Report on the design of environmental normative to promote renewable energy at local level

Document to be submitted as part of

ENERMED project - Pobla de Vallbona

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Prologue

This document is an output of a long experience of collaboration between a variety of actors involved in renewables energy and climate change. A community of practice in environmental issues has been created in Valencia region in the last few years starting from successful experiences as the program “Pioneers into practice” of Climate KIC platform and other university-government-business initiatives. Resources from different projects and initiatives were the base to develop this report and some of the critical ideas included in the proposed normative on the promotion of renewable energy for the city council of Pobla de Vallbona. As part of the search of new governance mechanism the following professionals and regional actors were part of this process to deliver an innovative result in term of process of policy design and participation:

- *Jose Luis Muñoz, Fundación Comunidad Valenciana Región Europea*
- *Mabel Sanchez Barrioluengo, Institute of Innovation and Knowledge Management - INGENIO(CSIC-UPV)*
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Further institutions and citizens to be included in a process of consultation among expert and non-expert knowledge are planned regarding the normative on renewable energy. The following document summarizes the key elements and idea included in the normative and belonging of a wider discussion within this emerging reflexive governance environmental regional system.

1. Introduction and objectives

This document aims to provide an extended description of the elements considered to propose a normative on renewables energy for the city council for Pobla de Vallbona in Valencia region (Spain). The proposed normative has been developed as part of the participation of the city in the European project ENERMED- Mediterranean renewables energy1 which seeks to reinforce the ole of regional authorities through different planning instruments, facilitate support mechanism for renewables energy and analyze and evaluate the situation of the energy sector by considering an multilevel environmental governance system.

With this initiative, the city council la Pobla de Vallbona looks for demonstrate and experiment on multipliers effect coming from the combining private investment with public funding. On the other hand, it looks to highlight the long term impact of the design of public policies by including critical actors on renewables energy to develop a shared vision and strategy. For doing so, the city council has promoted the creation of an “Innovation board” in order to generate valued added from the knowledge exchange embed in the region for the development of a renewable energy model based in a “integrated and multisectorial approach”.

The critical actors involved in this document are the Instituto Tecnológico de la Energía (ITE), Instituto Valenciano de la edificación (IVE), Fundación Comunidad Valenciana Región Europea (FCVRE) and the Institute for Innovation and Knowledge management –INGENIO (CSIC_UPV). This institutions has contributed to this document with their expertise on renewables energy, environmental normative, innovation policy and governance but also by analyzing and exploring the important multilevel background given by the European normative and the Covenant of Mayors on energy sector (2009).

To sum up, this document will describe an analyse the elements applied to design the proposed environmental normative to promote renewable energy (RE) at local level intertwine policy networks, multilevel governance and environmental policy that contribute to a better understanding of interaction between different actors and levels of governments. In addition, it provides guidelines of different mechanisms (such as activities and policy instruments) to support and manage networks to solve conflicts and achieve multiple objectives.

The document is framed in the following section: multilevel policy framework, where a top down perspective is applied to describe the set of normative and regulation affecting the sector; Best practice on promotion of renewable energy, where focus is put in the set of instruments driven by governments to foster the renewables energy sector; Valencia community and renewable energy, where main features are described as part of the context of ENERMED project; Society of knowledge and renewable energy in Valencia region, where the creation of networks and their activities are described and analysis and, finally Technology development of renewable energy in Valencia region, where main advances on renewables energy and related technologies are presented.

[1] http://www.enermedproject.eu/

2. Multilevel Policy framework

In the last two decades, an international system emerged among the main cities in both industrialised and developing countries which strongly interact with regional and local craft practices. The understanding of the pattern of development and the diffusion of green technologies cannot be separated from the broader technological, economic and political contexts confined to the urban sphere, specifically to a local arena of governance. Factors belonging to that broader context may explain how a variety of environmental techniques and approaches to sustainability have emerged in different locations by strongly combining innovations developed at international level with regional and local craft practices (Gann, 2003).

In this context Renewables Energy (RE) became less constrained by the local context and emerged to international markets. From an industrial perspective, two factors are critical in this movement: 1) technological developments in the supply side introducing new materials, components, and energy efficiency artefacts and, 2) the transnationalization of big RE companies. These events have been keys in the development of a regulatory policy framework at all levels. These mandatory regulations (i.e. norms and standards), linked to support measures as funding public research institutes or R&D subsidies, focus on the intervention in the innovation process by the exploration of how traditional activities and instruments facilitate this innovation (Beerepoot, 2007).

By considering the multilevel perspective the European, national, regional and, even more, local policies should be harmonized. However, the coordination dilemma appears as long as there is a possibility that policies of one jurisdiction have impacts (positive or negative) for other jurisdiction. Divergence on policy objectives, outputs and outcomes can generate implementation problems, and thereby, can force decision-makers to start again and to reformulate the policy objectives and strategies (Busch *et al.,* 2005). To find the balance between different levels of legislation is necessary to avoid significant misfit between policies at different levels.

This section includes a description of the key events, policy and programs at international, national and regional level to understand the change operated in a multilevel perspective on renewables energy and brief summary on the related Green building technologies sector.

2.1. International level: European Union (eu)

The environmental governance system involves new configurations of state and non-state actors playing a variety of roles under overlapping and competing authorities at different levels (Bulkeley and Betsill, 2005). The implications for local economies in term of the compatibilities (objectives, activities and instruments) with higher political levels (e.g. EU) and global organisations (e.g. NGOs, MNC) are substantial. EU legislation effectively creates the starting point from which local proactive strategies can proceed (Flynn, 2000).

In the second half of 90´s the EU establish the new rules for the energy market. The Directive EU 96/92/CE facilitated the common norms to set up internal energy markets

by guarantying security of supply under environmental criteria. Key actors as energy producers, transporters and distributors and their roles were defined where the each national state support the liberalization through subsides and open litigations. Finally, national governments can set up security of supply rules.

The promotion of renewable energy market stated with the Directive 2001/77/CE hen for the very first time, the EU keep the right to impose common norms among members states. Thus, members state began to be supervised on the development of renewable energy market by the requirement of submit periodical report to EU. At the same time, the renewables started to be understood in term of external markets opportunities. Three important statements o can be highlighted from the normative:

1. National goals for achieving the coverage of 12% of electricity demand with renewables energy by 2010.
2. Energy production with renewables energy should be 22,1% of total EU energy matrix (29,4% for Spain)
3. Each country can develop his own strategy to follow and commit the common framework

At this stage, the EU have not considered to propose a harmonized European system but only proposed to coordinate the supporting schemes to foster the cooperation between countries and the impact on national systems. In the following years, two directives define complementary aspects of the scheme

First, the Directive 2003/30/EC emphasize the support to specific renewables energies related to be applied in transport, in particular, biofuels. Second, the Directive 2003/87/CE established the regime on emission rights trade for green gas house. This scheme sets the limits on the base of Kyoto protocol and the new emission market. This mechanism looks for have an impact on the competence for more efficient and clean technologies in order to allow penalties to overtake the national limits.

Finally, the Directive 2009 modifies mainly the precedent Dir. 2001/77/CE. It set up the general binding objectives on renewables energy production for year 2020 in Europe. It enunciates a set of plans by with each state member should accomplish the directive in term of gross final energy consumption. It includes a new calculus mechanism for imported energy and the relevance of development lead by regions and SMEs. Decentralization of energy productions is also explicitly supported as well as an independent quota of renewable energy related to transport use.

2.2. National Level: Spain

As it was mentioned before, Spain showed an early leading position on renewables normative. Then, the evolution of the normative portfolio may be described in subsequent stages: the creation of energy market, the creation of renewable energy market and finally the crisis situation where conditions for the maturity of sector are established. They are briefly described below.

I. 1990-2000. Creation of internal energy market

The liberalization of energy market was early defined by the Energy National Plan **(PEN 1991-2000)** without putting attention to renewables energy (RE target was initially 3.2 %) but emphasizing the importance of security of supply. The national energy balance and the efficiy are key issues in the plan where environmental issues are introduced by "demand control regulatory" rather than the promotion of new technologies. At the same time, the market internationalization is considered in term of expectation regarding the creation of a common European Energy Market.

The first normative introducing renewables energy as structural in the system was the Royal decree **(RD) 2366/1994**. The normative provided new conditions for hidro, cogeneration and other renewables related infrastructures related to waste management under a special regime. The regime imposed the obligation to distribution networks of acquiring exceeding energy from those installations whenever it was technically possible.

After that, two laws where presented which settle the base of new market conditions. The **law 40/1994** creates a special regime to support electricity generation by renewables and cogeneration by which special tariff scheme and prices are defined and regulated by royal decrees. The following **law 54/97** (and related **RD 2818/1998**) seeks to consolidate the liberalization of energy market by introducing differences between traditional energy producers and renewables, medium term guarantee (5 years contracts) for producers under special regime (RE) and a 12% target on renewables for 2010.

The new special regime incorporates new technologies and allow RE producers to participate directly in the energy market. At the same time, RE producers receive a Prime (sum cost) as additional subside to the special tariff regime.

II. 2000-2010. Creation of renewable energy market and support for opportunities in external markets

The Supporting Plan for Renewables Energy 2000-2010 (**PFER 2000-2010**) was the first long term supporting policy on the area. It has the aim of guarantee the subsidies and funding specially for small hidro and wind energy. It also include priorities on the RE technologies to achieve the 12% target.

By following the EU normative 2001(**Dir 2001/77/CE** & **2003/87/CE**), Spain presented the first Action Plan for Renewables (**PANER 2005-2010**) and strategies on climate change for CO2 reduction where priorities sector are defined. Both programs support RE by mechanism of acquisition and R&D programs while foster technologies to increase efficiency in order to mitigate the impact of economic growth. However, the measures are not radical enough to produce a significant change (explicated in the Plan 2008-2012) where efficiency is more applied rather than substitution for RE technologies.

The National Energy Program (**PNE 2004-2007**) was introduced to support the technology development and competitiveness not only on RE but also other technologies addressed to increase efficiency at low cost as thermonuclear energy and

hydrogen cells. Following this program and as a revision of **PFER 2000-10**, the national government launch the National plan of Renewables energy (**PNER 2005-2010**) with the aim of introduce new practice to achieve the not accomplished expected objectives on RE and energy intensity (energy/GDP). This last increase support on the most successful technologies (i.e. the wind energy) establishes new objectives for 2020 and highlights the importance of decentralization in energy production, regional developments and SMEs

Regarding subsidies and financial mechanism, the **RD 1432/2002** introduces changes in the methodology for calculating the tariff scheme and thereby providing stability signals for the market while the **RD 436/2004** upgrade the regulatory framework and conditions for the special regime.

III. 2010 – Present. Economic crisis and new policy set

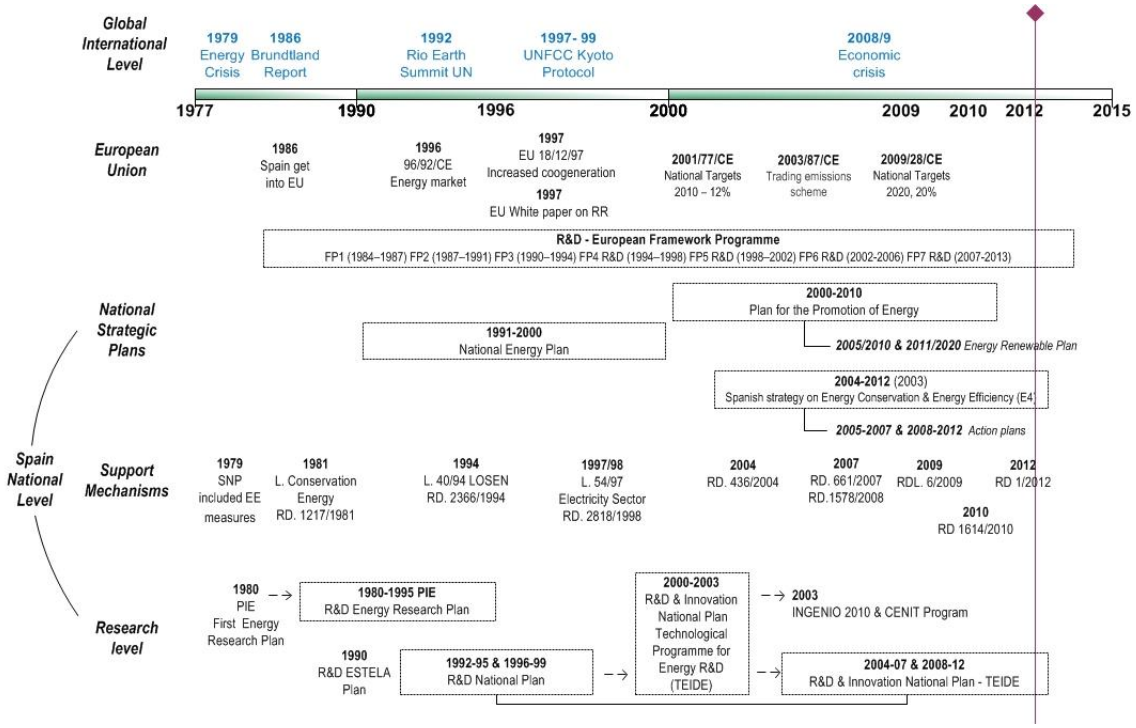
The main aspects of the special regime on themosolar and Aeolian energy are revised not only in financial but also strategic terms. In particular, the **RD 1614/2010** has a significant impact in the Aeolian sector as it intruded a temporal cut in for the remuneration to Wind energy installations. This change was based in the agreement between the central government and the Spanish Aeolian Energy Association (AEE) which accept the cut in exchange of other arrangements related to the previews **RD 6/2009** and a compromise of a more stable regulatory framework. However, the new normative guarantee to wind farms two main issues. First, the return to previews conditions from 2013 and second, further revision to tariff scheme will not affect the operating installations, however, both issues has created an scenario of uncertainty within the sector.

Renewables energy plan 2011-2020 **(PFNER 2011-2020)** present a future scenario where Spain achieve a share of 22.7% of renewable energy and 42.3% of electricity generation. That means a surplus that can be used to transfer energy to other countries under the EU mechanism.

Finally, the **RD 1/2012** stopped the mechanism for remuneration and other economics incentives applied to new installation of energy production within the categories cogeneration, renewables energy and waste management presented in the **RD 661/2007.** This measure means the end of the economic incentives under the special regime what had a particular impact in new installations, however, the special regime is still valid and the new installation would get the market price instead of a regulated price.

From this, each technology can have a different cause- effect in term of cost production, cost of energy substitution (self-consumption/ auto-producers of energy) and spread with the market price. The measure does not have retroactive impact in operating installations (i.e. prime already assigned) and keep the procedures to be register as energy producer.

Figure 1. Summary of policies and programs on renewables Energy with a multilevel perspective.



2.3. <u>Regional Level. Valencia Region</u>

The Valencia region has exclusive jurisdiction over land use and coastal, urban development and housing, as well as other materials that are affected by the Territorial Strategy of Valencia

The **LAW 4/2004**, of 30 June, of the Generalitat, Spatial Planning and Landscape Protection (LOTPP) deals with issues as strategic for the development of Valencia such as the landscape, housing, coastal, water or infrastructure; makes a decisive contribution to sustainable development through management actions direct and immediate impact on natural resources and enhancing soil and water savings and greater efficiency in energy consumption and production by source renewable.

For the system of territorial planning becomes a reality, the law of the necessary simplification and relaxation of planning instruments, eliminating unnecessary procedures, commitment to operational procedures and designs reminiscent, in essence, the urbanistic plans contained in the legislation. Among the instruments of supra-municipal zoning established by this law include the Territorial Strategy of Valencia and regional action plans.

The LOTPP includes a section devoted to the governance of the territory. An institution based on the White Paper on Governance of the European Union. Governance is a model in spatial decision making based on the principles of accountability, consistency, efficiency, social participation and access to information.

Fruitful dialogue between economic competitiveness and protection of limited resources is the context in which is inserted **Decree 1/2011**, of January 13, the Consell, by which approves the Territorial Strategy of Valencia (ETCV) as instrument summit and planning that actually inspires territorial policy of the Government for the coming years.

In the process of formulating and implementing the Regional Strategy of Valencia have followed all procedures established by **Law 4/2004**, Spatial Planning and Landscape Protection, the Law 9/2006 on the evaluation of the effects of certain plans and programs on the environment and other applicable regulations.

In its composition the guidelines incorporate twenty vision and general objectives of the Spatial Strategy of Valencia and the guiding principles, which collect and determinations materialize spatial planning emanating from the European Union and are binding for all public administrations with competence in the area of Valencia. Of the 25 general objectives ETCV, outlines six:

• Objective 2: Place the Valencia urban area within the set of major European cities.

• Objective 14: To prepare the territory for adaptation and combating climate change.

• Objective 15: Encourage the enhancement of new energy potential of the territory.

• Objective 17: Create a local environment conducive to innovation and creative activities

• Objective 19: To meet the demands of mobility in the territory of an efficient and integrated.

• Objective 25: Develop innovative ways of territorial governance.

And of these is developed in particular Goal 15: Encourage the enhancement of all the potential energy of the territory.

In this regard, it is noteworthy that the **LAW 1/2012**, of 10 May, the Government, on Urgent Measures to Promote the Implementation of Strategic Territorial Actions, regulates business initiatives which can benefit from the figure of Strategic Territorial Actions, which costs more advantageous conditions regarding the simplification of procedures, administrative burdens and time. This action of the Consell, is aimed at job creation and the revitalization of our productive sectors, as part of the ETCV, approved by Decree 1/2011, of January 13, of the Consell, which has, among other functions , the identify and promote those actions and unique projects that help qualify and diversify the territory in its different scales.

As for the industrial sector, regardless of state regulation, which has basic character in the Valencia area of application are the following regulatory provisions relating to the implementation of facilities for electricity production from renewable energy renewable associated facilities and facilities thermal energy production (heating and / or cooling) from renewable energy sources:

• Order of July 11, 1995 for recognition and registration of facilities under the special regime

• Agreement of July 26, 2001 of the Valencian Government for approving the Plan of the Valencian Community Wind

• Decree 88/2005, of 29 April by establishing procedures for authorizing the production facilities, transmission and distribution of electricity within the jurisdiction of the Government. Decree 177/2005, of November 18 the Consell of the Generalitat, which regulates the administrative procedure applicable to certain solar photovoltaic installations. Order of January 4, 2007 of the Regional Ministry of Infrastructure and Transportation that sets standards for the application of the Valencian Energy Agency.

• Order of June 6, 2008, which sets standards in processing supplementary registration of network connected solar photovoltaic installations in the Registry of Electricity Production Special Regime of Valencia.

• Order of June 10, 2008, amending the Order of June 6, 2008, which sets standards in processing supplementary registration of grid-connected photovoltaic systems in the Registry of Electric Power Production Special Regime Valencia.

3. Best practice on promotion renewables energy

The strategy of governments to pursue integrated approaches that coordinate policy across different domains consist in the adoption of a complementary, innovation friendly mix of policy instruments. From a policy perspective, different government levels seek sustainability objectives through these policy instruments (from regulation and subsidies to coordination and facilitation activities) to drive the behaviour of firms that are mainly driven by profit motives.

An example of policy instrument to promote the innovation in renewables energy is the Public Procurement of Innovation (PPI). PPI includes all stages of the product's lifecycle as well as all kinds of commercial public procurement that lead to innovation. On the other hand, Pre-commercial procurement (PCP) is the most concrete initiative made so far by EU policy makers to promote public procurement as a means to stimulate innovation.

3.1. Public Procurement of Innovation (PPI)

The European Commission has defined public procurement of innovation as something that occurs when a public agency purchases "goods and services that do not exist, or need to be improved and hence require research and innovation to meet specified user needs". This is a rather broad definition that includes public procurement of innovation in all stages of a product's lifecycle as well as all kinds of commercial public procurement that lead to innovation.

Procurement for innovation can take place at national, regional or supranational levels of government. Demand can be fragmented across or even within purchasing authorities. This fragmentation is perceived by industry as a major weakness of European markets. Coordination and "bundling" of demand can be used to create

markets of a critical size to incentivize innovation. On the other hand, “unbundling” may sometimes be necessary to create opportunities for innovative SMEs to obtain manageable contracts.

The EU creates the legal framework for Procurement in Relation to Innovation2. The focus of the EU legislation which is more on the procedure of buying (fair play) than on what is bought this, in practice, creates significant freedom for contracting authorities to set requirements that stimulate investment by private companies tendering for contracts. It should be borne in mind that the public procurement directives are not intended to transform national law into an airtight uniform model, but allow Member States significant freedom to draw up their legal framework according to the specific national situation. However, public procurement procedures in Member States should be established and run in an equal manner to enable enterprises to be familiar with the rules of the game, regardless of the Member State in which they tender.

EU has developed a general outline with ten steps[3], which represents a set of best practices that facilitate conducting a successful procedure for innovative public procurement. This outline includes:

1. Act as an ‘intelligent’ customer: To inform the market of your plans as early as possible and to create a professional public procurement function capable of handling innovation.
2. Consult the market before tendering: To identify innovative solutions on the market and to inform market players of your needs and discuss ways of meeting them.
3. Involve key stakeholders throughout the process: To identify key internal stakeholders and to secure their involvement and participation.
4. Let the market propose creative solutions: To give companies room to propose ideas and be open for alternatives and to ask for a solution, do not prescribe it.
5. Seek value for money, not just the lowest price: To decide which cost and quality aspects to take into account and to decide on criteria to reflect these aspects.
6. Take advantage of electronic means: To use electronic means to inform and be informed and enhance efficiency and to ensure the electronic means you use are well-adapted to your needs.
7. Decide how to manage risks: To identify and plan for risks and to designate the risk owner.
8. Use contractual arrangements to encourage innovation: To include in the contract incentives for further innovative solutions and to establish a policy on how to handle intellectual property rights.
9. Develop an implementation plan: To provide for an implementation structure and resources and to monitor and learn from implementation.

[2] http://ec.europa.eu/invest-in-research/pdf/download_en/edited_report_18112005_on_public_procurement_for_research_and_innovation.pdf
[3] http://register.consilium.europa.eu/pdf/en/07/st06/st06920.en07.pdf

10. Learn for the future: To bcome a learning organization on innovation and to establish evaluation and review procedures to improve knowledge of innovation in procurement procedure.

At the Spanish level, it has implemented a procurement policy that promotes innovation[4]; that is how to organize a tender that encourages the submission of offers incorporating innovative solutions. The innovative public procurement is an administrative action to promote innovation aimed at enhancing the development of new innovative markets from the demand side, through the instrument of government procurement. The objectives are:

- Improving public services through the incorporation of innovative goods or services
- Promoting business innovation
- Pushing the internationalization of innovation through the local public market as launch or reference customer.

3.2. Pre-commercial procurement (PCP)

The recently published guide (explained before) on the uptake of commercially available innovative products, works and services in the public sector identifies ten elements of good practice to promote the potential of public procurement for stimulating innovation. After that, European Commission addresses the concept of "pre-commercial procurement"[5] (PCP) which concerns the Research and Development (R&D) phase before commercialisation. PCP is intended to describe an approach to procuring R&D services other than those where "the benefits accrue exclusively to the contracting authority for its use in the conduct of its own affairs, on condition that the service provided is wholly remunerated by the contracting authority" and that does not constitute State aid. More specifically in pre-commercial procurement:

(1) The scope is R&D services only: R&D can cover activities such as solution exploration and design, prototyping, up to the original development of a limited volume of first products or services in the form of a test series (see Figure 2). "Original development of a first product or service may include limited production or supply in order to incorporate the results of field testing and to demonstrate that the product or service is suitable for production or supply in quantity to acceptable quality standards". R&D does not include commercial development activities such as quantity production, supply to establish commercial viability or to recover R&D costs, integration, customization, incremental adaptations and improvements to existing products or processes.

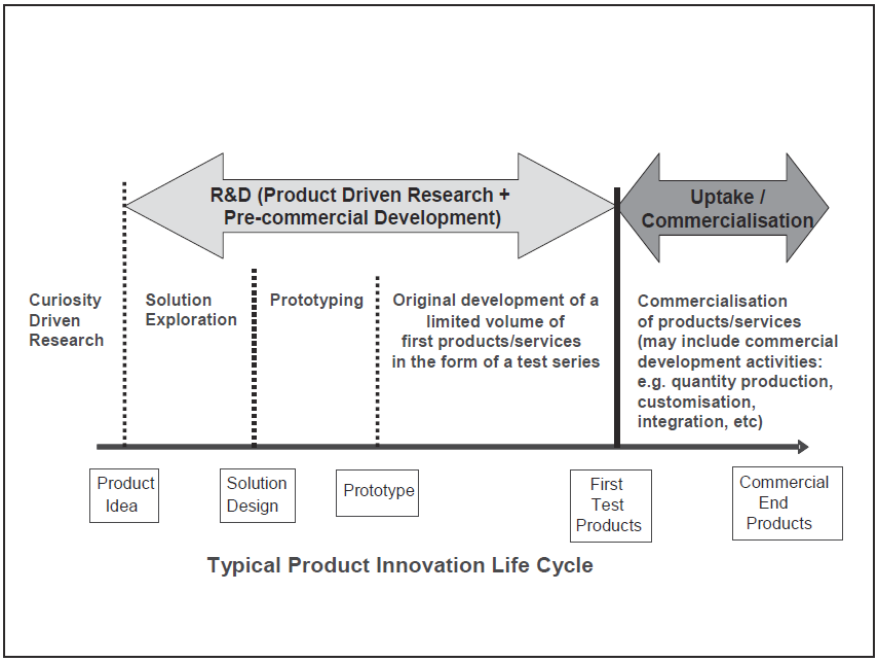
(2) The application of risk-benefit sharing: In pre-commercial procurement, the public purchaser does not reserve the R&D results exclusively for its own use:

[4] For more information, see:
http://www.idi.mineco.gob.es/stfls/MICINN/Innovacion/FICHEROS/Politicas_Fomento_Innv./Guia.CPI.pdf
[5] ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/pcp/pcp-brochure_en.pdf

Public authorities and industry share risks and benefits of the R&D needed to develop new innovative solutions that outperform those available on the market.

(3) A competitive procurement designed to exclude State aid: Organizing the risk-benefit sharing and the entire procurement process in a way that ensures maximum competition, transparency, openness, fairness and pricing at market conditions enables the public purchaser to identify the best possible solutions the market can offer.

Figure 2. R&D versus commercialization phase



EU members are in different stages to facilitate wider implementation of PCP across Europe. Spain belongs, similar to Sweden, to the third category, "Working on framework" (Rolfstam, 2011). In Spain, the Secretary of the State for Telecommunications and for Information Society (SETSI) has adopted different policies to promote the technological innovation, as for example the 'Plan Avanza' 2005-2008, and 'Plan Avanza2' 2009, which are part of the program 'Ingenio 2010' of the Spanish Government. Program 'Ingenio 2010' has been an initiative presented by the Spanish Government in June 2005 in response to the Lisbon Strategy deliberated by European leaders at the 2005 Spring Council. The aim of the program is full convergence with the European Union in 2010, in per capita income, employment and the knowledge society, by accomplishing the following objectives:

- To increase the Research, Development and Innovation (R&D&I) investment ratio with respect to GDP from 1.05% in 2003 to 1.6% in 2008 and 2% in 2010.
- To increase private sector contribution to R&D spending from 48% in 2003 to 52.5% in 2008 and 55% in 2010.
- To reach the EU-25 average in the percentage of GDP earmarked for Information and Communication Technologies (ICT) from 4.8% in 2004 to 6.4% in 2008 and 7% in 2010.

In Spain it seems to be more common the term of Public Procurement of Innovative Technology (Compra Pública de Tecnología Innovadora - CPTI), defined as the approval of an order by a public agency for a product, service or system that does not exist at that moment but it can probably be developed in a reasonable period of time. It requires the improvement or development of a new technology to meet the requirements demanded by the purchaser6 (PreCo, 2010). The main difference between the CPTI and the PCP concepts is that the first concept includes the commercialisation phase: "commercial development activities such as quantity production, supply to establish commercial viability or to recover R&D costs, customisation, integration, incremental adaptations and improvements to existing products or processes".

In Spain both CPTI is regulated in the next legal documents:

- Public Sector's Contract Law. Law 30/2007, 30th October[7]. In this law, by meaning of the art.11 are settled the bases for the public/private partnership and the specific procedure, the so called, "Diálogo Competitivo" used for the tender. Moreover, there are in this Law (arts.118 to 120) a special a preparatory actions (Previous evaluation; Functional Program and contract clauses) because of the high complication of this kind of contracts.

- Law 2/2011, 4th March, of Sustainable Economy[8]: This law is very important because amends the Law 30/2007 30th October, of the contracts of the public sector, which regulates the type of cooperation agreement between the public and the private sector, used for the pre-commercial procurement.

- Law 14/2011, 1st June, of Science, Technology and Innovation[9].

- Agreement 8th October 2010 for the Council of Ministers5 (In the field of State Innovation Strategy e2i) that establishes the procedure for the innovation public purchase in all the Ministerial Departments and public agencies: This is very important because there is an agreement which clearly specifies the public purchase for the INNOVATION. The principal aim is to encourage the innovative public procurement.

In summary, CPTI is the legal and ideal instrument to carry out pre-commercial acquisitions in Spain. The administration learns firsthand products and services that are new or are under research. To take place this, it is essential the clusters or networks to promote the administration's knowledge in new technologies and services, because they can do the marketing issues to promote the products and services.

3.3. Green Public Procurement (GPP)

Public procurement can shape production and consumption trends and a significant demand from public authorities for "greener" goods will create or enlarge markets for environmentally friendly products and services. By doing so, it will also provide

[6] *La Compra Pública de Tecnología Innovadora en TIC. Libro Blanco* (Cotec, 2008).
[7] http://www.boe.es/boe/dias/2009/05/15/pdfs/BOE-A-2009-8053.pdf
[8] http://www.boe.es/boe/dias/2011/03/05/pdfs/BOE-A-2011-4117.pdf
[9] http://www.boe.es/boe/dias/2011/06/02/pdfs/BOE-A-2011-9617.pdf

incentives for companies to develop environmental technologies. The potential of GPP as a policy instrument has been increasingly recognized, and over recent years there has been growing political commitment at national, EU and international levels. In 2002, the OECD adopted a Recommendation on green public procurement. Within the EU, the potential of GPP was first highlighted in the 2003 Commission Communication on Integrated Product Policy where Member States were recommended to adopt national action plans for GPP by the end of 2006. More recently, European Commission has published the public procurement for a better environment[10].

The basic concept of GPP relies on having clear and ambitious environmental criteria for products and services. A number of national criteria and national approaches to GPP have been developed. However, as the use of GPP increases, the criteria used by Member States should be compatible to avoid a distortion of the single market and a reduction of EU-wide competition. Having a single set of criteria would considerably reduce the administrative burden for economic operators and for public administrations implementing GPP. Common GPP criteria would be of a particular benefit to companies operating in more than one Member State as well as SMEs (whose capacity to master differing procurement procedures is limited).

The general objective of this Communication is to provide guidance on how to reduce the environmental impact caused by public sector consumption and to use GPP to stimulate innovation in environmental technologies, products and services. The specific objectives of this Communication are:

- A process for setting common GPP criteria.
- Information on life cycle costing of products.
- Legal and operational guidance.
- Political support through a political target, linked to indicators and future monitoring.

The Spanish Plan, answer to community objectives and, at the same time, intend to be a complement and support for other Spanish environmental policies, such as Saving Plan and Energy Efficiency in public buildings (*Plan de Ahorro y Eficiencia Energética en los edificios de la Administración General del Estado*), National Integrated Waste Plan (*Proyecto de Plan Nacional Integrado de Residuos –PNIR-*) and Spanish Strategy for Climate Change and Clean Energy 2007-2012-2020 horizon (*Estrategia Española de Cambio Climático y Energía Limpia horizonte 2007-2012-2020*).

The Spanish Green Procurement Plan is regulated by the PRE/116/2008 Order on 21 of January[11]. The general objective is the articulation of the connection between public procurement and implementation of practices that respect the environment. As specific objectives are: a) to establish quantifiable goals for groups of products and services considering as priorities to incorporate environmental criteria by the European Commission; b) to establish guidelines for the integration of environmental criteria in various stage of the recruitment. The Plan sets quantified targets for the incorporation of environmental criteria in procurement of 8 groups of products and services given

[10] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF
[11] http://www.boe.es/boe/dias/2008/01/31/pdfs/A05706-05710.pdf

priority. These groups are: Construction and Maintenance, Transports, Energy, Office Equipment, Paper/Publications, Furniture, Cleaning and Events.

Summing up, GPP is a process through which public authorities decide to purchase products and services in special sectors with a reduced environmental impact throughout their life cycle. GPP should be considered a valuable instrument to implement environmental strategies and business competitiveness. The GPP is one of the largest tractors change towards a model of sustainable production and consumption. The incorporation in the public procurement of sustainability criteria directly affects the life cycle analysis of the contracted product or service and generates significant environmental improvements.

4. Valencia Community and renewable energy

The Valencia Region has experienced a fast growth in terms of urban area and construction activity during the last 20 years, Urban area in Valencia has increased 27% from 1990 to 2006. The region is characterised by plain mixed use landscape with plenty of farms locations inner city and in peripheral areas. There is a significant variety of urban configuration after regeneration projects.

EE and climate change issues have been introduced into regional policy agenda through long term plans on Energy efficiency and Climate Change as “Plan de Ahorro de Eficiencia Energética de la Comunidad Valenciana” and “Estrategia Valenciana ante el Cambio Climático 2008-2012” as well as application of activities and economic instruments, both programs designed to support the local implementation of national (E4) and international policies. These actions have been coordinated by the regional energy agency AVEN (*Agencia Valenciana de la Energia*) and supported by the Valencian Institute of building (IVE).

More specifically, during 2011, AVEN has developed a joined project with IVE and two Valencia’s research institutes AIDICO (BCI sector) and Energy technological Institute (ITE) to implement an online software for the energy certification of buildings. Other regional policy regulates the conservation and technical inspection of buildings (*Modelo de Ordenanza Reguladora de la Conservación e Inspección Técnica de Edificios*), which is specified at local level.

Local authorities and research institutions has also supported a few examples of sustainable architecture such as the green building “Palacio de Congresos” and the prototype UPV solar house competing in the Solar Decathlon Europe 2010. Additionally, Multiple actors such as industrial associations, R&D institutions and different level of government actively support BCI expositions The most important series of forums and expositions are the energy efficiency exposition (Exponenergetica 2007-2011), Glaze and ceramic exposition (CEVISAMA) and Congress on Domotics by UPV 2004-2009.

4.1. Performance in renewables energy

The Valencia as modern society is immersed in this energy problem. Using data from the Valencian Energy Agency (2008), oil accounts for 41.6% of total primary energy consumption in the Region, natural gas accounts for 32.4% and 17.2% nuclear energy Renewables account for 3.2% and coal's contribution is negligible. From the point of view of consumption, transport (39.8%) and industry (32.5%) are the main users of energy, while the domestic sector and services together have a demand of 22.3%, with the primary sector the lowest consumption with 5.3% remaining.

Compared to the national and European, it is found that the dependence of primary energy sources of Valencia is 79.6%, the same order of magnitude as Spain (79%) and higher than the European Union (51%). This really puts the Region, similar to Spanish set in an upper-middle position in the energy vulnerability index for 2020, prepared by the European Commission. However, there are other data that are more positive and per capita consumption is below the European average (relative to GDP is quite similar), or CO2 emissions, both per capita and per GDP, which are smaller than the national and European references.

Given this dependence on primary energy sources, the Valencia reached in 2007 the balance between power demand and generator provided by the park located in the region. According to recent data, the power in service amounts to 7,166 MW, which exceeds demand and even helps ensure future connection to the Balearic Islands.

In this self-electric power plants contributed with 39% of the energy generated, hydro with 18%, the 15% nuclear, 14% wind, cogeneration and waste 11% and 3% other renewable sources. Noteworthy is the large increase in service capacity of wind power has increased from 21 MW in 2003-991 MW at the end of 2009. Meanwhile, the number of parks has increased from 2 to 29 in the same period. Thus, the weight of renewables in electricity generation reaches 35%, to 10 points above the national average.

Solar power, meanwhile, has also experienced phenomenal growth in recent years. This increase has been driven by favorable legislation and technological improvements produced in the sector. This energy is in the Valencia extraordinary potential as reflected in the theoretical example with some 25,000 hectares of solar panels would cover 100% of the current electrical demands of the Community and it is clear that there are other factors such as cost , land use, project profitability, legislation, condition the environmental and cultural values of the area, etc.., which determine the distribution of this renewable energy.

In fact, unlike other energy resources, which is more concentrated territorial competence, the potential to produce solar energy reaches the entire territory of Valencia, which is one of the European space that receives the most sunlight. According to the level of "Renewable Energy in the Territory" (Source: Department of Infrastructure and Transport. Climate Atlas and Spatial Valencia of Valencia), the estimate for the town of Pobla de Vallbona soils is that they are extremely adept at Solar Radiation, presenting annual average daily values of 16 MJ/m2.

However, the introduction of solar energy is more influenced by the vulnerability of the land, because fitness differences, in terms of solar radiation are insignificant. This circumstance requires, given the large growth of these facilities, the adoption of standards and controls to ensure the lowest possible condition of the territory and the people who inhabit it.

In this sense, PV on roofs of buildings is presented as an alternative of great importance because of their reduced condition the territory, for the large number of ships and buildings available for its advantages of linking production and consumption. The Valencia occupies, at this time, the first place in terms of installed photovoltaic power on industrial roofs.

If the solar potential is high, you can not say the same of other renewable energy sources. Wind energy could exceed current horizon Wind Plan of Valencia, but the maximum potential installable require a detailed study of resources and an updated analysis of the technical and economic feasibility of potential new wind areas. In terms of biomass, its potential is limited but has the advantage of not having intermittent problems and can be used indigenous biomass (agricultural residues, livestock and forestry) and energy crops. Regarding biofuels, the Region does not have an excessive ability to crop production applicable to the manufacture of these fuels, but the abundance of agricultural waste makes the option of generating second-generation biofuels (those not compete with crops food), is an option to consider in strategic territorial plans.

If consumption patterns before the crisis, and the energy structure is maintained, the BAU scenario "business as usual", or trend, will reach a high degree of unsustainability. Total consumption would be multiplied by 2.5 in 2030, CO2 emissions would double, external dependence would increase from 79.6% to 87%, while maintained the degree of self-sufficiency in electricity production as a result of increased renewable energy production and start-up of combined cycle plants. It is necessary, therefore a long-term strategic approach on energy to reduce external dependency and emissions of greenhouse gases and at the same time, improve energy intensity, both per unit of GDP and per capita.

Given this scenario, consider the objectives of the European Council, the scenario called 20/20/20, which means: saving 20% of energy consumption in the EU compared to projections for 2020, reduce by at least 20% reduction in greenhouse gases and achieve a 20% renewable energy in energy consumption structure of the European Union in 2020.

Thus a clear commitment to renewable energy and the promotion of energy saving and energy efficiency, as proposed by the PIE 2010-2020, is a road map to follow. Renewable energy, regardless of their social acceptance, exploit indigenous resources, reduce external dependence, affect job creation, especially in rural areas, and promote technological development.

Therefore, policies to support these energy sectors should continue to finish the transition to full compatibility with other sources, which outnumber positive externalities for the whole society.

From the territorial point of view, the strong commitment to renewable energy requires strength distributed energy systems in consumer items, which allow decentralized power system, reduce transmission losses, enabling cogeneration, a more flexible and resistant to energy system and allow the consumer to create the generator set to provide a more rational use of electrical energy.

In this way, the city would be a highly-consumer of energy resources to an entity producer, and marketer of a resource that has traditionally been dependent on having become one of his greatest weaknesses. It is essential to reconcile the drive for renewables with special attention to the rational use of energy. This should encourage saving measures and energy efficiency for all production sectors and at all levels of consumption.

It should also be emphasized modernization of networks, strategic reserve storage and network interconnects that enable more efficient management, balancing production and consumption and supply security tip.Implemented these objectives, it is possible to be optimistic and even the European Union raises the possibility of improving the scene 20/20/20 if possible according to the new technologies. In this sense, there are experts who advance a technological revolution following the incorporation of new technologies in renewable energy.

Finally, note that the Valencia is one of the leading regions in the development of renewable energy, particularly solar and wind. These activities with great potential for growth in its two applications, both centralized and decentralized. The latter will experience higher growth rates and will significantly change the usual way of thinking about energy production. The integration of photovoltaics in buildings, the assessment of sewage biogas energy, biofuels, etc.., Are important lines of work to follow in Valencia. There are already companies related to the sector, but the higher value-added segments are not concentrated in Valencia so it requires the collaboration of all the administrative, business and research to create a group of companies that supports innovation in strategic sector such as energy. The metropolitan area of Valencia, where is located the Pobla de Vallbona, is one of the areas proposed for the location of these activities.

5. Society of Knowledge on Renewables energy in Valencia Region

The Valencia Region has experienced some significant changes related with the environmental governance system of the BCI and energy sector. Most of those movements have to do with the challenge of implementation process of energy-climate change policy and the consequent tensions regarding resource competitions, responsibilities and the search for market opportunities.

The implementation process of energy-climate change policy in this region seems to be highly influence by the broad country characteristic which can be considered as a “laggard” in this policy area, or in other words, politically less powerful country with less advanced environmental policies compared to more influential northern European members states such as Germany or UK (Borzel, 2000). That influence seems to be

reflected in the relatively new establishment of relational mechanism and other coordination actions in this arena in term of links with national and EU objectives.

The two key elements regarding changes on energy and environmental concerns (i.e. the entry of Spain into EU and the decentralization process) seems to be critical factors for the articulation of stakeholders. From that, a new structure emerges based on the set of policies and programs at different level and, thereby, the needs to generate coordination mechanism not only to face the responsibilities but to take opportunities to develop new line of business and research.

Most of the mechanisms of knowledge flows are currently framed by policies, programs and instruments regarding energy and climate change issues such technological platforms (e.g.: CO2,EE) and building certification tools (e.g.: Green Build Challenge, IVE- Valencia). Simultaneously, integration of different political spheres was given by the need to articulate the implementation process at local level of normative and directives.

Technological institutes in Valencia region take the form of business associations which works together with universities and local authorities. That mixture provides a context for interaction and contributes to the development of common initiatives.

They are together with other public authorities the linkages at regional level and somehow key actor to manage connection between them. However, more knowledge is required to analyse their role in R&D projects, management of local and international resources as well as other types of cooperation activities.

5.1. Creation of networks and business associations

In the Valencia region R&D and technological innovation related activities are driven by several research centres within a wide range of sectors. The most important is glaze and ceramic lead by the Insitutote de Tecnologia Energetica (ITE), Instituto de Cerámica y Vidrio, the Instituto de Tecnología Cerámica (ITC) and AIDICO (Instituto Tecnológico de la Construcción) which cover a variety of energy technologies and construction systems. Finally, university labs and private firms have increased significantly the area of renewable energy, efficiency and sustainable construction which has been highly promoted by forums and expositions like the energy efficiency exposition described before.

The presence of a multiple agents and industrial associations is very important for the region, for example AVASEN, Valencian Association of Companies for Energy-Sector, FEVEC, Valencian Federation of construction companies (FEVEC) and other ceramic, manufacturing and industrial associations such as ASCER, ANFFECC, ASEBEC, ATC and ANDIMAC. They play a critical role in the industrial policy for innovation and international trade.

However, beside the significant number of institutions such as industrial associations, chambers of commerce's and professional associations (i.e. architect, engineers), the sector has seen in recent years the rise of specialized networks supporting sustainable related innovation in the area of Rewables energy and Building and Construction Industry (BCI). These new networks are highly promoted by traditional and new created agencies in different areas and levels. Six relevant cases can be identified:

AVAESEN. The Valencian Association of Companies for Energy-Sector-, created in 2006, has over 160 member companies, representing about 80% of companies conducting activities related to the energy sector in their area. Its main activity is fostering relations between partners, both economic and collaborations in R&D.

TECNIMED. Association of Engineering Consultants, Architectural Studies and Technology Services of the Valencian Community, established in 2006 with the intention of defending the professional interests of consulting firms in the sector and to promote awareness and reputation of the profession consultant. The association is part alongside other regional-level partnerships TECNIBERIA national association with more than 300 members.

FCVRE (Fundación Comunidad Valenciana Región Europea). The foundation (created in 2003), beside other objectives, looks for create bridges between Europe and the Valencia region by encouraging co-operation between different public and private actors and ,thereby, raising partnerships to bringing them closer to European projects, institutions and actors. Regarding the BCI, the FCVRE participate in the EU program Climate KIC (2010) as part of the international networks in areas of low carbon living and low carbon mobility.

Forum ESCV (Forum on sustainable construction of Valencia Region). The forum (launched in 2009) is an initiative launched by Edification Valencia Institute (IVE) which has had already two main events (Jan and Nov 2009) and the third expect in Nov 2010. These main events are created for networking and debate as well as the diffusion of innovation in technologies, normative and policies. ESCV also organise regular technical seminars on specific topics related to sustainability and BCI.

VIT – Energia. Scientific-Business network on energy sector sponsored by local government. The network (created in 2009) main objective is the knowledge and technology transfer by a variety of activities as business forums, training and publications. It encourages public-private cooperation for R&D and innovation activities on energy sector.

REDIT- The Network of Technology Institutes of the Valencian Region is a private, non-profit association that was created in 2001 by the Technology Institutes of the region and in collaboration with the Valencian Regional Government.

All the networks and business associations (N&BA) have particular features in their origins, size and scales but they share some common characteristics. FCVRE, Forum ESCV and VIT energy have as *leaders and coordinators* foundations with strong presence of authorities, the first two are connected with regional and the last with local government. However, the origin and current role of FCVRE is to build links between Valencia region and other regions and institutions at European Level. In the other hand, RENAC was created by a set of technological institutes which in fact are business associations. Regarding business association, AVESEN and TECNIMED has recently created. While the first one has a strong link with R&D technological institutes that emphasise the regional identity, the second one is focusing in consulting activities and is part of a bigger structure with members that operate at national scale.

Regarding *internal organization and governance structure*, the institutions closer to agencies and government (FCVRE, Vit energia) present more hierarchical structures

characterized by the presence of designed government officers in the main roles. REDIT, RENAC and the Forum ESCV present more horizontal configuration by incorporating governing boards, the last one present a set of Working Groups which decide about the activities of each of the areas of the forum (energy, water, sustainable design, materials, etc). In the other hand, the business associations (AVAESEN, TECNIMED, FEVEC) present a similar hierarchical structure leading by main position (president) and activities conducted by governing boards and executive and thematic directors.

However, these structures may not have a clear relation with *activities* develop by the networks and associations. The Table 1 shows a description of the set of activities that are been develop[12]. The data shows that distribution of activities may not have a particular pattern among each one of the cases, however, more specific activities can be found in AIDICO and Forum ESCV as well as common networking strategies (i.e. Internationalization, partners search) can be found for the business associations. Formation activities are included in almost all the cases as well as information and dissemination activities are present in all of them.

Table 1. Main activities of BCI networks and business associations

Activity	FCVRE	AIDICO	Forum ESCV	VIT Energia	ITE - AVAESEN	TECNIMED	FEVEC
R&D	Dissemination partner	Applied research	-	EU Applied & social research	EU Applied & social research	-	-
Regulation & legal advice	EU programs	EU programs	Building directives	-	Legal and technical	Legal advice	Legal and labour advice
Technical support	-	High tech laboratories	-	-	Financial, IPR, Insurance, subventions	-	Insurance
Networking	Partners search	Members	-	Partners search	Internationalization, Partners search, trade missions	Internationalization, Partners search	Internationalization, Partners search
Formation	-	Workshops and seminars	Workshops and seminars	Workshops and seminars	Workshops, courses and seminars	Workshops, courses and seminars	Workshops, courses and seminars
Information & dissemination activities	R&D program diffusion	Online info & Newsletter	Events and online Info, & technical documents	Newsletter & technological surveillance	Events, newsletter and online	Events, newsletter and online	Events, newsletter and online

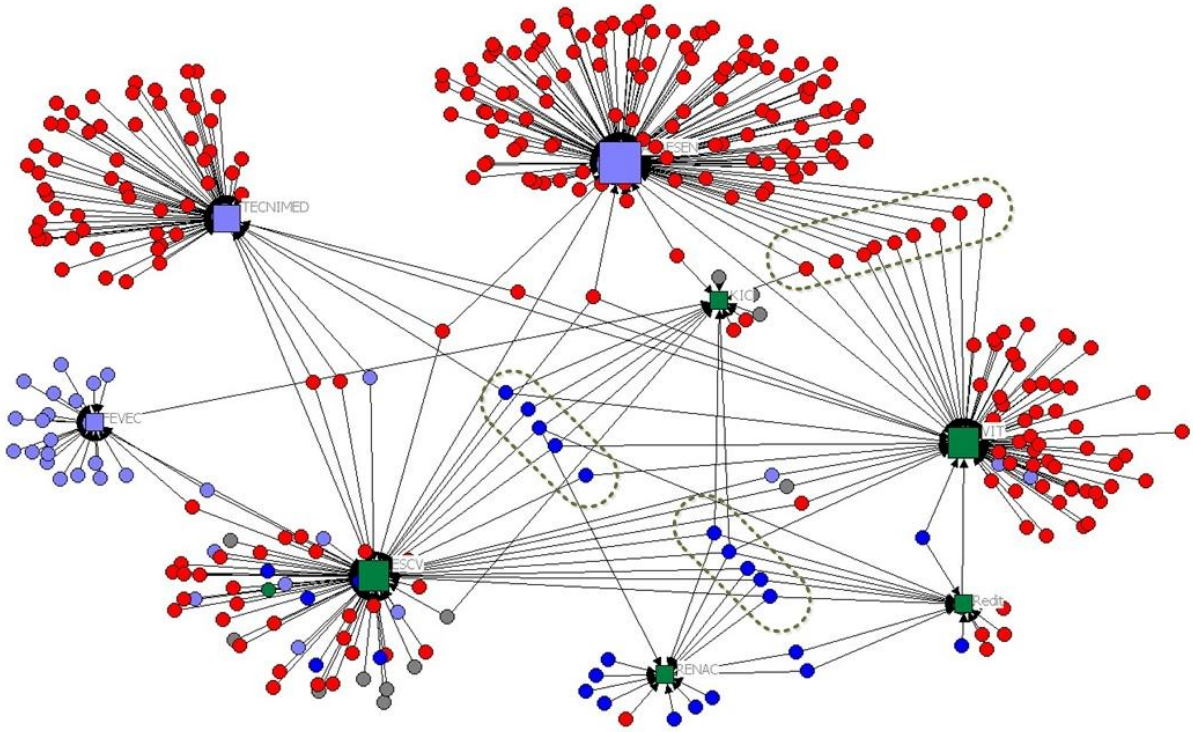
Source: own elaboration based in online information

Complementarities and overlaps may be possible by considering the distribution of activities; however, the analysis of member's interaction can be a possible way to improve the understanding of the context of application of those activities.

[12] The data has been obtained from websites and other public documents available online.

The Fig. 1 shows a scheme of N&BA by affiliation in the Valencia Region[13][14]. The rounded nodes are the members of the networks and mentioned business association (both square), node colours distinguish the type of organization: firms (red), blue (R&D), light blue (business association) grey (professional association) and green (network). From a first view, three main aspects of the figures can be easily identified. First there is a set of firms affiliated to the two energy related business associations (AVAESEN and VIT energia). Second, several R&D institutions showed in the centre of the figure present more than two affiliations, which can be explained by the similar configuration of REDIT and RENAC. Finally, all the N&BA seems to be linked to each other by at least one member. The exception may be the traditional association FEVEC, which just holds links with two networks.

Fig1. Affiliation Scheme of BCI networks and business associations



Source: own elaboration based on online (websites) public data

The number of affiliation by type of organization can be seen in Table 2 where, again, R&D institutions show most of the cases of multiple affiliations. To sum up, the general picture shows that almost 90% of the members of selected N&BA have got just one affiliation, over the total of firms, just 7% has got more than one affiliation. Regarding sectorial issues, the members are this distributed as follow: Construction (15, 8%), Energy (55.3 %), Construction/energy (13.0%) and others (15.8%).

[13] Information on member's affiliation was obtained form public data available in each website and analyzed by UCINET software.
[14] KIC refers to the network formed by members of the EU Climate KIC program managed by FCVRE for the Valencia Region. Further affiliation analysis is required on the project of FCVRE.

Table 2. Affiliations of BCI networks and business associations by type of organization. Total number and share of total. 2011

	Firms	R&D	Professional association	Government	Total	
Total	274	26	12	11	323	
Share	85%	8%	4%	3%	100%	**Share**
Affiliations						
5		1			1	0,3%
4		3			2	0,6%
3	3	4			8	2,5%
2	15	3	2	2	22	6,8%
1	256	14	10	9	289	89,8%

Source: own elaboration based on online (websites) public data

5.2. Main instruments and contribution of Valencian Institute of Building (IVE)

A brief explanation of the developments of material, and instruments on renewable energy and green building construction developed by IVE is presented.

Guide incorporating renewable energy in building design

The Guide incorporating renewable energy in building design for studying technical and economic factors to be taken into account for integration both in new buildings and in existing ones. With a practical approach, the guide places particular emphasis on the technical and economic feasibility of the solutions, as well as its impact on the building. The document is complete with real examples15, many of the buildings in Valencia. The Valencian Institute of Building, through the Forum for Sustainable Construction of Valencia, has edited this guide in the series Guidelines for sustainable building ESCV Forum. The guide has been developed with the collaboration of GRUPOTEC and the Energy Technological Institute (ITE).

[15] The content (chapters) are: Historical introduction renewable energy in buildings, Solar thermal, Media Temperature Solar Thermal, Photovoltaics, Mini-Wind, Energy biomass, Low enthalpy geothermal, Hydrothermal , Micro-cogeneration. More information can be found in
http://www.five.es/tienda/product_info.php?cPath=57&products_id=175
http://www.five.es/publicaciones/pdf/Extracto_GUIAEERR.pdf

Other instruments developed by the Valencia Institute of Building on green building technologies are listed as follow.

I. Quality Profile Distinctive for Renovation of existing buildings (PdC-R). 2010

The Quality Profile Distinctive for Renovation of existing buildings is a voluntary mark that expresses the main characteristics of refurbished residential buildings through a characterization on the requirements of energy saving, sustainable use of natural resources and accessibility. Furthermore, the profile of quality of renovation is a tool used from the very beginning of the renovation process to mark the late goals.

The scoring system helps making decisions on improving a scale consistent with the objective of maximizing operational efficiency and minimizing environmental impacts.

II. Quality Profile Distinctive (PdC) v03 2010

The Quality Profile Distinctive is a voluntary mark that expresses the main characteristics of residential buildings based on the 'essential requirements' of The Construction Products Directive (Council Directive 89/106/CE) which are also included in the Spanish Technical Building Code. The requirements regarded in the Quality Profile are: space functionality, accessibility, protection against noise, energy saving and sustainable use of natural resources.

Specific Quality Profile Distinctive (PdC) v02 2009

The Specific Quality Profile Distinctive is a voluntary mark that expresses the quality of residential buildings in terms of energy efficiency and sustainability for all those

elements involved in the constructionsector. The Administration provides financial assistance to social housing with these distinctive quality criteria based on energy and sustainable.

6. Technology development on Renewables energy in Valencia Region

ITE´s capabilities in research and development in renewable energy (wind, photovoltaic, thermal, biomass, energy vector and storage) are centred into design and develop innovative technologies in order to improve the control and management of:

- Generation: Distributed Energy Resources (DER) as renewable energy generation.
- Consumption: Renewable systems oriented to minimize energy consumption.
- Storage: Integrated Distributed Energy Storage (DES) systems.

Nowadays, the state of automation systems applied to renewable energy systems are limited by basic monitoring, which centralizes data plants in traditional SCADAs remote. The information is related to basic operation, production and meteorological data. Furthermore, the automated operation in plants in order to integrate them into infrastructures or energy grids is negligible. Scenario obstructs the renewable energy plants operability and efficiency, and their integration within future Smart Grids.

In order to improve the current scenario, ITE is working in the following R&D topics:

(In all cases it is possible to apply the work into: plants, for example, ground mounted photovoltaic; or integrated systems, for example a renewable energy system integrated in a building. Always promoting the Distributed Generation)

6.1. Advanced monitoring systems applied to renewable energy systems

The advanced monitoring encompasses the following functionalities:

1) Integration of new components and methodologies of the future Smart Grids as for example: smart metering, new electrical communication protocols, energy data models, demand side management concepts [3], dynamic electrical tariffs.

2) Developing intelligent behaviours to improve the automated understanding of great collection of data collected.

Currently, renewable plants monitoring acquire a large volume of data. In many cases, these data are simply used to represent the operate conditions of the system and display yielded power in a graphical manner. However, the analysis and processing of data is using artificial intelligence techniques, namely data mining and machine learning. It allows discovered the implicit connection between them, in order to facilitate an increase data mining and machine learning in the plant performance, namely:

- Data clustering and classification techniques allow identifying patterns of similar behaviour. From these results, a decoupled analysis could be performed, of certain variables to assess execution of the plant under different conditions.

- Anomaly detection based on unusual data. It makes reasonable to identify possible malfunctions and wrong behaviours of the plant under certain conditions.
- Set up of models for predicting power output.
- Predict the deterioration and degradation of the equipment performance in order to adopt predictive maintenance strategies [(1), online software tool with an algorithm that fits periodically the performance degradation of different technologies]
- Optimization of set points and operation modes to maximize production.

3) New relational information interfaces to promote active users and information system specialized in energetic costs/productions.

6.2. Supervised expert support in order to improve the operability plant

(This is supported by the advanced monitoring system described previously)

This perspective proposes to achieve a fault detection, diagnosis, evaluation and automated suggestion of actions and control strategies by means of Expert Systems.

Nowadays, a proper operation and maintenance of renewable system is based on the experience and knowledge of an operator or an expert supervisor. However, this knowledge could be integrated in the know-how based on an expert system to provide direct support to decision-making when faced with any action needs in the plant. Moreover, the integration of information related with use cases and special or abnormal operational situations in the system may allow further diagnosis and detect anomalies in plant before this leads to a significant loss of performance.

6.3. Improve local control and new concept of teleoperation of renewable energy systems

The aim of the proposal is to improve:

- The performance of renewable plants for electrical generation.
- The performance of renewable plants to support the minimization of energy consumption. [(2), optimizing control of building HVAC fed by a solar thermal installation].
- The capability to integrate renewable systems efficiently into infrastructures and energy grid.

For this purpose, it is necessary to develop innovative automation and control technologies, local and remote. It improves the plant operation modes to achieve an increment of their performance. It is necessary to develop local specialized controllers that allow:

- Reliability and better power production.
- Grid stability, power quality and efficient energy supply.
- Better strategies of maintenance and safety.
- More life cycle of components and reduction of functional costs.

Besides, develop control centres specialized in energy management of renewable systems to:

- Improve performance. *(Previous description)*
- Implement management strategies to integrate energy resources (DER, DES).
- Implement Demand Side Management strategies associated to renewable resources. [(3), client segmentation according his consumptions].
- Implement collaborative behaviours with Smart Grid infrastructure: integrate actively the renewable plants.

6.4. Integration of DER and DES in buildings, infrastructures, neighbourhoods and cities

The objective is to obtain neutral or positive energy areas minimizing the energy wastes and controlling the generation and storage resources integrated in the area.

An example at this point is the improvement of energy efficiency at buildings, aiming to achieve a reduction in energy consumption, maximization of renewable energy integration and an optimal control of both them that may lead to a zero energy balance of area. [(4), zero energy balance methodology applied to tertiary building] [(5), integration of controlled energy resources in a district]

Besides, if this area has the capability of interact with the grid, consuming or providing energy, it will be an Active Node of Smart Grid.

6.5. Integration of DER and DES in a Smart Grid

The main purpose is to integrate Distributed Energy Resources and Distributed Energy Storage in a Smart Grid, it leads to the concept of Virtual Power Plant, which behaves as a single power generation plant and thus allows for a comprehensive and integrated management of distributed energy resources as a whole. [(6), buildings integrated in microgrids]

In order to develop these concepts it is necessary to ensure interoperability and coordination between different energy systems. In this sense, a distributed control architecture based on intelligent agents would act as superior control entity to set up operation modes to maximize the performance of plants both locally and globally.

6.6. Control systems and technologies to hybridize different renewable energy sources

The goal is mix two or more technologies of electrical generation, in order to optimize global efficiency of the process. These systems could be presented different operation modalities. It is necessary implement complex control and automation strategies.

In this sense ITE has set an experimental plant for electrical energy production and supply, which implements PV modules with the total of 7.5 kWe (2.5 kWe per phase), a

wind turbine of 6 kWe, a 4 kWe PEM Fuel cell, a 6 kWe Electrolyzer, and a meteorological station, which collects the values of different weather variables [(7), prediction of optimal weather to hybrid generation].

The research has been done to analyze the relation among the different combinations of weather conditions and the result of outcome of electrical energy production from the PV modules and wind turbine. To combine these different resources in the optimum way, some automation techniques and control strategies is being implemented oriented to experiment with:

- Towards Zero Energy Balance scenarios. “EBEC” control system in ITE.
- Microgrids functionalities and scenarios. “Demand Side Management Laboratory” in ITE.

Other example of this is the combination of Heat pump and thermal plant for HVAC taking into account load demand in the buildings improves considerately the efficiency of the systems, decreasing the necessary amount of energy used. This infrastructure is being integrated in the previous experimental plant.

7. Final comments

There is a need to broaden the context to analyse the way in which problems are solved at local level by considering multiple dimensions. In the other hand, the evolving structure of society and governance structures sector regarding innovation, creation of knowledge and relation between actors foster the prominence of a set of instruments designed to support and drive changes.

By considering that perspective, this report has compiled a set of elements regarding promotion of renewable energy by focusing at regional issues such as the available policy instruments, the formation of knowledge and innovation networks and the technological capacities.

Main highlights are the strong presence of industrial capacity and R&D activity regarding renewables energy, the emerging networks and business association developing activities and objectives, where formation, internationalization and R&D activities are common. On the other hand, new governance mechanism seems to emerge supported by local governments as Pobla de Vallbona, regional agencies and R&D institutions which have a main role, as managers and facilitators of resources.

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