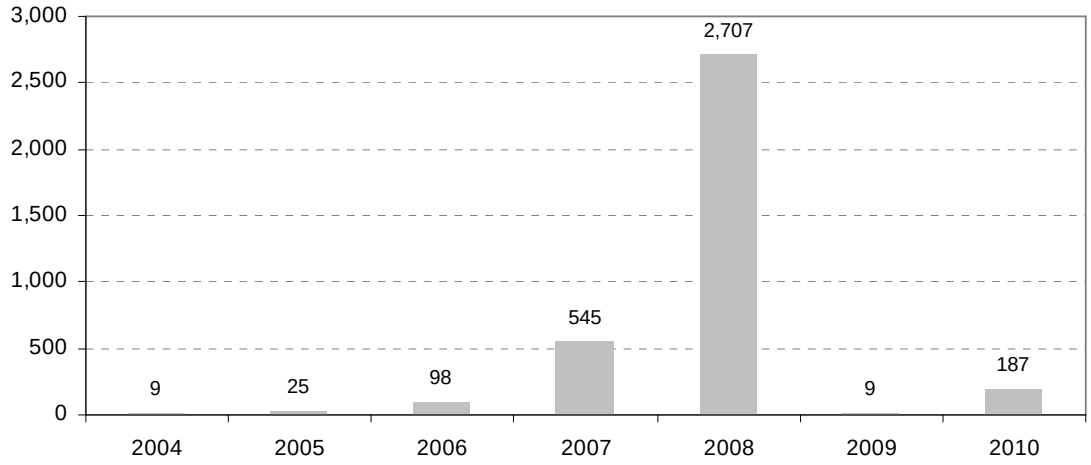


Source: MITyC.

2. The huge rise in PV production

In Spain, the public boost given to PV solar energy started with the Plan for the Promotion of Renewable Energies approved by the Government in 1999. The aim of the plan was to account for 12% of energy consumption by the year 2010. The Spanish Government primarily set two mechanisms in motion: on the one hand, by setting regulated rates via a feed-in tariff (FIT) mechanism with some very attractive premiums; on the other hand, by establishing incentives in the form of preferential access to credit (via the ICO, the Official Credit Institute). However, in accordance with some researchers, these mechanisms did not turn out to be particularly necessary [6] in addition to subsidies from the Institute for Energy Saving and Diversification and the Spanish regions.

Figure 3. Installed cumulative PV capacity per year in Spain (2004–2010)



Source: put together by the authors from CNE data. Note: 2010 data as at August of that year.

Nonetheless, the true public commitment to renewable energies in general and to PV solar energy in particular did not really get underway until, in a more favourable economic climate, the Plan for the Promotion of Renewable Energy (PER) 2005 was designed, which established an objective of 371 MW installed capacity by 2010. In the period since the PER 2005 was designed until the end of its temporary lifespan (2004-2010), five regulatory systems came into effect regulated by four Royal Decrees (RDs): RD 436/2004 (2004-2006), RD 661/2007 (from June 2007 to August 2007), RD 1110/2007 (from September 2007 to September 2008), RD 1578/2008 (from September 2008 to December 2010) and the RD 1565/2010 (starting from December 2010). The recent work by de la Hoz *et al.* 2010 [7] analyzes the development of this regulatory framework that established the incentives in greater depth and more rigorously, without undertaking an analysis of the latest reforms that will be analyzed in the next section of this article.

In short, the fact of the matter is that already by September 2007, 85% of the 371 MW goal set for 2010 was reached. Moreover, one only has to refer to a single datum to clearly illustrate the boom period experienced by the Spanish photovoltaic solar energy sector (see figure 3): during 2008, Spain installed over 2,700 MW, whereas by the end of the previous year —in 2007— its

installed capacity was approximately 700 MW. Thus, it almost quadrupled its potential in one year — a genuine world record.

There are many factors that need to be taken into consideration to help understand the phenomenon of the boom and slump that have occurred recently in Spain between the years 2004 and 2008 in the photovoltaic sector, from the socio-economic standpoint. By way of a summary, the most important factors can be grouped together into three:

1. The scope and characteristics of public intervention: public intervention in the sector was of an extraordinary intensity and, according to what can be gathered from analyses carried out on the subject, not altogether successful [7]. The Spanish Government approved a line of assistance for the photovoltaic tariff without any link to the gradual reduction in costs as a consequence of technological development and learning economies. This gave rise to over-incentives, which enabled certain possibly excessively attractive business margins to be glimpsed [CNE]. Additionally, owing to a regulatory peculiarity, Spain failed to establish a maximum limit for power to be installed between September 2007 and September 2008, thus resulting in its proving to be of great appeal. Reports published by CNE and the Ministry of Industry show the existence of an over-incentive in the economic framework applied to the grid-connected PV systems. As de la Hoz *et al.* 2010 [7] analyzed, one of the main reasons for the outsized installed cumulative PV power was the control action implemented, which in fact did not take into account the degree of accomplishment of the objectives of the economic policy in order to modulate the value of the FIT being applied. Attention should also be drawn to the fact that during the period under consideration, many of the bureaucratic obstacles inherent in the different Spanish public administrative bodies were relaxed in order to promote investment in the sector.

2. The national and international financial situation: on the one hand, attention should be drawn to the fact that in the years prior to the expansive growth in the PV sector, there was major liquidity in Spain due to the fact that real interest rates were maintained at historic minimums. Thus, banks provided very easy credit to investors to invest in all types of sector [8], and the PV energy sector was no exception. In addition, it should be taken into account that after 2006 there were diverse international bodies (e.g. the IMF, OECD) that predicted an imminent bursting of the Spanish property bubble. Thus, many investors saw a profitable and safe investment option in the PV sector. Along the same lines, the subprime crisis in the USA exploded on the international stage in the 2007, which had a huge impact on financial markets: as a consequence of this crisis, there would be major disinvestment in financial sectors which in turn gave rise to a high level of liquidity resulting in investment being sought in safe and profitable products in the long term —so that investors could protect themselves from the instability existing on the financial markets.

3. Technical features of the sector's development: different features unique to the Spanish sector made very rapid growth even easier, if possible [6,7]. On the one hand, as far as accessibility to the grid was concerned, the electrical system and distribution networks in the country were able to absorb the huge volume being installed. New solar plants were able to be connected in large regions of the country. Additionally, as far as the characteristics of the plants installed were concerned, it should be taken into account that owing, among other factors, to the geographic features of the country, the vast majority of the installed power corresponded and continues to correspond to ground facilities of a certain relative size, rather than to a model focused on small installations located in buildings. The last-mentioned model would not have been able to undergo such rapid development.

3. New legal and policy framework

In view of this situation, the Spanish Government decided after 2008 to carry out a brusque reconversion of the Spanish PV sector within a socio-economic context, highlighted by the major prevailing crisis.

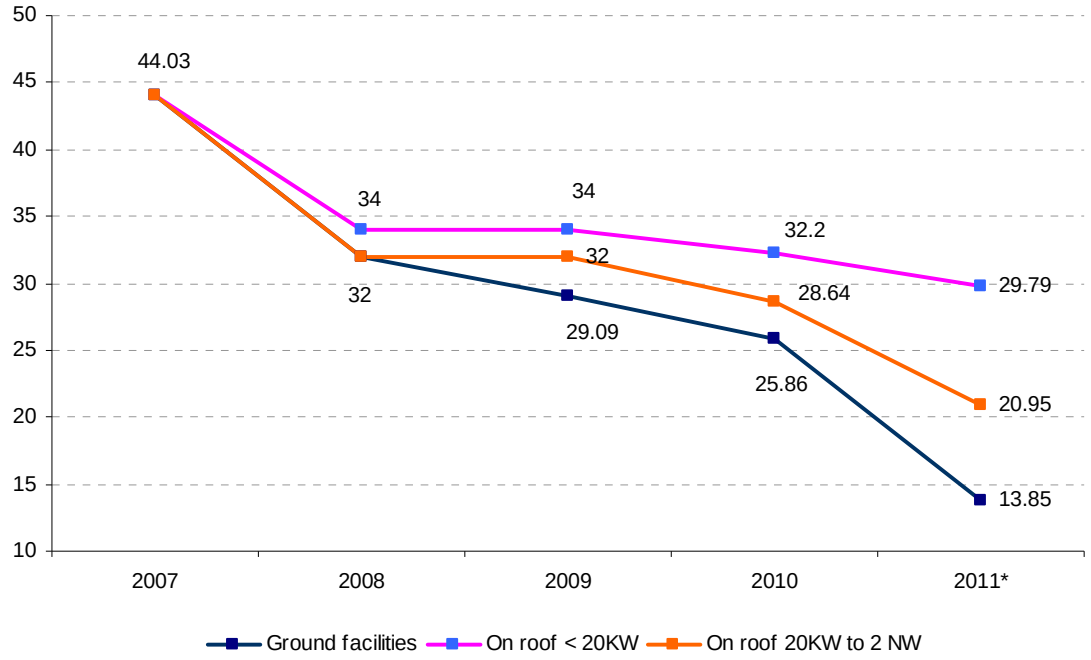
Royal Decree 1578/2008 set forth a very restrictive regulation for the industry and the Spanish PV sector facing a substantial change of paradigm. This new regulatory framework was based on a system of increasing quotas and decreasing tariffs, to try and boost installations in buildings. It greatly decreased payments for new installations, applying a reduction close to 30%, which especially affected the ground-installed photovoltaic industry. Moreover, a quota system was implemented to monitor the expansion of the industry. Following a slowing down of development in the sector in 2009 and 2010 due to this first reform, the Spanish Government enacted the new Royal Decree 1565/2010 in November, whereby an attempt was made to have an effect on the sector's reconversion.

Within this new regulatory framework are included cuts in premiums that range from 5% for small roof installations, to 25% for medium-sized roof installations and 45% for ground installations. Likewise, the new regulation contemplates a 25-year limit on lifespan in terms of the right to earn an equivalent premium that was established in previous regulations. Furthermore, a retroactive effect has been applied, replacing the right to earn the equivalent premium for photovoltaic installations on reaching their 25-year lifespan. The new regulatory framework also includes other new features aimed at improving the technical integration of installations of renewable sources of energy and cogeneration sources, as well as simplifying and facilitating administrative procedures.

With the new Royal Decree, it has been made clear that there is more emphasis on household systems in any political reforms the Spanish Government wishes to make. Prior to the crash, vast and somewhat controversial ground-mounted arrays made up the bulk of installations. These may now be a thing of the past.

The Government points out that the main aims of the Decree are: to reduce costs, especially those of photovoltaic energy, to the benefit of consumers; to improve the technical integration of renewable source and cogeneration installations, and to simplify and speed up applicable administrative procedures. The Government's argument in favour of reducing aid for the sector is clear: the public coffers are in bad shape and a message of austerity needs to be conveyed to the markets. The cuts, which will come into force in December 2010 (although the reduction in tariffs may well start to be applied in the first official announcement in 2011), will enable an estimated 607.2 million Euros to be saved until 2013. This amount is divided up into 141.5 million in 2011, 202.3 million in 2012 and 263.4 million in 2013.

Figure 4. Evolution of the PV tariff (c€/KWh) *in Spain*



Source: EPIA and CNE. Note (*): Government proposal.

The Spanish Photovoltaic Industry Association (ASIF) rejected the plan for the new regulation and condemned the fact that the new law would reduce the sector by 50%. Although the associations guarantee that this measure is clearly retroactive in nature and is therefore patently anti-constitutional, and they also express their strongest possible objection to the consideration of any such retroactive reduction, government sources have predicted that the judgement issued by the State Council has validated the legality of the regulation.

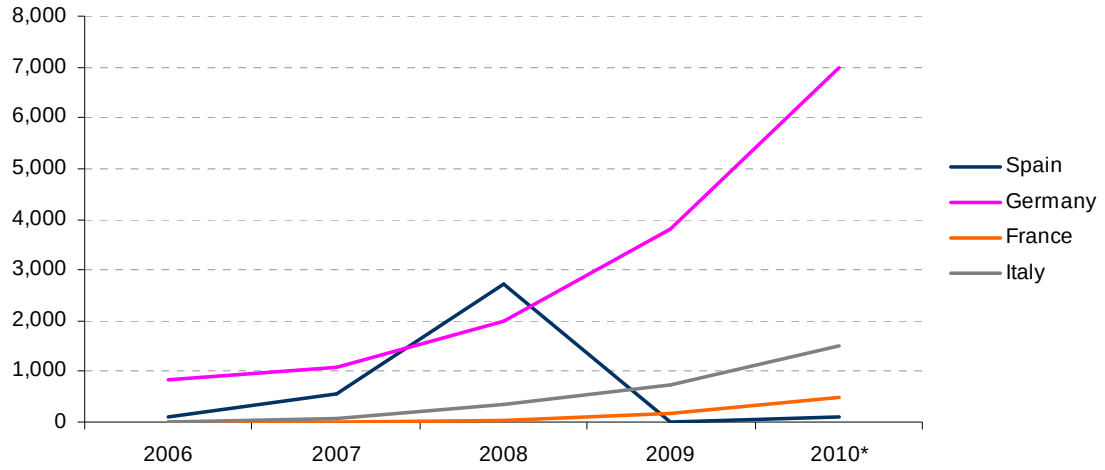
Therefore, less than 200 MW has been installed in nearly two years according to CNE data, which is in marked contrast to the results in the sector obtained from other countries (see figure 5). The uncertainty surrounding the regulation has brought the Spanish market to a standstill.

Looking to the future, it appears difficult to make forecasts as far as Spain's future evolution in the sector is concerned. The 2009/28/CE Directive issued by the European Parliament and Council dated 23rd April 2009 governing promotion of the use of energy deriving from renewable sources, sets a 20% quota for energy deriving from renewable sources as a general objective in the gross end consumption of energy in the transport sector in each Member State for the year 2020. To do this, it sets out objectives for each Member State by 2020 which, for Spain, translates into the fact that renewable sources will represent at least 20% of end energy consumption by the year 2020 —the same objective as for the EU average— together with a 10% contribution of renewable energies in transport by the same year. In accordance with the new National Action Plan for Renewable Energy for the period 2011-2020 (PANER), this objective would appear somewhat demanding.

Specifically, the foreseeable contribution of photovoltaic solar energy towards complying with the binding objectives for 2020 is estimated at 14,316 GWh, generated by an installed cumulative capacity by 2020 of 8,367 MW. The increase in capacity during the period 2011-2020 is estimated at 4,346 MW. Similarly, the European Photovoltaic Industry Association

estimates that this market could continue to add around 375–500 MW a year until 2013, which would maintain Spain as one of the top global markets, and enable PV to generate 4%–4.5% of the national electricity demand (equating to roughly 20% of domestic household electricity demand).

Figure 5. European comparison of the increase in production in the PV sector



Source: EPIA and CNE. Note (*): estimation.

On this point it should be made clear that even if the major criticism of the PV industry lies in the fact that public incentives are crucial elements for its survival, this criticism should be made within a suitable context and playing it down in respect of the type of public intervention existing in other sectors. Indeed and as is highlighted in specialist literature on renewable energy sources [e.g. 6,9], it should be pointed out that other energy industries also receive massive subsidies from governments both directly and indirectly. Attention should also be drawn to the fact that, like many nascent industries, the public policy implemented to promote the sector and PV solar energy proves very important – among other factors, because a vicious circle emerges in which the technology is not adopted because it is expensive, and the fact that it is expensive because it is not adopted has to be broken [10].

4. Discussion and further research

Have we experienced a new economic bubble? In other words, could the huge rise in PV production experienced in Spain be referred as a renewable energy bubble? In our view, wanting to highlight the nature of the bubble created in this situation is clearly of interest in comparing it to the residential real estate bubble which in Spain saw real estate prices rise by 200% from 1995 to 2007 according to the Spanish Ministry of Housing.

In short, we don't think the experience of the Spanish PV sector should be labelled, strictly speaking, as an economic bubble. In our view and taking the specialist economic literature that analyzes the characteristics evident in the formation of speculative bubbles as a reference [e.g. 45], what took place in Spain between September 29th 2007 to September 29th 2008 should not, strictly speaking, be categorized as a speculative bubble, as the changes that occurred need to be understood in terms of market fundamentals. In short, it was a rational response to an over-incentive error [11] in public policy involving the promotion of the photovoltaic industry. Nonetheless, it is noted that in general public debate the terms *bubble* has ended up collectivizing Spanish public opinion, with this metaphor having a major influence. In our opinion, this is a good example of a key metaphor which, like other rhetorical devices, are deployed by journalists (and quite possibly some academics too) in order to convince the public opinion by putting a situation in a particular light [12].

Finally, regarding the evolution of the Spanish PV sector there are a set of interesting issues that could be taken into account for further research:

- *Capacity for job creation*

The general public debate on the capacity for job creation of the PV sector has been very long-winded in Spain in recent years. The seeds of this debate derive from the publication of a series of studies aimed at analyzing the impact of renewable energies on employment, in a country in which even during the most expansive part of the economic cycle relatively high levels of unemployment were maintained in comparison to other European countries, and in which public opinion is very sensitive to this social problem. As regards this point, there are two markedly different cases of discourse: on the one hand, there exists discourse that highlights the possibility of creating jobs in the sector based on reports issued by different bodies [e.g. 13], and, in contrast, one which points out that support for the renewable sector has a bearing on the loss of jobs in other industries and even in net terms [14,15].

- *Cost of the energy produced*

Another of the great debates which has been reflected in the media has focused on the cost of energy produced in the PV sector, and on whether the PV energy promotion system via FIT raises or lowers the cost of electricity. The standpoint that is critical towards the contribution made by the PV energy sector, pints out the increase in Spanish electricity rates. This standpoint is directly in contrast to the stance taken by defenders and promoters of PV energy. These sources point out that if premiums received by renewable energies as a result of the generation of energy are compared to the cost saved in CO2 emission rights and imports of replacement fossil fuel, then renewable energies constitute a good business for Spain. It is also stated that renewable energies reduced the total cost of electricity by 15% in 2009. It is argued that Spain has managed to become an inexpensive energy producer in record time in relation to others, and in turn completes the greatest price reduction cycle among all renewable sources. Along these lines, it is interesting to point out that several studies from Spain and beyond indicate that PV energy will soon be cost effective and will not require the co-financing offered by FITs, since grid parity will be reached around 2012 [e.g. 16].

It would seem clear that this is a question of interpretation and perspective in terms of the internalization of costs. Indeed, Díez-Mediavilla *et al.* [1] state, not only does this take into account purely economic factors, but social and environmental ones as well, such as the price of electricity, greenhouse gas emissions, availability and technological limitations, electricity generation efficiency, and environmental and social impact —as del Río and Unruh [17] point out—, rural and regional development opportunities, reduction in unemployment levels and local acceptance.

- *Investment in the sector*

Another aspect to which attention has been drawn is related to the characteristics of investors and investments made in the Spanish PV sector. The perspective that analyzes the development of the sector from a very critical standpoint tend to point out that the vast majority of investors in the Spanish PV sector belong to major financial or business groups. In other words, they establish an average profile of the clearly corporate investor. In contrast, the standpoints which are most in favour of developing the sector, such as those taken by producer associations, stress that the reality of the situation is something quite different. It is argued that most investors are in fact small promoters: families, SMEs, small investors who at the time preferred to invest in renewable energies rather than in the property sector.

From the analysis carried out by the authors of this article and Rivela-Rodríguez [59], the following may be gathered from the Special System Installation Registry published by the Ministry of Industry:

> - There are currently over 50,000 photovoltaic installations in Spain connected to the national grid and, according to what can be gathered from the analysis, the vast majority do not appear to belong to large financial or business groups.
>
> - Over 35,000 installations are of less than 20kwn, belong to small private investors, families or SMEs that invested an average € 20,000, and became indebted by a € 80,000 over a 10 year period [18].
>
> - A further 13,000 are company installations (SMEs) of an average 100 kw on roofs of industrial premises that invested an average €100,000, and became indebted by a further €400,000.
>
> - Most solar farms were promoted with a view to encouraging participation by small savers, as only a limited number of installations were promoted by investment funds and large groups of companies. According to data published by the sector and analyzed in the field work, only 5% of solar farms were equipped with installed capacity of over 15 MW.

Another issue that generated a certain amount of debate with regard to investment in the sector is the aspect of rates of return that has already been mentioned. Critical stances highlight the high rates of return obtained, most of the time without going into details about the specific investment figures and their average rates of return. In the cases of impact gathered from stances within the sector or close to it, these defend the fact that investors made their investment by taking Government incentives into account and foreseeing returns of their investment deemed not at all speculative —corresponding to pay backs of between 9 and 12 years. From the field work that we've carried out it can be gathered that, in advertising from companies that attracted and continue to attract small investors, photovoltaic solar energy offers the chance to obtain returns estimated at 10% of their investment over € 15,000 [19]. However, it *was* ascertained that viability calculations provided by some companies that we have been able to consult (e.g. IRRs of 15%) invite over-optimism, if one takes into account specialist literature available for calculating IRR [20].

Looking to the future, there is a need for research that combines qualitative and quantitative approaches on the economic evolution of the Spanish photovoltaic sector and other sectors of renewable energies. For that purpose, contributions should be made from a clearly inter-disciplinary perspective by taking the complex interrelations into consideration that exist between the technical, political, economic and social implications of renewable energy sources.

6. References

[1] M. Díez-Mediavilla, C. Alonso-Tristán, M.C. Rodríguez-Amigo, T. García-Calderón, Implementation of PV plants in Spain: A case study, Renewable and Sustainable Energy Reviews 14 (2010) 1342–1346.

[2] I. Martínez de Alegría, P. Díaz de Basurto, I. Martínez de Alegría, P. Ruiz de Arbulo, EU's renewable energy sources and energy efficiency policy review: The Spanish perspective, Renewable and Sustainable Energy Reviews 1 (2009) 100-114.

[3] C. Espejo, La energía solar fotovoltaica en España, Nimbus 13-14 (2004) 5-31.

[4] E. Collado, Energía solar fotovoltaica, competitividad y evaluación económica, comparativa y modelos, E.T.S. Ingenieros Industriales, UNED, Madrid, 2009.

[5] E. Pérez, Temors in the Spanish Photovoltaic Industry, Polytechnic University of Valencia, 28 June 2010.

[6] V. Salas, E. Olías, M. Alonso, F. Chenlo, Overview of the legislation of DC injection in the network for low voltage small grid-connected PV systems in Spain and other countries, Renewable and Sustainable Energy Reviews 12 (2008) 575–83.

[7] J. de la Hoz, O. Boix, H. Martín, B. Martins, M. Graells, Promotion of grid-connected photovoltaic systems in Spain: Performance analysis of the period 1998–2008, Renewable and Sustainable Energy Reviews 14 (2010) 2547–2563.

[8] J. García-Montalvo, Financiación inmobiliaria, burbuja crediticia y crisis financiera. Lecciones a partir de la recesión de 2008-2009, Papeles de economía española, 122 (2009) 66-85.

[9] Fundación Biodiversidad and Observatorio de la Sostenibilidad en España, 2010 Informe Empleo verde en una economía sostenible, Madrid, 2010.

[10] P. Del Río, M. Burguillo, An empirical analysis of the impact of renewable energy deployment on local sustainability, Renewable and Sustainable Energy Reviews 13 (2009) 1314–1325.

[11] Consejo de Administración de la CNE, 2008. Informe 30/2008 (CNE 297/ 2008. 29/07/2008).

[12] T.A.Van Dijk, News as Discourse, Lawrence Erlbaum, Hillsdale, New Jersey, 1988.

[13] ISTAS (Instituto Sindical de Trabajo, Ambiente y Salud), Energías renovables y generación de empleo en España, presente y futuro, Madrid, 2007.

[14] G. Calzada, R. Merino, J.R. Rallo, J.I. García, Study of the effects on employment of public aid to renewable energy sources, University Rey Juan Carlos, Madrid, March 2009.

[15] M. Fernández-Ordóñez, Lo insostenible de la Sostenibilidad con Energías Renovables, Grupo de Estudios Estratégicos, Madrid, Enero de 2010.

[16] Spanish Photovoltaic Industry Association, El papel de la generación fotovoltaica en España, Madrid, 2007.

[17] P. del Río, G. Unruh, Overcoming the lock-out of renewable energy technologies in Spain: The cases of wind and solar electricity, Renewable and Sustainable Energy Reviews 11 (2007) 1498–1513.

[18] A. Rivela Rodríguez (Finance Associate Professor IE University), La verdadera situación de la energía fotovoltaica en España, June 2010

[Online at: http://finance.blogs.ie.edu/archives/2010/06/la-verdadera-situacion-de-la-energia-fotovoltaica-en-espana.php].

[19] Instituto para la Diversificación y Ahorro de la Energía, Energía Solar en España: Estado actual y perspectivas, Madrid, 2007.

[20] D.L. Talavera, G. Nofuentes, J. Aguilera, M. Fuentes, Tables for the estimation of the internal rate of return of photovoltaic grid-connected systems, Renewable and Sustainable Energy Reviews 11 (2007) 447–66.

Acknowledgements

This article is a result of a Research Group funded by the Basque Autonomous Government (*Grupos de investigación del sistema universitario vasco; IT423-10*). The authors are especially grateful to the stakeholders who were interviewed from the sector. Likewise, the authors sincerely thank the comments given by Jordi de la Hoz, from the Universitat Politècnica de Catalunya.