Residential Renovation towards nearly zero energy CITIES

R2CITIES

"Renovation of Residential urban spaces: Towards nearly zero energy CITIES"

D2.1 Report on architectural barriers for green energy technologies

WP 2, Task 2.1

April, 2014 (M10)

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Collaborative Project – **GRANT AGREEMENT No. 314473**

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1. Executive Summary

1.1 Purpose and target group

R2CITIES project aims to develop and demonstrate replicable strategy for designing, constructing and managing large scale district renovation projects for achieving nearly zero energy cities. The R2CITIES methodology are being validated and refined by a strong demonstration framework, spread among three demonstrations of residential district retrofitting, in different countries, climate conditions and user's habits.

The main phases of this methodology **are conducted within WP1, WP2, WP3 and WP4.** The WP2'*Selection of Low Energy Technologies and Solutions'* aims to define the *most appropriate and cost effective technologies, materials and processes to achieve a near zero energy district renovation*. Thus, WP2 will support the integrated design (WP3) which will include the optimum combination of the technologies identified as suitable for each demo site in WP2in order to reach the targets fixed by WP1 and task 2.1by overcoming the identified barriers for low energy districts.

In this context, the Deliverable 2.1***"Report on architectural barriers for green energy technologies"*** covers part of the work performed within task 2.1 linked with the deliverable 2.2 (also developed in this task) which is the core of the "*design phase*" in the methodology defined within R2CITIES (**D3.1**). In this sense, the main concert of deliverable 2.1 is summarised in the following subtask:

- **ST 2.1.1.** Identification of design, functional, technical and economic barriers for integrating green energy technologies in buildings.

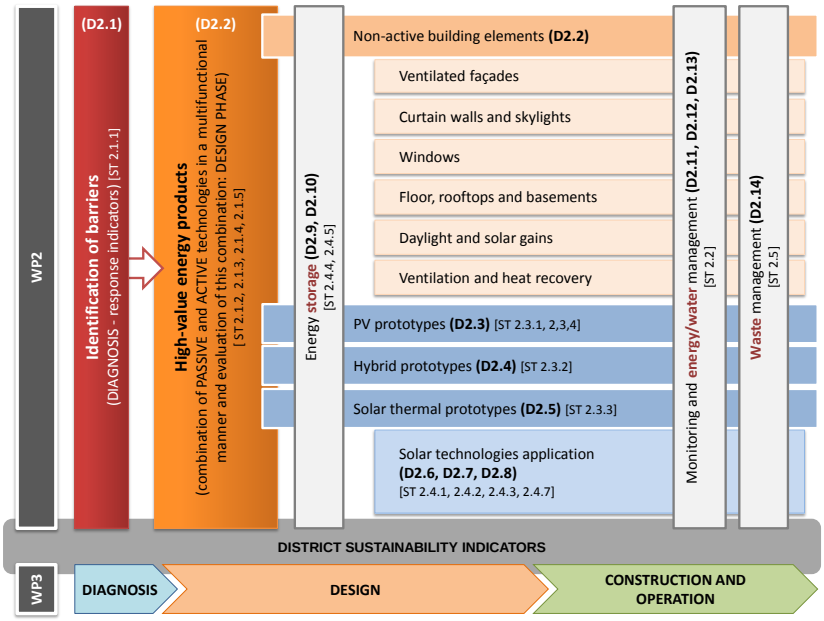

Figure 1: WP2 scheme

Thus, this deliverable aims to analyze why, despite all the progress made by the technological sector to offer the appropriate solutions adaptable to the diversity of the construction market demands, still no proper stability and development of the sector is displayed. The main causal factors are non-technological barriers. The legal, social and economic aspects could involve important limitations when facing the comprehensive rehabilitation of buildings or districts, whether the building stock is large enough to ensure profitability and market stability of rehabilitation activity for the next decades.

Analyze and propose solutions to overcome the identified barriers along the value chain of rehabilitation of buildings and a district are the main objectives of this report.

This deliverable is structured as follow:

Part 1 and 2: where it is introduced the work method followed within deliverable 2.1 and its alignments with other tasks in the R2CITIES framework.

Part 3: analyzes the main barriers to the comprehensive rehabilitation of districts and for integrating green energy technologies in buildings. The main barriers are presented as follow:

(1) That makes an overview of the problems and barriers inherited of the housing policy in Europe
(2) Legal barriers associated to the urban legislation and barriers at building market legislation. This one also includes the barriers at construction products level.
(3) Economic barriers
(4) Social and cultural barriers
(5) Technical barriers, that may include social barriers associated to the technical aspects. This barriers are subdivided in four parts:
    a) Design & construction barriers
    b) Operation and maintenance
    c) Comfort barriers
    d) Aesthetical barriers

Part 4: summarize the main characteristics and current barriers of the residential areas in which R2CITIES project is focused on.

Part 5: summarizes the suggestions for overcoming the identified barriers

Part 6: summarizes the general conclusions and shows the qualitative analysis on the targets and goals to be reached by R2CITIES methodology.

1.2 Contribution of partners

Participant short name	Contributions
ACC	Overall report
DEMO site leaders	Review of legal barriers and contribution in the particular legal barriers, incentive policy and their residential district description.
WP2 task leaders	Review of technical barriers
VERDI	Review of economic and financial issues

1.3 Relation to other activities in the project

Deliverable	Relationship
D3.1	Defines the systemic and integrated strategy for NZE renovation of existing residential districts, where the general strategy to overcome the identified barriers will be defined.
D2.2	State of the existing and new products or technologies to be integrated in order to improve the energy performance of buildings at district level in a multifunctional manner integrating passive and active strategies. Those strategies must overcome the identified technical barriers associated to the development of the innovative construction products.

2. Introduction

Despite the title of this report appears to be focused on technological aspects, within R2CITIES research field and the districts where the project are focuses, It has found broader barriers related the rehabilitation process itself. This is why this report have refocused the analysis on barriers from a broader perspective (urban planning, legal and social issues) to particular aspects inherent in the technology (technical and economic barriers). Thus, we expect that this new approach can provide a broader view of the obstacles to realizing the great efforts are being made by various stakeholders.

2.1 Why rehabilitation?

The eternal dream of the big city: its bright lights, the tall buildings and the traffic jam, have turned into an explosion of urban spots scattered everywhere, which complicate the sketch to the city limits and therefore block the city management. At the same time complexity of the city increases, also, the relationships and the number of stakeholders involved, and the quality of life of citizens change while generating a countless of social, economic and environmental issues that complicates the efficient management of the urban patrimony.

If the public management and urban planning fail, the private capital holds the needs of the citizens offering “small cities” that copy the real city, but sometimes with a disguised interest of offering solutions to the needs of the citizens. Why disguise?...Because while the pragmatist conception of the city is planned to inhabit, recreate, work, relation…the new “ideal cities” offer these activities with unique performances and a main target for the developer: sell; and for the citizen: consume…The consumerism consequences impact on the whole city support structure (energy sources, water, economic capital, human capital….) generating a high energy consumption on the one hand and tons of polluting waste on the other.

On this basis, we must invest in urban planning that includes the recovery of the existing city in its schedule (opposite to only promote new urban developments). From the research field of R2CITIES, we understand that joint efforts between public and private sector should lead positive effects for the management and development of the city with a greater investment of private capital, otherwise, the damage for the urban structure and even more for the environment could be irreversible.

The urban renovation concept was born in the middle of the last century like conclusion of the International Congresses of Modern Architecture. As a result of the postulates of undefined growth crisis began to rethink the “new town project” by the “project of the existing city”.

In principle, this term applies to the recovery of the historic buildings, but later spread out to residential buildings, neighbourhoods, etc. In seeking to assess the recovery of historic downtowns as a whole, it has been checked the transformations or the morphological, functional and social degradations that the historic city had suffered.

The need to address a correction beyond the physical restoration of existing buildings and the urban environment, allowed assessing a new theory of renovation that is focused on the existing city. Besides the idea of historic preservation were other social reasons such as deterioration of the traditional inhabitants: aging, low income, low productive activities, etc. It represents the waste of city facilities and the imminent need to build other neighbourhoods in the suburbs. ***Due to the lack of methodologies and technologies that facilitate the maintenance of the old "new city", the building park rapidly was deteriorated.***

Later, it has been used the sustainability term that integrates environmental and socioeconomic aspects and undoubtedly begin to assess energy aspects, mobility and associated CO2 emissions.

Therefore, we could understand the urban rehabilitation as:

"…Urban rehabilitation starts with the multidisciplinary diagnosis that enables the knowledge of the neighbourhood and goes beyond buildings, the infrastructures or the public spaces, to involve different actors and inhabitants. It is on this solid base over where politicians make key decision and drive urban management, legal instruments and necessary economic resources. In summary, the goal of the degraded areas revitalization is carry out regeneration strategies which allow stop the deterioration of the urban and social fabric, preserving its heritage values, strengthen social cohesion and promote economic activity."[1]

Under this premise, the R2CITIES promotes the approach of a holistic strategy for district energy refurbishment. It is focused on the development of a methodological framework that involves all interested people in the process and provides the support tools to make decisions in each stage. Among them, it should be noted the possibility to assess technological solutions adapted to the building refurbishment market.

It is for this reason whereby through this report we try to provide an overview of the existing issues and barriers that today prevent the materialization of all great efforts being made in the field of energy efficiency on buildings and districts in the European Union. Although, today, it is very common for us to focus only on the technological area, so, if you want to take the leap from energy efficient buildings towards energy efficient districts, the scenario shall change to a horizontal landscape that integrates all the efforts and great advances, that have been realized on technological level with the legal, social, political and economic aspects that are inherent to the city.

[1]Rubio del Val, J. (2011) "Urban rehabilitation in Spain (1989-2010). Present challenges and recommendations to overcome them", Informes de la Construcción Vol. 63, EXTRA,5-20

3. Barriers and opportunities to the comprehensive rehabilitation of districts and for integrating green energy technologies in buildings

This section aims to analyse the barriers departing from the general framework for the comprehensive rehabilitation of districts (housing policy, urban planning, legal and social aspects) towards integrating green energy technologies in districts. Development scheme of this section is presented in the figure below.

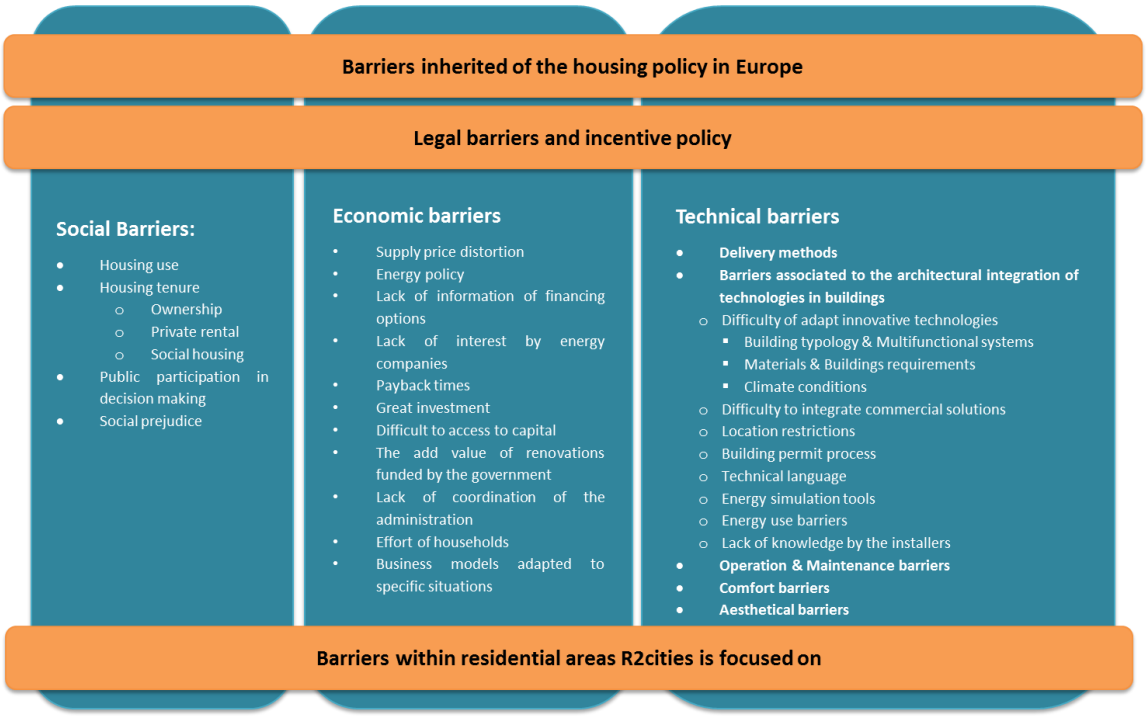

Figure 2: Summary and classification of the main barriers

3.1 Barriers inherited of the housing policy in Europe

In the context of the research done in this project, the analysis of the History (evolution and decision making) related to housing policy, helps us to understand the current situation, aspects that are not reflected in a traditional energy audit and goes beyond the diagnosis of the neighbourhood physical condition.

This analysis is done in order to assess the problem in its context, since suggesting shifts of objective actions, it is necessary to follow the dynamics of the city with a holistic approach that takes into account the circumstances that led the decision making, because in the neighbourhood history may be the problem but also the solution. That is, if you know what the root of the problem is easier to find partial or total solutions to face that problem.

On the other hand, this exercise helps us to assess the ability of the city to face new challenges and add or face more complex situations in its revalorization process. Also it helps us to assess how can be the results or suggestions for overcoming existing barriers that aims to answer the new methodology developed in R2CITIES framework.

Thus, this section is dedicated to analyse the causes and consequences associated to housing policies in Europe (legal, social and economic aspects).

3.1.1 Problems of the housing policy in Europe

From the early twentieth century it has been begun to give real solutions to housing issues of factory workers with few resources for access to housing. From this moment, social housing policies were adopted, mainly in the northern European industrialized countries, later in France (50´s). Different from Mediterranean countries (Spain or Italy and Greece, where there never was) characterized by lower relevance of social housing.

Due to the conflicts of the early twentieth century, all necessary houses weren´t built and around 30´s it was generalized the policies of freezing the rents, which aimed avoid speculation and make easy the access to housing.

Finally, these measures, along with other factors, discouraged private investors. And, adding the participation of most countries in the Second World War and the civil wars that obliterated much of the built park, around 50's all over Europe suffered a lack of housing, coinciding with the rural exodus into cities.

The massive attraction of the cities and the post-war baby boom accrued the problem of housing demand, so it became imminent the promotion of housing assistance to meet the demand. Within these measures, it should be noted:

- Production grants: applicable to social park first and then the free market. It aims to reduce the investment cost of housing construction
- Personal grants: directly to users who are not able to withstand the loads produced by the housing expenditure. From the 80´s, these aids began to generalize, gradually replacing the production grants and extending to future owners.
- Fiscal aids: tax cuts

Thanks to the impetus given to the building construction between 50´s and 80´s, social housing park increased considerably. However, the increase of housing stock was prioritized and although the quality of housing was regulated, **it was not paid attention to urban fabric type that was being generated, with very poor quality and lack of services.**

The integration of all interested people in the management process of social rental housing had an action to highlight, the transfer of competences to non-profit organizations that work

best than public authorities, had better management capacity and a decentralized system different from the bureaucratic machine of the state.

Like aforementioned, the freezing of rents even allowed access to low-income people, it caused discouragement of private investors. The free rent park was deteriorating due to the stock of very poor quality, outdated and full of gaps. When the freezing was eliminated, quickly the prices increased a lot, so the personal grants (aforementioned) began to establish to hold people to support these increases. However, these measures were not enough. The renovation of this park typically located in the oldest areas of the city, caused an increase in prices and a gradual expulsion of the population that resided there.

During the 80´s, the economic crisis promoted cuts in housing policy. After leasing the rental market, many countries chose to enhance the property as the main tenure system and conserve a small percentage of social housing. Production grants were reduced in favour of personal grants and fiscal benefits that were widespread.

Personal grants were focused mainly in building and district refurbishment, in this way it was intended to improve the low quality of neighbourhoods and minimize the effects that rent freeze produced years ago.

Around 90´s, most of social housing was managed by NGOs (NGO-non-governmental organization) which were managed with private money while in the United Kingdom social housing were managed by public money and received state subsidies. In some countries like Denmark and Scotland the NGOs had great participation of the tenants, who were involved in the decision making process. Not so in France and UK where tax policies downplayed participation of tenants.

The aids started by each country were closely linked to tenure regime favoured by each one.

The financing of home ownership during this period was based on household savings and mortgages granted by banks.

While in northern European countries the housing construction and the public expenditure are linked to social spending and is it cut due to EU convergence rules; in the South, where housing market is shifted from this aspect, it is used to heat the economy and generates wealth. It also involves, in the case of Spain, a change in the concept of home use, not as a basic consumer good but as an investment to speculate.

Moreover, with the oil crisis of the 70's appeared a new way of interpreting the actions within the consolidated city. This crisis raised the price of building materials and their transport and began to appear economic doubts about whether rehabilitation or renovation was the most appropriate action to the city issues. Demolish and rebuilt or refurbish were compared, but later it began to take into account other factors different from the economic.

The demolition and subsequent construction of the poor condition buildings are much more expensive from an energetic point of view, in the other hand the renovation implies much more labour, so it is posed as an immediate solution. However, customary practices were related to urban renewal laws to demolish and rebuild. A practice that apart from not being the best in energy and economic terms, promotes social segregation, because usually, in degraded neighbourhoods live low-income people who cannot afford the price of a new home because after the revaluation, the prices increase exceeding the purchasing power of the original users.

By contrast, rehabilitation was seen as an economically and sustainable path and as a way to preserve the existing culture, history and users, becoming a political and social action that favours people who live there. Therefore, pit promotes citizen participation in the process.

3.2 Legal barriers and incentive policies

This section provides an analysis of legislative issues that have a direct or indirect impact on the comprehensive rehabilitation of districts. Including not only the actual energy or technological aspects, but urban, social and economic issues associated with housing policy in Europe and fiscal policies.

The main legal problem is that there has never been a horizontal view of the entire regulatory framework associated with the urban rehabilitation, at both building and district level. In addition, there is a legal vacuum that really associate interactions with the buildings and their neighborhood.

In general terms, the rehabilitation policies should involve collaboration among the stakeholders involved in the process: public sector, private sector and the collective. This promotes their integration into the actions of the social, health and environmental field.

3.2.1 Urban barriers

The urban legislation in each European country is characterized by an almost exclusive dedication to encourage the tenure regime more relevant to the state authorities, regardless this legislation do not promote the sustainable development or comprehensive rehabilitation as an engine for social and economic development of the most vulnerable communities.

In addition, in some European countries, housing policy is managed independently without coordinating with the urban planning regulations. Similarly energy policies do not take into account the social aspects as housing tenure or economic status of neighborhoods.

The current urban legislation promotes urban sprawl, the creation of new cities, with little or no regulation for the actions in the existing urban network.

Due to the crowd of stakeholders, the various situations in which it is find each one (unemployment, aging, youth, etc.), the various social problems that may arise (social exclusion, illegal leases, accessibility, etc.), physical limitations of the urban network and the actual situation of the neighborhoods, **it is indispensable new urban planning instruments appropriate to the specific context in which it is intended to perform some actions or urban regeneration. However, at the same time these urban planning strategies must have a certain degree of flexibility to handle more specific aspects, because by this way it would prevent the sequence of partial laws that worsen the problem instead of solving it.**

3.2.2 Barriers at building market legislation

3.2.2.1 Sustainable construction standards at international and European level

Sustainable construction is one of the six sectors of the Lead Market Initiative adopted by the European Commission in late 2007. This initiative includes a set of actions in the field of regulation, public procurement and standardization, in order to reduce barriers to launch new products or services in the residential and non-residential building market. Although 40% of the construction works are demanded from the public sector, the green public procurement criteria are not usually taken into account. Notwithstanding these criteria would promote the demand for sustainable solutions aimed at innovation, considering the life cycle assessment and the cost-effectiveness analysis.

At the standardization level, every day new tools are integrated to obtain a continuous improvement in the field of building efficiency and commitment that must be undertaken at the municipal level. There is a pressing need to establish a comprehensive view of the construction of energy efficient buildings considering all the stages involved in developing sustainable land management, construction, operation and maintenance.

This is compounded by uncoordinated sector legislation and lack of coordination among stakeholders to prevent the materialization of various energy initiatives arising from a localized among some players in the sector of construction and proper planning.

Recently was released the **International Green Construction Code** (IgCC). The IgCC is the first model code to include sustainability measures for the entire construction project and its site from design through construction, certificate of occupancy and beyond. The new code is expected to make buildings more efficient, reduce waste, and have a positive impact on health, safety and community welfare., the International Code Council, made up of major industry groups like the U.S. Green Building Council (**USGBC**), the American Institute of Architects (**AIA**), the American Society of Heating, Refrigerating and Air-Conditioning Engineers (**ASHRAE**), Illuminating Engineering Society (IES and the global standards firm **ASTM**

International, created industry-wide municipal guidelines.[2]The IgCC provides: Baseline Green Requirements, Economic Benefits, Professional Development & Technical Support.

Also, at international level are being carried out by the **Technical Committee ISO/TC 59/SC 17**[3]Sustainability in buildings and civil engineering works which is divided into several subcommittee/Working Groups:WG1: General Principles and Terminology, WG2: Sustainability Indicators, WG3: Environmental Declarations of Products, WG4: Framework for Assessment of Environmental Performance of Buildings and WG5: Civil Engineering Works.

However, although the International Committee works continuously in getting of a successful range of sustainability indicators and the development of a methodology that can be applied globally, is not able yet of being applied at European level. It needs to be clear about the indicators and the methodology assessments.

In the context of the **European Committee for Standardization (CEN),** funded by national agencies of the European Economic Community and EFTA (**European Free Trade Association**) brings together different experts from the construction sector, among others. By the **Vienna Agreement**, **CEN and ISO will recognize each other's work and will not duplicate it.**

It must be highlighted that these standards which were suitable for individual assessment of the parameters of a building, currently it is being taken into account combined assessment of all the indicators that affect the sustainability of a building. In this sense, they recognized that it is important to develop an integrated methodology that would enable an overall assessment of all parameters involved in the value chain of a building.

Nevertheless, it is still necessary to extrapolate all the knowledge achieved from energy efficient building design towards energy efficiency district renovation.

3.2.2.2 Building Energy Codes (Energy Performance of Buildings Directive EPBD)

Currently, the EU is developing several policies aiming to rationalize the energy consumption in buildings, increasing the indoor quality and reducing the impact during the building whole life cycle. The European Commission introduced, in 2003, the Energy Performance of Buildings Directive (EPBD), with the aim of promoting good practices in the building sector. However its application is limited by the complexity of coordinating the different actors involved in the construction sector. Recently, the EPBD recast has been adopted, establishing new targets for the member states.

The Energy Performance of Buildings Directive 2002/91/EC includes environmental information in energy certificates and, particularly, in CO2 emissions. Environmental

[2]http://www.iccsafe.org/cs/IGCC/Pages/default.aspx

[3]http://www.iso.org/iso/iso_technical_committee?commid=322621

performance is a major driving force for energy saving (climate change, exhaustion of resources, nuclear waste, toxicity aspects, etc.). The reduction of the building sector environmental impact requires appropriated evaluation methods allowing:

- The integration of environmental performance levels into local codes (e.g. requirements in municipal policy and building programmes).
- Training and awareness campaigns to the designers, architects and consultants.
- Guidance for efficient operation and management of buildings, so that actual performance corresponds to design performance.
- Methods and tools to evaluate the most cost effective measures for energy savings and reduced environmental impact over the whole building life cycle.

The energy certification processes for buildings that are being applied in European countries, as a consequence of the transposition of Directive 2002/91/EC to the national laws, constitute a fundamental step for improving buildings' energy efficiency. European Community countries have developed large changes in their edification policy, increasing the energy requirements.

In May 2010 the recast of this Directive was finished and the Directive 2010/31/EU was approved. The new text adopted has a greater scope, clarifying, simplifying and strengthening some aspects in order to increase the energy efficiency in buildings and to reinforce the exemplary role played by the public sector. The new Directive proposes that all the new residential, offices and services buildings to be built from 2020, must be zero energy buildings. The deadline for new public buildings is 2018.

However, despite all these good efforts, the methods for sustainability assessment and energy efficiency evaluation of districts are still very limited. Uncertainty in cost effectiveness of energy efficiency measures and renewable integration, has led building promoters to meet only the minimum requirements of the current legislation in new construction, not in the field of rehabilitation.

3.2.2.3 Construction products: harmonized conditions for the marketing

There are several directives and laws across the European Union about construction materials and construction systems, according to the range some normative is national and some other is European; and according to the target some legislations promote the energy efficiency and building retrofits and some other regulate the basic requirements for construction works as a whole and in their separate parts.

Construction Products Regulation (EU) Nº 305/2011[4]

Construction Products Regulation (the CPR)is to ensure reliable information on construction products in relation to their performances. This is achieved by providing a "common technical language", offering uniform assessment methods of the performance of construction products.

These methods have been compiled in harmonised European standards (hEN) and European Assessment Documents (EAD). This common technical language is to be applied by:

- **the manufacturers** when declaring the performance of their products, but also by
- **the authorities of Member States** when specifying requirements for them, and by
- **their users** (architects, engineers, constructors…) when choosing the products most suitable for their intended use in construction works.

The "*Regulation (EU) Nº 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC" consider that "the rules of Member States require that construction works be designed and executed so as not to endanger the safety of persons, domestic animals or property nor damage the environment"* these rules have to regulate the requirements of construction products, which are reflect in national product standards, national technical approval sand other national technical specification.

Due to this, it has been established basic requirements that construction works and construction products have to satisfy. There are harmonized standards and European Technical Assessment that collects more concretely the basic requirements that a specific product has to satisfy, in that case, the product manufacturer shall draw up a declaration of performance when such a product is placed on the market. By drawing up the declaration of performance, the manufacturer shall assume responsibility for the conformity of the construction product with such declared performance.

Due to the complexity of some kind of innovative products or construction technologies, sometimes there is not a clear understanding on how to declare the conformity of them. As an example the architectural integration of PV technology in building sets out a double challenge to the products that integrate it (PV modules, support structures, inverter units and the rest of the system). ***Thus, PV systems not only must fulfil the electrotechnical standards, but also must fulfil the rules and practise that govern the construction sector. Nowadays, the low specific regulation applicable to the BIPV technology complicates the creation of a European market of products.***

However, in that case regulatory harmonization, which is taking place within the CEN (European Committee for Standardization), implies a unique opportunity for PV technology to develop and adapt their products in accordance with the *Regulation of Construction Products*

[4] http://ec.europa.eu/enterprise/sectors/construction/legislation/index_en.htm

(EU) Nº 305/2011, where these are defined as products manufactured for incorporation in a permanent building and civil engineering works, affecting essential requirements of construction products established in this regulation :Mechanical resistance and stability, Security in case of fire, Hygiene, health and the environment, Safety in use, Protection against noise, Energy economy and heat retention, Sustainable use of natural resources (*new incorporation on Regulation 305/2011*).

3.2.3 Incentive policy at European level

In Europe, it has been adopted the *Directive 2010/31/EU of 19 May 2010 on energy performance of buildings* that promotes the improvement of the energy performance of buildings within the European Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness.

Related to incentive policies, the Directive establishes:

1. Energy performance certificates: Member States shall ensure that EPC is issued for:

- Buildings or building units which are constructed sold or rented out to a new tenant.
- Buildings where a total useful floor area over 500m^2 is occupied by a public authority and frequently visited by the public. On 9 July 2015, this threshold of 500m^2 shall be lowered to 250m^2.

It allows buyers, renters and users to compare the energy performance between different buildings and dwellings and chose the best option. Therefore, it will cause in building owners the need to make energy retrofits for have competitive buildings in an energy performance point of view.

2. Minimum requirements to the energy performance of new buildings and new building units:

Member States shall take the necessary measures to ensure that minimum energy performance requirements for buildings or building units are set with a view to achieving cost-optimal levels, both in new buildings and existing buildings retrofits.

In the case of this project, it is very important, because all the demo-buildings has to be retrofitted having several minimum requirements according to different national regulation (derived from the Directive). For example, in the case of Spain, the retrofitted building must follow the CTE-DB-HE (energy performance regulation for buildings in Spain).

3. Technical building systems:

Member States shall, for the purpose of optimizing the energy use of technical building systems, set system requirements in respect of the overall energy performance, the proper

installation, and the appropriate dimensioning, adjustment and control of the technical building systems which are installed in existing and new buildings.

The system requirements shall cover at least the following:

- Heating systems.
- Hot water systems.
- Air-conditioning systems.
- Large ventilation systems.
- A combination of such systems.

Member States also shall encourage the introduction of intelligent metering systems, active control systems such as automation, control and monitoring systems that aim to save energy.

4. Nearly zero-energy buildings:

Member States shall ensure that:

- After 31/12/2020, all new buildings are nearly zero-energy buildings.
- After 31/12/2018, all new buildings occupied and owned by public authorities are nearly zero-energy buildings.

Member States shall draw up national plans for increasing the number of nearly zero-energy buildings, but these national plans could include targets differentiated according to the category of building, including at least the following:

- Definition of nearly zero-energy buildings, reflecting their national, regional or local conditions, and including a numerical indicator of primary energy use expressed in kWh/m2 per year.
- Intermediate targets for improving the energy performance of new buildings, by 2015.
- Information on the policies and financial measures for the promotion of nearly zero-energy buildings including details of national requirements and measures concerning the use of energy from renewable sources in new buildings and existing buildings undergoing major renovation.

5. Economic incentives:

Mainly there are two European sources for invest in building energy performance:

- The frame work program “Horizon 2020”, which give grants for cooperative R&D projects inside Europe.
- Loans from the EIB (European Investment Bank).
- Grants by FEDER funds

The Member States have already adopted different articles from the Directive; therefore, the demo-buildings will be affected by the national regulation.

3.3 Economic barriers

This section shows the main barriers associated to economic aspects. Some of the found barriers may be related to the technologies itself, but in general they are related to the financial policy of the countries (lack of financial aids, confused subsides for the rehabilitation, etc.) and split interests between stakeholders.

Split incentives: when the building developer and the beneficiary differ. There are two types:

First: When the building owner pays the energy bills but the user or tenant (different from the owner) consume that energy. In this case, the user is not aware of energy efficiency and energy saving, so he will not pay more for a better dwelling in energy efficiency terms, and it doesn´t encourage the energy refurbishment if the energy is cheap.

Second: When the building developer is not the same person as the future owner or tenant. In this case, the developer is not interested in invest money in energy efficiency systems more expensive than minimum requirements because he will not pay the future energy bills.

In conclusion, for achieve a good energy strategy in real estate developments or retrofits, **it is preferable that energy consumer should pay the bills in the case of renting; nevertheless, for home ownership it´s very important that people should be conscious of the energy performance certificates to promote high performance new buildings and high performance retrofits.**

Supply price distortion: refers to the cheap reference price of energy from conventional sources that do not include external supply impacts (for example: pollution). It makes comparing renewable sourced supply to conventional supply cost unfair; thereby some scenarios might be very sustainable but are not economically viable because of price distortion.

Energy policy of the country: Inside this barrier is included the government grants to the removable power production, and the energy policy about what to with the electricity generated in different cases. For example: The energy produced from a PV panel integrated on a residential building roof doesn´t have the same possibilities of use in Germany that in Spain, in the first country, you can consume it or sell to the grid at a good price. However in Spain, it´s better to consume the energy because the selling price is minimum or nil. These options will lead the pay-back period of the investment.

Lack of information on financing options: Information on financing refers to limited actor knowledge in dealing with both upfront costs and financing schemes for running cost and cash flows.

Lack of interest by energy companies: Energy retailers have an obvious disinterest in supporting a client's initiative to reduce energy use. Recently however energy suppliers are

adopting alternative business models that secure energy supply to a customer while implementing renewable generation technologies. Examples are utilities supporting homeowners with loans for small scale PV and wind instillations. Firms however must use alternate means to finance renewable energy projects without direct help of public energy utilities.

Payback times: the building promoters do not realize of the high potential of green energy solutions, especially PV, as Distributed Energy Source (DER) that might lead to interesting payback times and IRR if compared to traditional and conventional construction materials that provide null payback times and non-existing IRR (just building material amortization).

Large pay-back period in some cases: Various sources indicate renewable technologies are not competitive with conventional supply and therefore cannot give adequate returns on the capital investment. This idea contrast with the green technology integration in buildings, where, construction systems with renewable technologies can, at least, be amortized; and the conventional solution, with any saving, are only an expense inside the building maintenance.

Great investment: The implantation of renewable technologies on buildings is much more expensive than convectional solutions on a retrofit, which is closely linked to low return of investment previously mentioned.

Difficult access to capital: Difficulty accessing capital is influenced by other barriers like perceived higher risk of technology, and lack of technical knowledge. This barrier is specifically related to home owners, and small business owners. **There are alternatives to avoid these barriers, for example, leasing and renting on green technologies, where the amortization quote can be paid with the energy savings from bills.**

The add value of renovations funded by the government: in many European countries the neighborhoods most needed of rehabilitation are usually habited by poor people, unemployed or socially excluded. Consequently, if a rehabilitation runs, public administration aid is required, so should be regulated and graduate limitations on the subsequent sale, so the added value will not be privatized. **In this sense, it is necessary to develop financing products for rehabilitation: loans, government guarantees, microcredit, etc...**

Lack of coordination of the administration: In some countries, such as Spain, there is a lack of coordination between administrative areas and industry to promote housing finance products for energy rehabilitation of buildings, so these ones remain unclear and some confused at present.

Effort of households: in many countries has grown household spending. The spending devoted to physical maintenance of housing has declined significantly, resulting in deterioration of the park, on the one hand, and the reluctance to invest in new renovations, on the other. However, it must be highlighted that **this barrier can be an incentive for rehabilitation if it is**

showed that the energy rehabilitation may significantly reduce household spending, with the added benefits of having the property in better condition and improve the comfort inside.

Business models adapted to specific situations: The current business models cannot be adapted to particular requirements of the stakeholders and to some specific economic, social and physical situations.

3.4 Social and cultural barriers

In this section are being included the social and cultural barriers not associated with technological aspects. The most relevant are the following:

Housing use: The use of the home (primary residences, second homes and empty homes) can cause a greater or lesser interest degree in the refurbishment, so, it represents a barrier to analyse in the context of this deliverable. Thus, the use of housing represents one of the biggest problems in dealing judicious management of the housing stock by the little or inexistent interest to refurbish which may have the owner.

Housing tenure: The housing tenure can be an important consideration to take into account for rehabilitation works. On the one hand, owners might be more interested in rehabilitating homes if it is necessary, issue that is not interesting to people who live in rented. While the fact that tenure is ownership, it drives a greater number of stakeholders (owners) that can hinder the decision making to implement any intervention. Also, homeowners under private rent might be no interested in running some works for which is not their main home. **This situation forces the authorities to promote, through legislation, financial incentives or tax benefits to refurbishment works, in the case of tenure is private property or rental; or invest if tenure is social housing. In both cases, is considered the sustainable development.**

- **Ownership:** exceptions, households whose tenure is ownership have higher incomes than those who live in rented. However, currently there are a lot of homeowners who are in financial difficulties, mainly in Mediterranean countries (where is the greatest percentage of home ownership):

    - Unemployed people who are in difficulty to pay the mortgage and the costs generated by the property.
    - Old people whose homes are not adapted to their needs.
    - Old people with low income who own dwellings those need to be refurbished and have poor maintenance.
    - Fractured families where one of the members creates a demand for rent.

- **Private rental:** People living in private rental generally have fewer resources and are not open to take any action in a home that is not their property. It should be noted that although this tenure has decreased in European Union, the park in this situation is quite important and is usually what has lower quality. The percentage of households on this tenure varies between 5 – 15 % among the countries of northern and southern Europe.

To overcome this barrier it should promote tax incentives to tenants to maintain the park with good quality (like Germany and France).

Other rehabilitation policies that can be highlighted are UK, Netherlands and Denmark, whose homes are acquired by NGOs that manage social housing to be rehabilitated or adapted to the needs of different groups.

- **Social housing:** in some EU countries an important part of social housing has very poor condition in physical aspects and quality of life because they are areas of great poverty (Dublin, Paris, London, Copenhagen, Berlin...) .Many of these households that were poor but had jobs, now, due to the economic crisis they have suffered a reduction in their prospects of an improvement. Thus, the aging of population and the increasing number of pensioners in the social park, rising rents, rising unemployment and economic recession have become the expense of housing subsidies in a disturbing situation for the governments. Consequently, while social housing has become accommodation for the problematic parts of the population, like unemployed, single parents, ethnic minorities and immigrants, it has favoured spatial segregation, which reduces the user interest for invest in refurbishment works, on the one hand, and the government interest in the other hand (because they are a load for the state that should support them to survive).

Public participation in decision making: one of the greatest barriers to social issues that exist today is that no one considers citizen participation in decision making. Since the main objective of urban renewal is to improve the quality of life of users and the development of community, it is essential to them the participation in making decisions throughout the process.

Due to the vulnerability of certain social groups, to ensure the correct public participation is necessary to make available the necessary tools (stable social management bodies equipped with adequate staff, like social workers, mediators, educators, etc.) to give the necessary training and monitoring, and reinforce the existing social structure to integrate the marginalized groups, among others.

Social Prejudice: In some cultures, such as the Spanish, persists the myth where the periphery is an ideal habitat and sign of upward mobility compared to traditional neighbourhoods, making it difficult to understand rehabilitation as improved quality of life. Also, while rehabilitation is considered as a mere expense of maintenance or preservation rather than as a true investment, there will not be a real culture of rehabilitation.

3.5 Technical barriers

This section is dedicated to analyze the technical barriers that may affect the *design and construction (D&C) process*. It must be highlighted that are being mentioned some social aspects, but only these ones associated to the technical aspects.

In the aforementioned sections have been mentioned the barriers that may affect one or various stakeholders involved the D&C process. However in this section will be mentioned another specific barriers from the point of view of the *Owner team, Design team and construction team*.

3.5.1 Barriers associated to the design and construction methods

This kind of barriers may affect all the stakeholders involved in the design and construction process; in fact they are directly associated with the social aspects. **However, they are the barriers with more influence on the management of the technical aspects and for sure over the whole results of the project (energy, environmental, economic etc.)**. Thus, for its better understanding it has been included as an introduction of this section.

Delivery methods[5]

The communication flows and stakeholder's types of collaboration established the building design & construction process is one of the most important barriers that preventing the materialization of various energy efficiency strategies.

Sharing of data between project stakeholders is a key element in the BIM lifecycle. In the traditional construction scenario, project data from each stage is handed down to the next stakeholder who must now spend considerable time and resources deciphering the previous teams plans, specifications and other data before they can proceed towards their scope of work. And on to the next phase this process is then repeated.

The traditional "Design-Bid-Build": In the traditional "Design-Bid-Build" contract scenario (competitive bid) the Architect & Engineer (AE) do not work as closely with the General Contractor (GC) and the project information is disseminated from the planning phase to design phase to bid phase to construction phase and then into building occupancy, representing enormous amounts of lost time and the potential for mistakes.-

[5] [1] http://www.trimbleextensions.com/i_i/industryinsights/bim_present_and_future/#sthash.mLey0zRA.dpuf

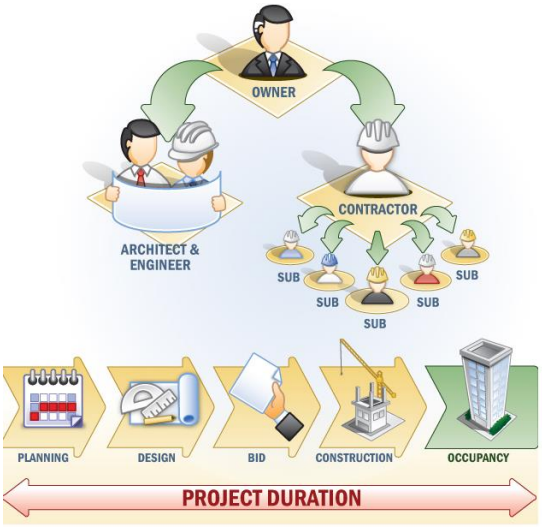

Figure 3: Schedule of the traditional "Design-Bid-Build" [1]

Design-Build: In the "Construction Manager (CM) at-Risk / Design-Build" contract scenario the Contractor is selected much earlier in the process. The Owner, AE and GC work more closely together resulting in a compressed construction schedule. Also notice the overlap in stages of construction, removing or mitigating the lost time in deciphering project data and mistakes in the workflow. RFI's (requests for information) are not removed; many are relocated to the modeling stage where it is much easier and cost effective to deal with them versus during the construction phase.

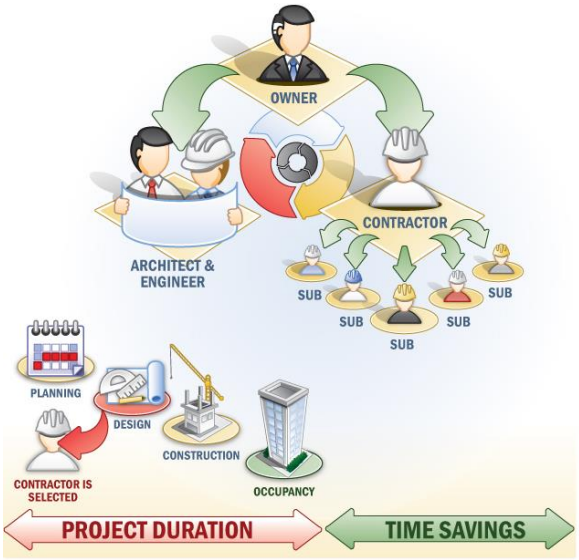

Figure 4: Schedule of the Design-Build method [1]

Current industry practice is to communicate this information using a variety of methods including, but not limited to, mail, shipping services, fax, email, FTP, and internal servers configured to allow limited access to external parties through a firewall. While functional,

these methods can lead to a confusing blur of communication without clear organization or accountability.

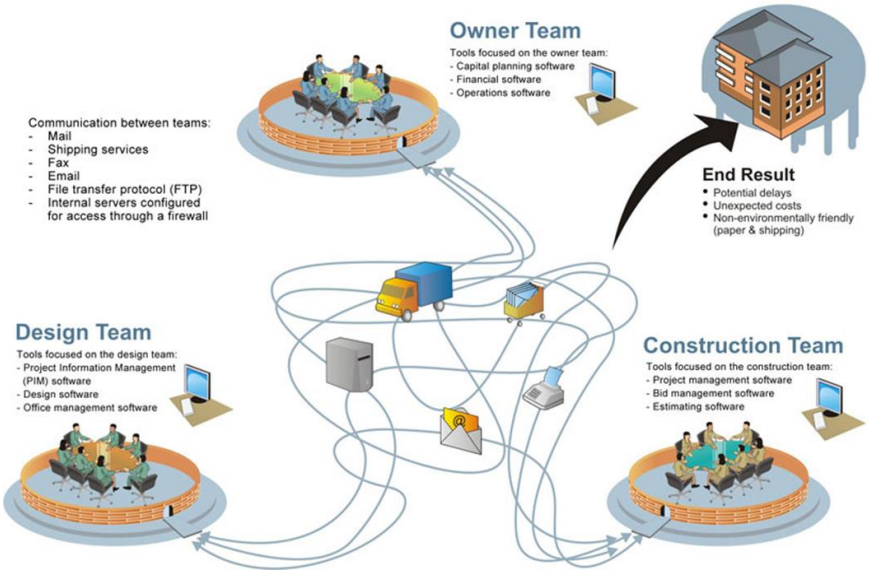

Figure 5: Schedule of the current communication flows [1]

Nevertheless, it must be highlighted that there are a news proposals to overcome this barrier: for example, the ***Integrated Project Delivery in the Cloud***", allows all project team members to sit at the same virtual table, hosted on the Internet, with access and accountability for each participant. IPC software is designed for shared use, in contrast to other systems that are designed primarily for the benefit of only one part of the project team. IPC does not replace other software solutions, but complements them by providing a central location for information generated in other systems to be shared and responded to by the full integrated project team.

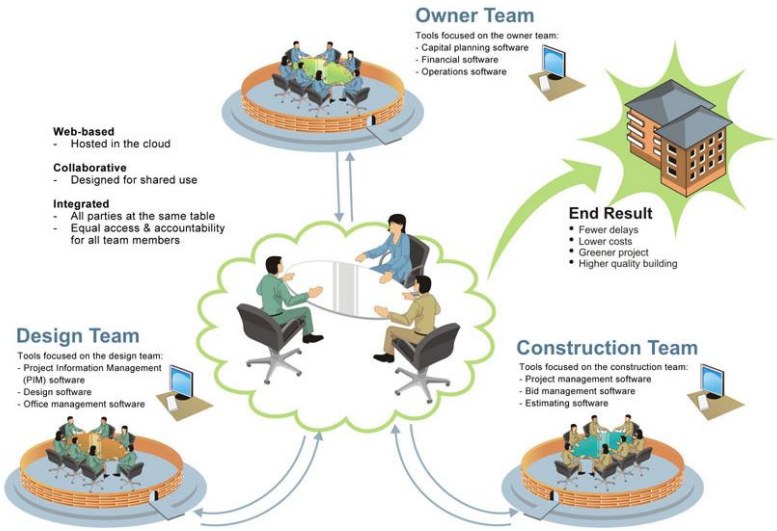

Figure 6: Schedule of the Integrated Project Delivery in the Cloud [1]

But the problem is that the stakeholders are not aware of the real benefits of these new methods. On the other hand there is a lack of knowledge regarding the use of some kind of tools and the interaction between them.

3.5.2 Barriers associated to the architectural integration of technologies in buildings

Difficulty of adapt innovative technologies:

Building typology: a lot of innovative solutions cannot be adapted to all typology of buildings, from social housing to the most outstanding building, from multi-residential to multifunctional (hotels, hospitals, commercial centers, etc.). Thus, green energy solutions should get adapted to all type of buildings, taking the districts and the whole urban area as a balanced grid where every building acts as ballast. This idea should overcome certain prejudices are found in terms of cost/m2, however, ***this barrier should be easily overcome as far as the new solutions retrofit or replace and displace the alternative non-active construction element.***

Multifunctional systems: within the green building sector, the approach to energy efficiency is based in a pyramidal-based model, where the passive strategies lay on the bottom and the active ones are above. *Maybe the approach should come from the development of multifunctional solutions.*

Integration and durability of the materials: it is found some kind of materials not adapted to the buildings codes and needs in terms of comfort, safety, structural and mechanical parameters. On the other hand, a lot of construction solutions are composed by various materials with different durability levels. Thus, it cannot be guarantee the durability of the whole system. **These kinds of solutions should be designed in such a way that all the materials should achieve high durability levels and it should be designed to facilitate the maintenance or repair when necessary.**

Adaptability to the building requirements: there are some construction solutions that cannot be integrated into a building because they increase the weight of the structure, or for the effective area of the building reduction. In addition, there are many solutions that involve long time for its installation which prevents their use in certain types of buildings that cannot stop working.

Climate conditions: Many of the existing building technologies cannot be extrapolated to different climatic conditions. But considering that each building is unique, this is not a problem in itself; the problem is that there is no clear explanation from the developers on best applications of its products to ensure proper integration of the building in its context, to be exact for its correct operation.

Difficulty of integrate commercial solutions:

There is some kind of innovative technologies that cannot be easily integrated in a building. E.g. The sizes of the majority of PV and solar thermal modules defined by manufactures don´t have sizes multiple of 100 mm, a value that is consider a measure standard parameter in building industry, therefore, it´s difficult to cover all the envelope with modules specially if it doesn´t have a flat surface. So, the lack of different products by size, form, thickness, color, type of application, finish, PV technology and construction functionality, is an important technical barrier of design for architects and building designers, who cannot use these technologies as traditional products, and having to adapt the building design to the commercial product; this is illogical for building design process, because the method is normally the opposite.

In recent years, especially in PV technology, the market has been offering PV products with an acceptable aesthetical appearance, or at least, a variety of options where the designer can find the best adaptable solution for his needs. But, there is always the option of tailor-made solutions, but the high cost of it could offer unattractive pay-back periods.

Location restrictions:: This kind barrier may affect the architectural integration RES technologies in the building. Among them:

Solar technology: which obviously needs good solar irradiation, therefore there are several restrictions for locate it. According to the different national regulations, there are maximum values of losses comparing to the ideal installation. The demo-buildings, will be placed in Valladolid (Spain), Genoa (Italy) and Istanbul (Turkey), so, each national regulation shall limit these losses. The losses are due to orientation, inclination, shadows, and the PV connection system.

The system losses is an internal condition that cannot be modify because is due to the performance of different devices, but orientation, inclination and shadow are conditions can be chosen (inside the existing options) in the design phase to optimize the power and thermal production.

Solar systems integrated in building normally are fixed (without rotation axis to follow the sun). Therefore, there are several positions and inclination that cannot be chosen, like façades with certain deviation from south or roofs with many shadows. Therefore, all these condition restrict the options of a building integrated solar system.

Outside solar technologies, **wind turbines** offer a different green energy solution in buildings. This option is more difficult to integrate, due to two reasons. First, is the need of strong winds in the location, condition that is not met everywhere. Secondly, the wind needs to cross the turbine so is not possible to put a turbine in the building body, making it necessary to locate over the roof and increasingly the height of the building. So, these barriers make that

nowadays there are few commercial solutions to integrate on buildings, being the majority tailor-made solutions with high prices.

Another important issue inside location restriction is the structural resistance. **Thermal solar panels**, PV panels and micro wind turbines over the roof are the best example. Maybe people could think it is not difficult to put modules or turbines on the roof of a building, but some roofs have not been designed to support the additional weight, and it has to be check before any decision.

Building permit process: Building process and permit application procedures are often lengthy for some renewable systems, specifically when drilling is involved (geothermal heat pump) and the wells could affect some underground facilities. Another case is when the retrofit of the façade makes it thicker than before, and it means take up more space, infringing on the street, so, this operation must be authorized by the local authority.

Technical language: one of the main barrier for Energy Conservation Technologies market consolidation in the building sector is that green energy manufacturers (PV, thermal...) do not consider the needs and requirements of building developers, and the "green energy language" used by them is often ambiguous for the key stakeholders of the building sector, especially for the decision makers, architects and promoters. As a result, architects are inclined to have unjustified prejudices and consequently tend to not consider the possibility of integrating these green technologies, mainly due to the aesthetical appearance of the standard solutions.

Energy simulation tools: The above mentioned barriers are associated to the limitation of the energy simulation tools to calculate the real benefits of the innovative systems or technologies. Today it is still necessary to calculate the benefits of some kind of innovative technologies in a separate way, e.g. the TABS (thermal activated building system) is an active/passive construction technology that cannot be simulated in a simple manner by the most typical simulation software. Another example may be the Canadian wells that cannot be simulated in a simple way.

Thus, if it is added the lack of knowledge on the part of the designers in the use of the tools and the difficulty of **validating Energy Performance (EP) models**, this may represent a big barrier that can be traduced in a lot of mistakes in the calculation of real benefits and costs of the technologies.

Validating EP models within operation phase (real performance) is essential to assess the assumptions made in the design phase, but the complexity of the validation processes, lack of knowledge, costs and timing make this validation quite difficult. In fact, it is still very difficult to quantify the benefits of application of certain technologies and the advantages of using certain BIM modeling tools or specific energy simulation models.

Energy use barriers: this barrier is divided in two sub-barriers, power energy use and thermal energy use. For power, depend on the country energy policy, there are several possibilities to

use the electrical energy produced (PV or wind); in some countries is better to use yourself instantly or save in batteries to use whenever you need, in other countries could be better dimension it as large as possible and sell the power excess to the grid. So, power distribution systems are very different in complexity from each facility in each country. In the cases of self-consumption in multifamily buildings there is another problem, the distribution of energy between the owners, so in these cases is better to supply energy only for common facilities like stairs and car park illumination or lifts.

The barriers for solar thermal installation are easier, because energy is used only in self-consumption for sanitary hot water or heating. Therefore, the energy use only has the issue of distribution between owners in multifamily buildings, where owners could have different preferences, for example, sanitary hot water heated with thermal solar panels could be used by tenants with measuring system or without, and these meters can be a problem of lack of space to locate it inside a retrofit, however, SHW consumption without meters is not a good solution because tenants could use it without awareness of complementary cost of other backup energy sources. So, really, the issues in renewable thermal energy facilities are the same as traditional facilities from a distribution point of view. However, the problem of solar thermal disappears when this facility is installed for supporting some existing (or new) centralized system.

Lack of knowledge by installers: Renewable generation systems and energy savings technology performance is highly dependent on proper installation and setup. In addition, renewable systems in buildings often involve the integration of several systems designed to work in combination. In comparison to installing conventional energy systems there are fewer certified installers for renewable technologies, and especially in the case of renewable technologies integrated in the building envelope, where system are more complex because combine traditional system with green energy technologies.

Lack of knowledge of the users: Regarding active systems, there is usually an advanced automatic control systems that only requires knowledge by the user in some specific issues (e.g. thermostat set points), but for passive strategies (green houses, blinds, etc.) the users' awareness about its use is essential.

3.5.3 Comfort barriers

The implementation of green energy technologies in retrofits can modify the envelope conditions and the internal conditions. Therefore, it is going to be analyzed different parameters that can be modified due to the building integrated green technologies.

Modification of thermal conditions:

The best example to explain effect is the location of PV modules over the façade. It´s know that the PV cells exposed to solar radiation heat themselves and transfer the heat to their back side, which implies the need to study, with a dynamic simulation system, how affects this residual energy to the thermal demand of the building. So, the thermal increase of the façade external surface can generate a reduction on the heating demand in winter, which is good for energy efficiency, but can also generate an increase on the cooling demand in summer.

The increase of cooling demand can generate two different problems. First, if the cooling system has enough capacity to cover the demand, it involves higher energy consumption. Second, if the cooling system doesn't have capacity, it involves more time of discomfort due to the higher internal temperature.

Modification of indoor air quality:

This is a very common barrier when the need to insulate the envelope makes to forget the minimum ventilation flow must be guaranteed inside the building. The idea of designing energy efficient buildings and airtight, which have not taken into account certain health conditions and wellness as simple as indoor air quality. Due to improper indoor air renewal other problems such as condensation, mold and others arise in the walls. Therefore it is important to seek a balance between energy efficiency and indoor environmental quality in general.

Modification of illumination conditions:

The best example to explain effect is the location of PV modules over the openings. From a natural illumination point of view, some applications of PV over claddings like curtain-walls, sky-lights or some solar protections, can create undesirable effects inside the building. The light effects provided by the PV modules based on crystalline silicon technology, can annoy occupants, because it projects shadows and high contrast bright lights. In this sense, the thin film technology produces an illumination with a much more pleasing diffuse light level (but with less power production). So the main barrier in this case, is the election of the correct technology to balance out the illumination with the power production.

It should be noted that in all buildings today, the common practice is to offset the design errors through other systems like air conditioning or artificial lighting. This means that the elements that harm user comfort are overcome by using larger consumption of primary energy. So, in these cases, to analyze the quality of BIPV elements integration in terms of user comfort, it´s necessary to quantify the real consumption of the building for air conditioning and lighting comparing to previous situation.

Modification of acoustic conditions:

Inside green energy technologies for building integration, only solar technologies are silent. Therefore, all the other systems have to be analyzed to carry out a solution with a good acoustic insulation.

Thermal generation: biomass boilers and geothermal heat pumps are renewable solutions that can replace other kind of thermal systems (like fuel or gas boilers and traditional heat pumps), but both technologies (renewable and traditional) make noise, so the design considerations to insulate from noise are the same in both cases. It means that renewable thermal generators don´t have new comfort barriers, from an acoustic point of view, because designers take the same considerations than in traditional systems.

Power generation: like aforementioned, solar technologies are silent, therefore only wind turbines make noise inside the renewables solutions (if cogeneration is not taken into account). Wind turbines, unlike biomass boilers or geothermal heat pumps, cannot be kept inside a room to avoid the noise, so it´s necessary to check if the installation meets the allowed acoustic levels. It should be noted that vertical axle wind turbines are a better option to integrate in buildings, due to their smaller size, less noise, and better aesthetical appearance, and unlike horizontal axle turbines, they don´t need to be placed over such a high support.

3.5.4 Aesthetical barriers

Green technologies systems have its own aesthetical appearance and standard sizes in the majority of cases, and can induce fear in building developers and stakeholders to integrate these technologies on buildings. It may be, and it is, a major barrier when talking about the rehabilitation of historic neighborhoods, where the preservation of the image of the neighborhood is important to preserve the culture of a city.

For example, in the case of PV technology, normally each solar panel manufacturer develops its own size and it doesn´t facilitate the designer´s work for the integration of PV panels into the buildings, from an aesthetical point of view. Last, structural manufactures should try to get some standard on solar panels installation over the photovoltaic structure, thereby avoiding the need for the installer or architect to design the connection of the panel to the structure. But now, more and more companies are producing tailor-made PV panels and BIPV systems to achieve better integration in façades and avoid an industrial appearance far from the architectonical harmony.

In the case of thermal panels, currently there isn´t so much research lines to integrated it in façades, because roof surface is usually enough to achieve the thermal energy necessary to heat an important percentage of sanitary hot water (the main use), but there are some cases where designers decide to increase thermal generation (for example, to support heating system), and it´s necessary to locate panels over the façade, in this case, same aesthetical issues have to be solved like in PV solutions.

In micro-wind generation, the aesthetical issue is one of the largest problems. Usually these turbines have to be located over high supports outside the building or over the roof but at least 3 or 4 meters above the highest point, so it makes really difficult to integrated wind turbines in buildings. Nowadays, vertical axle turbines can offer a better aesthetical solution but far from building-integration. Only in new buildings, a good integration can be achieved, if the roof is designed to locate wind-turbines with a special architectural solution.

The other green technologies, like biomass boilers, geothermal heat pumps or cogeneration systems don´t have aesthetical barriers because usually they are located in internal spaces like traditional boilers and heat pumps.

4. Barriers and incentive policy at residential areas R2CITIES is focusing on

This section is dedicated to analyse the specific residential areas to refurbish in which R2CITIES will focus on. This analysis includes social and economic aspects as well as legal issues and incentive policy.

The aim of this section is to evaluate current situation of the district and the main barriers to overcome in the project. Following, there is a synthetic analysis of the main problems in the demo sites.

4.1 The Cuatro de Marzo demonstration site in Valladolid, Spain

The district is located in the south part of Valladolid Urban area. It was projected in 1955 as a residential area at the end of the main boulevard in the city of Valladolid. All the buildings were built between 1955 and 1960. In those days this district was a suburb, but today it is right in the commercial city centre.

The restoration project in the district is being promoted by the Valladolid Municipality. Specifically, the municipal-owned company for ground and dwelling ("Sociedad Municipal de Vivienda y Suelo de Valladolid (VIVA, S.L)") will play the role of coordinator/supervisor of the refurbishment works. Moreover, it encourages the neighbors to join to the retrofitting urban plan. In order to carry out the renovation works in a building, commonhold association approval is required.

4.1.1 Buildings current situation:

The “Cuatro de Marzo” district was built in the middle of the 20th Century, when in Spain an important migratory movement from villages to cities occurred as a consequence of a retarded industrialization process. Thus, a drastic need of new dwellings appeared. The economic situation in this age did not allow private promotions to cover this demand, so the Government will assume this demand and will guarantee the urban growth that was produced in Spain in the 50-70s. In the particular case of Valladolid, the population reached the maximum growth in its history in these decades (55%), growing also 36.9% in the next decade, reaching 320,281 inhabitants in 1981.

These new promotions, as it is the case of “Cuatro de Marzo”, were built in a very short time following a unique project, where the planning, management, parcelling, urbanization and edification were promoted by the same agent. These integrated projects followed the principles of the hygienic housing and recurrent constructive and aesthetic solutions, resulting in homogeneous areas. Thus, in “Cuatro de Marzo”, the parameters of scale, controlled planning conditions and typologies that are always of open blocks and towers followed the

same principles. All these issues, along with the application of the International Style language, allows to explain the great amount of deficiencies that are present in these buildings and in all buildings promoted in this age by public bodies.

The homogeneity of these areas is one of the most important characteristic in order to tackle integrated renovation processes, easily replicable in the whole district, reducing the costs and execution times.

The whole "Cuatro de Marzo" district accounts 1947 dwellings, and was inaugurated in 1959. It was deployed in two phases, covering 1175 dwellings, one church, 2 schools, the House of the "Frente de Juventudes" and 17 business premises in the first phase, and 772 dwellings, 4 business premises, 2 schools and the civil works in the second one. It is located in a strategic area of the City, which was the Periphery in the age of construction but know it belongs to the City central area. This district is in the South of the City Centre, surrounded by one of the main communication paths of the City (Paseo the Zorrilla) in the east and the river in the west.

It was built in an area of 16 Ha, accounting 81,000 m^2 of residential surface under the premises of the protected social house, distributed in 189 buildings, being 183 linear blocks with 4 or 5 floors and 6 towers with 10 residential floors and a basement used for commercial premises, The conditioned area of the dwellings is 72.20m^2, 91.29m^2 and 94.28m^2 in the blocks and 100.45m^2 in the towers.

The property structure of the dwellings is private, being thus each dwelling owned by one family, existing one commonhold per building, which can derive into a barrier in terms of integrating district facilities due to the strong "Horizontal Property Law" existing in Spain.

The main problems detected in these buildings are to the lack of insulation in the envelope, appearing also thermal bridges that in some cases provoke condensation problems. Also, although some dwellings have been renovated and do not present this problem, in most of dwellings there are high infiltration levels in windows that are similar to the levels existing in all building of this age. All the information about the energy consumption and main problems detected in the buildings are deeply analysed in the District Audit carried out within D1.1 (District Level Audit and Diagnosis Methodology), where it is shown the infiltration levels detected through the utilization of the pressurization tests, the problems of thermal bridges through the use of IR thermographies and the analysis of the energy consumptions carried out collecting the energy bills and energy performance simulations.

For this diagnosis, also some questionnaires have been circulated to the owners, in order to collect data about not only energy aspects, but also comfort conditions, and social and economic information of the inhabitants. All the information collected in these questionnaires is also presented in such D1.1.

4.1.2 Social aspects

The district is characterized by a high population density (200 inh./Ha.) and high construction density (100 DU/Ha[6]).

Housing tenure: Dwellings are in private ownership and it is usual that each nuclear family owns its home. Therefore, the buildings are multifamily and multi-property. But also a residential commonhold is established among all the flat-owners in each building. This commonhold association is the vehicle which owns and manages the common parts of the building and to which all unit-holders belong.

Housing use (principal house, secondary, empty house...): According to the current data the majority of the families are using the Dwellings as a principal house. But there are around 19% of empty houses.

Users' profile: The average age of the neighbors range from 42 to 72 years old (53 year old). At first view this is not a problem, but analyzing the buildings particular situations it is found some aspects, only related with the owners age, that may block the negotiation phase (apart from the Spanish legal issues) because it's difficult to offer them a business models attractive and adapted to its particular situation.

As an example: the building located in Turina 16 street has 10 houses in total and four of them are unoccupied. There is only one house with two people living inside, while in the others live only one person. Summarizing, in a flat of 10 houses are living seven people, whose average age is 72 years old.

This situation may represent a big problem when the building needs for renovation, but the owner is not aware of this necessity or do not have the intention to perform any intervention in its house. Then, what kind of business models can be offer in this situation? This is a good question. This example explains why it is so important to analyze the socials aspects in diagnosis phase.

4.1.3 Economic aspects (neighbourhood category, financial issues)

The population of "Cuatro de Marzo" district is relatively aged being the percentage of old people 28.8% of the inhabitants, while the percentage of young people is only 9.9%. The percentage of immigrants in this area is 6.9%.

[6] DU/Ha=Dwelling Unit/Hectare

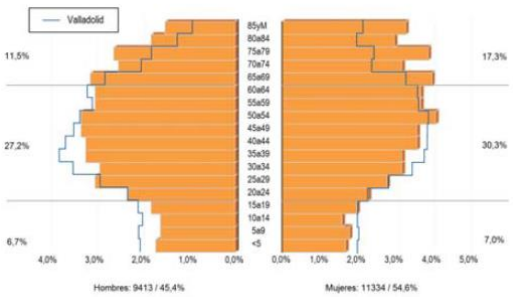

Figure 7: Population pyramid in "Cuatro de Marzo" and surroundings[7]

Thus, almost one third of the inhabitants are pensioners, while the level of unemployed people is approximately the 20%.

Figure 8: Number of inhabitants in "Cuatro de Marzo" and surroundings[8]

- **Financial aids:**

Some business model options (as an ESCO involvement) are under study and valuation and not determined yet.

In a first economic approach to the total amount of the intervention, the renovation works will be subsidized by the Municipality (30%) and the EU grants (20%) while the remaining investment will have to be subsidized by the building owners (50%). This means an average investment by the owners of 100€/m^2 of conditioned area (i.e. approximately 7,000

[7]Source: Instituto Universitario de Urbanística (IUU), 2013. Revisión del Plan General de Ordenación Urbana de Valladolid. Universidad de Valladolid.

[8]Source: Instituto Universitario de Urbanística (IUU), 2013. Revisión del Plan General de Ordenación Urbana de Valladolid. Universidad de Valladolid.

€/dwelling). Given the existing conditions of the people living in the district, this investment could be high for some of the families, so an attractive business model has to be offered to the owners, accompanied by an intensive awareness campaign in order to show the benefits of the renovation plan (not only in energy terms, but in long term economic benefits).

Considering the package of technologies under analysis, the active measures to be implemented (i.e. biomass centralized heating and DHW system and PV technologies) make an attractive model for the participation of an ESCO, that could be in charge of a part of the initial investment establishing an energy contract with the building owners. Also, when combining the passive and active measures, advanced business models appear, where the establishment of an association of a Construction Company and an ESCO, can offer a more beneficial product to the owners, covering the whole intervention initial investment and offering a long-term financial plan to the owners that may facilitate the negotiation.

4.1.4 Legal barriers and incentive policy at Spanish demo

The most important barriers for the rehabilitation of residential buildings in Spain are inherited from the housing policies, which have focused on new construction as a vector for economic development without coordination with the urban planning regulations. Consequently, the housing park is oversized and underutilized, and is accessed through the property. The rent is a residual scheme. And there is no park of social housing that responds to the needs of the disabled population, except in new and recent promotions.

On the other hand, the economic growth was not used to address the problem of freezing of rents, resulting in rapid deterioration of the housing stock.

In this scenario remain some laws, no outdated or partially updated hindering the comprehensive rehabilitation of buildings stock. To this situation must be added the partial laws and the legislative mismatch between the central government and the autonomous communities, to promote not contradictory actions or generate real benefits to owners or investors.

- **Spain condo laws**

The urban suburbs rehabilitation is focused in the residential areas, therefore much of the aid and subsidies offered by the government are aimed at communities of owners, thus it is still needed to review the regulation of agreements that they can take in relation to access to these subsidies and generally on the development of this type of work, the management is hindered greatly by the horizontal property law (Ley de propiedad horizontal), even if they are approved by a majority of the owners.

It must be highlighted that the Sustainable Economy Law (Ley de Economía Sostenible) amended this law in some of its articles, several reports claim that the extension of the concept "necessary works" for the purposes of the majorities required by reason of the

thermal comfort and efficiency of the facilities still need adaptation to the current legislation, as it was done some years ago with the installation of lifts. Also it is convenient bolstering the legal entity to the condominium, including facilitating the legal incorporation by qualified majorities (not unanimously) to other management bodies for the rehabilitation of buildings environments (associations, management bodies for rehabilitation or urban renewal).

- **Urban Leases Act**

Some studies suggest a new regulation, updated and adapted to the objectives of promoting comprehensive rehabilitation of neighborhoods, the obligations of owners and tenants in the financing of works and the rehousing in situations of ruin or comprehensive rehabilitation of the building. **But from R2CITIES perspective and considering the situation in which the majority of the population is rented, we see more fruitful regulating rents and the obligation of the owners to invest part of the profits of income in the housing rehabilitation or assume responsibility for maintenance / renewal by tenants if adjusted rents. In any case, it is a situation to be studied carefully.**

Incentive policy in Spain

In Spain, during the last two decades, rehabilitation has focused primarily on the historical centers of our cities, from the perspective of cultural and heritage protection. However, the concern for environmental and social sustainability of our cities, currently attached to the economic recession, has put in the spotlight on the suburbs of our cities, and for several years pioneering programs are being developed in various municipalities. In addition, public authorities have begun to develop programs and grants to promote the rehabilitation of these neighborhoods, the best example is the inclusion of the concept of rehabilitation in the last two state House Plans.

The main strategies that are being developed in Spain in this matter will be mentioned below, which although not fully deserve must to be mentioned in this section. For a better understanding they are grouped into different administrative levels: national, regional and local.

- **Policies to promote private rehabilitation**
  Through the Central Government and Autonomous: They focus exclusively on the encouragement and promotion of residential rehabilitation and eventually redeveloping spaces close to buildings. They are presented as financial subsidies, tax breaks, subsidized loans etc. And they are addressed to the owners or tenants.
  Municipalities or municipal corporations: these grants are managed by Public Companies, municipal ordinances or Rehabilitation Plans, initially targeting the historic centers or downtown and types of concrete works (walls, elevators, etc.). Some benefits have been extended to peripherals neighborhoods and to other issues such as energy efficiency, renewable integration, etc.

As previously mentioned, sometimes these aids are not compatible with those for the same purpose by the central and / or Regional government. It is for this reason that a minimum inter-agency coordination and some convergence at the policy level are urgently needed.

- **Maintenance / rehabilitation of social housing**
  They are characterized by a systematic intervention or framed within broader programs of maintenance and / or rehabilitation of existing social Housing Park (between 1940-1980).

  In the case of Spain, these homes have become property of the autonomous communities, which in turn have a different destiny: the rent until complete the deferred access to the property (20-30 years) and in other cases accelerating access to housing without meeting deadlines for deferred access, by selling the houses to their tenants in the moment they were transferred from the state. In both cases, due to the low quality housing and little or null maintenance (or rehabilitation actions), the public intervention is necessary to stop the rapid deterioration or to promote their energy rehabilitation.

- **Mixed rehabilitation programs / restructuring or remodeling:**
  These programs involves the systematic rehabilitation in neighborhoods built between 1940-1980, with a predominance of the comprehensive rehabilitation of their buildings but also applicable to partial or total remodel because of physical or economic infeasibility of their comprehensive rehabilitation.

- **Comprehensive programs of action in neighborhoods**
  These programs promote cooperation between administrations and coordinated actions in the territories of different administrative areas, led by local authorities responsible for project development and ongoing management. These include: the URBAN Community Initiative, Urban Initiative 2007-2013. The actions of these programs are subsidized by European FEDER funds. These are focus on public spaces, economic recovery etc including circumstantial rehabilitation of a building, but there is no help towards the rehabilitation of residential buildings, so it is an example of initiatives that could be of benefit to the present study, but today they are not.

- **Others:**

"Real Decreto 233/2013, de 5 de abril, por el que se regula el Plan Estatal de fomento del alquiler de viviendas, la rehabilitación edificatoria, y la regeneración y renovación urbanas, 2013-2016"

4.1.5 Conclusions

As it has been observed, the main barriers found in the “Cuatro de Marzo” district to be addressed in R2CITIES framework are associated to economic and social aspects.

Due to a significant portion of the cost of rehabilitation must pay by the neighbors, the negotiation phase will be essential to determine whether to go ahead with the initial proposals. In this regard, the technological package bid from conceptual design should be attractive in terms of energy to ensure public subsidy and economically feasible to achieve the vote of the neighbors who assume the remaining costs

In this scenario, if it is intended to obtain a high success rate with that phase, the abovementioned social and economic conditions found in many of the residents must be taken into account.

4.2 The Yakacik demonstration site in Kartal, Turkey

Project area is located between the Sea of Marmara to the south and the Trans-European Motorway (TEM) to the north. Motorways, ferries, suburban railways, the Kartal Metro extension and the completion of the Marmaray rail make the location as one of the most accessible sides in Istanbul. Housing area consists of 42 Ha. and is 7.5 % of the total municipality land use. Kartal is dominated by working and middle low income class of Istanbul. This reflects to building clusters, existing buildings don’t have good infrastructure and building quality.

4.2.1 Buildings current situation

The retrofitting plan targets to create appropriate examples to improve the quality of life of the city. The selected pilot site located at Yakacik district of Kartal. Three residential buildings which have different building characteristics were chosen to represent the energy profile of residential buildings on the district. These three buildings are named as Building 1, Building 2 & Building 3. Buildings are between 7 to 20 years old. They were all built as a single concrete block and have 5 to 8 stories. All three demo buildings have poor quality of internal building systems especially in lighting and considerable amount of energy consumption for domestic water heating. Therefore, energy efficiency strategies for potential saving were set accordingly.

The project aims to develop a methodology to retrofit a residential district with energy efficient strategies,which are identified as not energy efficient. Passive design strategies, heating & cooling sources and integrationof renewable for building envelope were examining.

For the scope of this project, retrofitting plancovers3 building blocks with 18.813 m2 floor area and total 580 inhabitant.Density of residential area: 26 Dwelling Unit / Ha; Density of population: 211 inh. / Ha.

50% of retrofitting cost for the proposed interventions will be covered by Kartal Municipalities as the rest will be financed by the R2CITIES.

4.2.2 Social aspects

Housing tenure: The building 1 is owned by municipality as it has different management policy. It is built and being used for an elderly house. Elderly people rent the room from municipality.

Other two buildings are owned by private owners which have multifamily and multi properties. Middle income people accommodates in these buildings.

Housing use; Buildings, including elderly house are used as principal house.

Users; Building 1 occupied by people, older than 50 years old, 10 % of them need special care. The other two building' tenant profile are varies, occupied by families with kids, some families accommodate their parents also.

4.2.3 Economic aspects (neighbourhood category, financial issues)

Demo site buildings are occupied by working and middle low income class. Therefore, no contributions from the tenants or building owners will be expected. 50% of retrofitting cost will be covered by Kartal Municipalities.

4.2.4 Legal barriers and incentive policy at Turkish demo

Even though Turkey has gone a long way to create a convenient regulatory environment concerning energy efficiency investments for new building constructions, there are still no serious regulatory system developed for existing building stocks.

The "Bylaw on Energy Performance of Buildings" by the Ministry of Environment and Urbanization will require buildings to meet the minimum performance criteria and standards concerning architecture, heat insulation, heating and cooling systems and electrification. According to this regulation, an "Energy Performance Certificate" is given starting in January 2011 in order to give information on energy expenses and CO_2 emissions for new buildings and buildings which have been purchased or rented. Utilisation licences will not be granted to new buildings which receive less than a "D" class rating. Furthermore, central heating is compulsory for the new buildings having area of more than 2000 m^2.

Main barrier of the existing building sector which prevents to establish any policy and legislation is a lack of capabilities to evaluate energy efficiency options locally and accordingly seeking out advices.

a) Legal barriers

In Turkey, in general, the focus of policies and legislation is on construction of new buildings as it is mentioned above and applying energy certification, rather than on rehabilitating existing buildings. Target is to start energy certification obligatory for existing building is 2017.

Main barriers for energy efficient retrofit;

- No energy efficiency regulation scope for existing building renovation yet
- Inadequate level of compliance with the current regulations,
- Lack of incentives and investment, mechanism models for energy efficient buildings
- *No regulation on setting up "Energy Management System"* and its implementation in building.

b) Incentives policy in Turkey

There is no incentives policy developed yet in Turkey. The major problem that prevents to establish incentives and related policy is the lack of replicable investment and financial mechanism models for energy efficient buildings.

Nevertheless, there are some projects have already promoted by Ministry of Energy and Natural Resources to enforce the improvement of the energy performance standards, building codes, enhancement of building energy management and to introduce the use of an integrated building design approach as well as incentives policy.

4.2.5 Other aspects

The construction works for the each intervention in the demo buildings will be done by following the tender evaluation process from the stakeholders. This will be done by Kartal municipality under their procedure. Also municipality will have the responsibility to commission the implementation and realisation of the selected interventions.

4.3 The Lavatrici demonstration site in Genoa, Italy

4.3.1 Buildings current situation

For Genoa demosite was chosen a part of the Pegli 3 district. Pegli 3 is located in the west part of Genoa, the original Zone Urban Plane (PDZ) of the district (by application of the Italian Law for council housings 167/62, 1976) includes many hectares with a capacity of many thousands of habitants.

It is divided into several sectors where a lot of social services were included (i.e. schools, spaces for sports, supermarkets, highways, etc). There are not built sectors, an area build with private funding, one build by ARTE (Azienda Regionale Territoriale per L'Edilizia - Regional body dealing with the construction and refurbishment of public buildings) and finally the part that will represent R2CITIES demo site: the "Washing Machines".

In particular the site consists of 688 dwellings. It is divided in four main blocks and each of them is composed by three different types of building: a "high block", a "low block", and “the steps”. The complex is diverse in ownership (some public some private), energy infrastructure (some renovated some not), and population (some private, some public, young, and old). The complex has one common area, ample parking, and is served by a public bus line

The selected demo district in Genova is owned by the Municipality of Genova that is partner of R2CITIES project and it will co-invest 50% of the intervention in order to refurbish an area of 18.000 square meters corresponding to two high bars.

4.3.2 Social aspects

Housing tenure: The selected demo district in Genova is owned by the Municipality of Genova and is allocated to low income tenants as social housing. The rent that is payed by tenants is variable and calculated based on the salaries.

Housing use: (principal house, secondary, empty house...) the 160 dwellings part of the demo in Genova are used as principal house.

Users’ profile: the profile of tenants is variable. There are elder people but even single users quite young with low incomes or unemployed. There are also big families even are few compared to the other typologies of users.

4.3.3 Economic aspects

As detailed above the selected demo is for poor people that are quite often unemployed or pensioned. The selected intervention in Genova will not foresee any additional contributions from tenants or ESCO. For this reason the selection of intervention that allow to respect the ambition of the project involve several activities and is under deep evolution among all the partners of R2CITIES involved in the project.

4.3.4 Legal barriers and incentive policy at Italian demo

a) Legal barriers in Italy

Italy has an up-to-date national regulation for energy efficiency of constructions. The 10/1991 national law was in force several years before the Kyoto Protocol and it contains several principles used in the European Directives on the energy performance of buildings (2002/91/EC and 2010/31/EC). Recently this law was modified with two ministerial decrees to introduce other energy efficiency principles of European Directive (MD 192/2005 and MD 311/2006). Several Italian Regions (also the Region in which the Lavatrici are located, Liguria, RL (LR) 23/2012) decided specific rules to apply locally the National Regulation for energy efficiency of constructions.

This fragmentation could be a barrier since the 20 Italian Region have specific regulation.

In Liguria the law reports that refurbishment intervention has to bring to increased energy efficiency. The energy requirements are modified every five years and it is there established an energy certification have to be done by a certified auditor.

In addition several National regulations for the renewable energy are published. In particular the MD 28/2011, into force on 31 May 2012, transposes the European Directive 2008/28/EC on the promotion of energy from renewable sources for new buildings and for the existing building (subject to demolition and reconstruction or to complete renovation of the external envelope).

b) Incentives policy in Italy

Refurbishment of the primary house;

In February 2014 the Agenzia delle Entrate, national body responsible for the management of public incentives, has published an updated guideline for the incentives for refurbishment of existing buildings. The reference laws are art. 16-bis D.P.R. 917/1986 and the subsequent D.L. 201/2011.

The laws have been updated different time and the last modification have been done with the L 147/2013 also called “legge di Stabilità”. In the L 147/2013 are regulated the percentage of deduction that could be claimed for refurbishment of the primary house. It will be possible to have a deduction of 50% for the maximum amount of 96.000 € up to the 31.12.2014, then for the following year the deduction will be 40%. From the 1.01.2016 it is now foreseen that the deduction will 36% for a maximum amount of 48.000 €.

Renewable energy production and energy efficiency the law MD 28/2011, into force on 31 May 2012, transposes the European Directive 2008/28/EC on the promotion of energy from renewable sources for new buildings and for the existing building (subject to demolition and reconstruction or to complete renovation of the external envelope).

Even for the Energy efficiency and renewable intervention the reference in Italy is the Law 147/2013 that establishes the criteria to get fee deduction and in particular currently it is foreseen:

- 50% deduction for intervention with photovoltaic systems with VAT fixed at 10% instead of 22%
- 65% deduction for intervention addressed to the energy efficiency with VAT fixed at 10% instead of 22%

4.3.5 Other aspects

The intervention in the demo will follow a tender evaluation for the selection of the stakeholders that will implement and realise the selected interventions. This procedure has to

be followed since we are dealing with public money. The mandatory tender procedure has required an additional commitment from the Genova team in order to be able to respect the workflow of the project.

5. Suggestions for resolving the identified barriers

As it was observed in the present report we have offer some suggestions in parallel with the analysis of the barriers. So, in this section we will collect those general and most relevant for the scope of this project.

Although some specific suggestions are being presented, we think that the most critical and important are those recommendations most general which should promote the change in the current scenario. This is by integrating at the same equation the aspects that affect the whole city as: social, political, economic, physical and functional aspects.

Thus, below we propose some recommendations that may address the identified barriers. Independently, they should be part of the R2CITIES strategy.

- ***Recommendations for the general framework***

These suggestions should be associated to social, policy, urban or economic aspects.

Urban planning: The new urban approaches should be based on the existing problems in the city. It should promote the recovery of the existing city as overall strategy, rehabilitation as a way to create more sustainable city, worthy, more attractive to its citizens, promoting social cohesion. New housing developments should be raised as a natural continuation of the city according to the actual need of housing. Also housing policies should be coordinated with urban planning and recovery strategies and rehabilitation of the existing city.

The urban planning instruments must be appropriate to the specific context in which it is intended to perform some actions or urban regeneration. However, at the same time these urban planning strategies must have a certain degree of flexibility to handle more specific aspects, because by this way it would prevent the sequence of partial laws that worsen the problem instead of solving it.

Thus, efforts must be made between the public, private and collective, by promoting dialogue between stakeholders and involving them in decisions making and individual commitments within an overall strategy to retake the city making it more intelligent and efficient.

The citizen participation in decision making is essential. Since the main objective of urban renewal is to improve the quality of life of users and the development of community, it is essential to them the participation in making decisions throughout the process. But, they are indispensable in the development of management and maintenance strategies of buildings, condominiums and districts.

As it has been mentioned before, due to the vulnerability of certain social groups, to ensure the correct public participation is necessary to make available the necessary tools (stable social management bodies equipped with adequate staff, like social workers, mediators, educators,

etc.) to give the necessary training and monitoring, and reinforce the existing social structure to integrate the marginalized groups, among others.

The urban regeneration should be raised in the public sector priorities agenda, not only as a vehicle for circumstantial economic development but as a medium to long term investment anchored for urgent need to improve the quality of life of the citizens and sustainable development .

Fiscal policies and urban regeneration legislation may not be taken as political circumstances of a particular period of government, they must be part of an overall strategy where the converging efforts of government are brought together and taken into account the citizen participation.

The incentive policies for energy rehabilitation of buildings should be detached from the interests of particular sectors that put pressure on the central government. This will prevent the release of partial laws that benefit one sector but are detrimental to the interests and needs of the collective.

The public management process for social housing rental and retrofitting actions should be complemented by the creation of new management grids within agencies and also private enterprises that could increment the potential and solve centralized government inefficiencies

It is needed promote the legal resources to regulate rents and for obligate the owners to invest part of the profits of income in the housing rehabilitation or assume responsibility for maintenance / renewal by tenants if adjusted rents. In any case, it is a situation to be studied carefully.

Condo laws regulations: the barriers associated to decision making in multi-family buildings, due to multi-ownership, could be effectively addressed by appropriate regulations, facilitating the decision making process between the different stakeholders. Also may be promoted the innovative technologies integration by ending the conservative approaches adopted by both construction companies and clients.

New methodologies and technologies should be promoted to facilitate the maintenance of the whole city and for buildings.

- ***Recommendations for construction legislation***

At the standardization level, it's necessary to coordinate the initiatives arising from the players in the sector of construction and proper planning to establish a comprehensive view of the construction of energy efficient districts.

It is needed more investigation in the field of sustainability indicators and methodology assessments that can be apply globally. These methods must include sustainability assessment

and energy efficiency evaluation of districts; including an objective evaluation of the technologies to be integrated (cost effectiveness, pay-backs periods, etc.)

In order to offer a clear understanding on the construction products regulation should be fruitful more training and awareness campaigns to developers, designers, architects and consultants.

- ***Recommendations for overcome some economic barriers:***

Split incentives: For achieve a good energy strategy in real estate developments or retrofits, it is preferable that energy consumer should pay the bills in the case of renting; nevertheless, for home ownership it´s very important that people should be conscious of the energy performance certificates to promote high performance new buildings and high performance retrofits.

Business models: It is necessary to develop a new business models adapted to the social and economic condition of the owners, in this sense should be useful to integrate efforts between private and public sector to promote the rehabilitation of the districts with private investment. Thus, they must be adapted to particular requirements of the stakeholders and to some specific economic, social and physical situations.

Financing aids: It is necessary to develop financing products for rehabilitation: loans, government guarantees, microcredit, etc... Especially for those neighborhoods usually habited by poor people, unemployed or socially excluded. But it must be regulated and graduate limitations on the subsequent sale, so the added value will not be privatized.

It must be improving and streamlining the processing of aid, through management bodies created to effect, partial deliveries by providing subsidies, without waiting for the completion of the works which forcing the self-financing by the Community of Owners, with the difficulties entails.

Concentration of economic aids exclusively in the most deprived areas, necessarily linked to the existence of managers bodies with participation of administrations

Training on financial aids: In cases where is needed to educate owners about existing aid and its benefits, it is essential recline upon qualified staff that can act as mediators.

Public support schemes: it is necessary coordinating efforts between administrative areas and industry to promote clear housing finance products for energy rehabilitation of buildings. Availability of different kinds of subsidies, loans, grants and innovative measures can boost their willingness of private investors and can act as a driver for innovative solutions to enter the market.

Access to capital: Due this barrier is influenced by other barriers like perceived higher risk of technology, and lack of technical knowledge, the alternatives to avoid it should be, for

example, leasing and renting on green technologies, where the amortization quote can be paid with the energy savings from bills.

Lack of interest due to housing tenure: it must be promoted, through legislation, financial incentives or tax benefits to refurbishment works, in the case of tenure is private property or rental; or invest if tenure is social housing. In both cases, is considered the sustainable development.

- ***Recommendations to overcome technical barriers in the design & construction process***

As we mentioned before, from our point of view, out of the technological field itself, there are multiples obstacles to the large-scale integration of green energy technologies in the rehabilitation market, especially the integration of innovative solutions. Thus, to overcome the mentioned technological barriers, it is presented some recommendations which should ensure the elimination of the most critical, among them:

Integrated Project Delivery approach: It must be improved the communication flows and stakeholder's types of collaboration through the building design & construction process. This is one of the most important barriers to avoid for materialization of energy efficiency strategies in buildings and districts. So, we recommend the use of IPD approach in the generations of new comprehensive strategy for district renovation. In this sense should be necessary educate the stakeholders that are not aware of its real benefits.

Awareness strategy, education & training: improving the confidence in energy efficiency among the stakeholders involved in the building design & construction value chain is one of the most important barriers for uptake of energy efficiency measures in the rehabilitation market. In the same way, as it has been mentioned, the technical knowledge in some specific areas by those actors involved in the process must to be improved. .Consequently, the teamwork skills must be enhanced in order to meet the increasing construction demands towards energy efficient districts.

Consciousness in the use of tools: the designers must be aware in the use of such tools for calculate benefits of integrating a technology package in the buildings, as well as avoid the mistakes that occur in the construction phase due to a misconceived design, which not only increases costs but decreases the quality of the building and proper functioning of technologies (with subsequent loss of confidence by the client). An example of this kind of tools may be the use of BIM, which not only allow a correct integration of the team work, but can predict mistakes or coalition between construction elements and installations in the detailed design phase.

Clearly stated benefits: this is a recommendation to avoid the ambiguous technical language that green energy technologies manufactures often use. The energy benefits and properties/features of the new solutions need to be clarified clearly.

– ***Recommendations for the technology integration:***

Adaptability of buildings typology and climate conditions: The developers of new construction solution must clarify best applications of its products to ensure proper integration of the building in its context, to be exact for its correct operation.

Multifunctional systems: in order to offer technical solutions to integrate passive/active systems, the developers of new constructions solutions must be coordinated. On the other hand, the architects/engineers must be aware of the benefits of the hybrid systems.

Durability of materials: The new construction solutions should be designed in such a way that all the materials should achieve high durability levels and it should be designed to facilitate the maintenance and repair when necessary.

Adaptability of buildings requirements: The new construction solutions to be integrated in the existing building should take into account that this type of work can be more restrictive than new developments, so new technologies have to be adapted to a non-modifiable conditions or critical requirements such as structural, timing, cultural and so on…In this sense the installation of the new systems must cause the minimum disturbance and should be installed in relatively short time and low disruption for the occupants.

Aesthetics: The aesthetic integration to adapt to buildings' requirements must be addressed (appearance, texture, materials and so on).

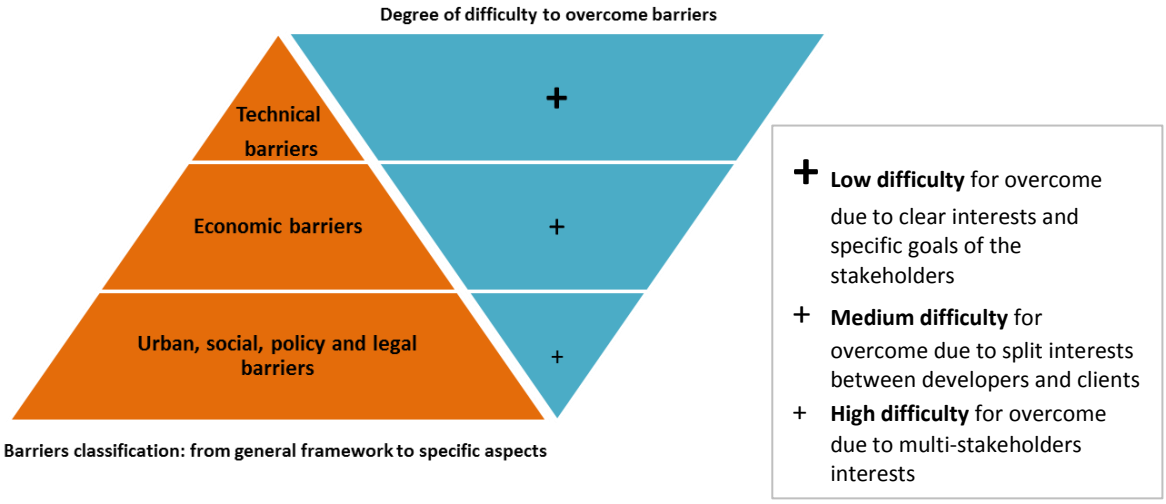

Figure 9: Rating of different barriers for the rehabilitation of neighborhoods according to the level of difficulty to be overcome.

6. Conclusions

The analysis done in this report arises from the study of those barriers within rehabilitation market that impede integrating technologies to buildings at districts scale.

As it is shown throughout this report, technological barriers, although existing, they are not the main issue to boost the market for large-scale rehabilitation. Today, despite the technology for rehabilitation of energy efficient buildings is available, they should be improved. The market is so large that specific solutions can be found but requiring specific knowledge and accessibility (This is one of the main barriers: the lack of knowledge regarding particular benefits of energy efficient technologies, the ambiguous specification by developers and the high costs). However, our point of view is consistent with some of the items it has used as a reference in this report: ***the problem of rehabilitation is management: economic, social and administrative***[9].

As it is mentioned at the beginning of this report, to take the leap from energy efficient buildings towards energy efficient districts, the scenario shall change to a horizontal framework that integrates all the efforts and great advances, which are being realized on technological level with the legal, social, political and economic aspects that are inherent to the city.

It is essential to develop new approaches that facilitate the multidisciplinary work, which involves all the actors across rehabilitation value chain. This is from the diagnosis phase to identify the neighbourhood needs and opportunities; the design phase to asses technological solutions adapted to the real needs; the construction phase to guarantee the correct application of solutions and resources management and finally the O&M phase to apply methods and/or technologies that facilitate the management of the building park, as well as to assess that project goals and stakeholders needs and demands are met. **In this way, the needs of key decisions, new legal instruments, financial resources needs and drive urban management by the administration, will be shown. Also this is the solid base over where the politician make these important decisions we are asking for.**

In fact, **hand in hand with technological development should be given administrative initiatives in the field of urban planning and construction market legislation,** which redirect the situation to the real needs of the building stock. The technology may be new and very attractive in general, but if they are not adapted to market needs will have no ability to be integrated within it and much less scale up to be positioned. It is often forgotten that the best solution is the simplest and the basic principles of passive architecture are not "novel". The novelty lies in the creation of new materials and construction solutions that compete directly with traditional technology. Therefore, if technology is not correctly positioned they will be destined to perish.

[9] RUBIO DEL VAL, J. 2011 *"Urban rehabilitation in Spain (1989-2010).Present challenges and recommendations to overcome them".*

Thus, this report serves as the basis for the holistic strategy for the refurbishment of nearly zero energy districts posed by R2CITIES project. This strategy focuses on technical and managerial aspects of the design and construction process, providing the tools for conducting systematic studies or audits based on social, climatological, typological and morphological aspects of the neighbourhoods, facing to provide a broader view of the problem in context and possible answers should be given from a holistic approach. As a result, through a series of **indicators** may be established objective assessment parameters of applicable technology to support decision making through the process.

This strategy will be based on **IPD (Integrated Project Delivery) principles to** define the workflow to cover the requirements for developing and managing the entire lifecycle of a building or district rehabilitation. **Thus, this new methodological framework ensures the successful integration of stakeholders in the process, providing the support tools to make decisions in each stage and raises the generation of business models appropriate to the socio-economic needs of the pilot sites**. Among them, it should be noted the possibility to assess technological solutions adapted to the building refurbishment market.

It must be highlighted that in the market there are mature technologies that could be easily integrated in the field in question (e.g. WP2 technology package), but these technologies are still without a stable market. Why? Being concise, concerning the results of this report, the main barriers to be overcome by these technologies and to extrapolate all the knowledge to achieve the low energy districts R2CITIES are being focused, must be considered the following aspects:

First. The technology market for energy efficiency buildings is not an isolated market, independent of the bureaucratic machine inherent to construction market, so in order to achieve efficient buildings and districts we have to learn new ways or good practices and unlearn wrong practices of the current model. Namely, green energy efficient technology market is very important, but it alone will never achieve the top position in the current construction market. It must be taken into account that **new practices undoubtedly requires combined efforts among all sectors involved in the construction market: administration, developers, builders, designers, investors, owners, etc. So, the key words in this study are: integration and coordination.**

Second. It is so important to have the necessary technical skills, as well as having a good organizational framework to support decision making at all stages of the process.

Third. To overcome the main barriers associated to technical aspects.

Fourth. Awareness strategy and training adapted to the stakeholders already mentioned.

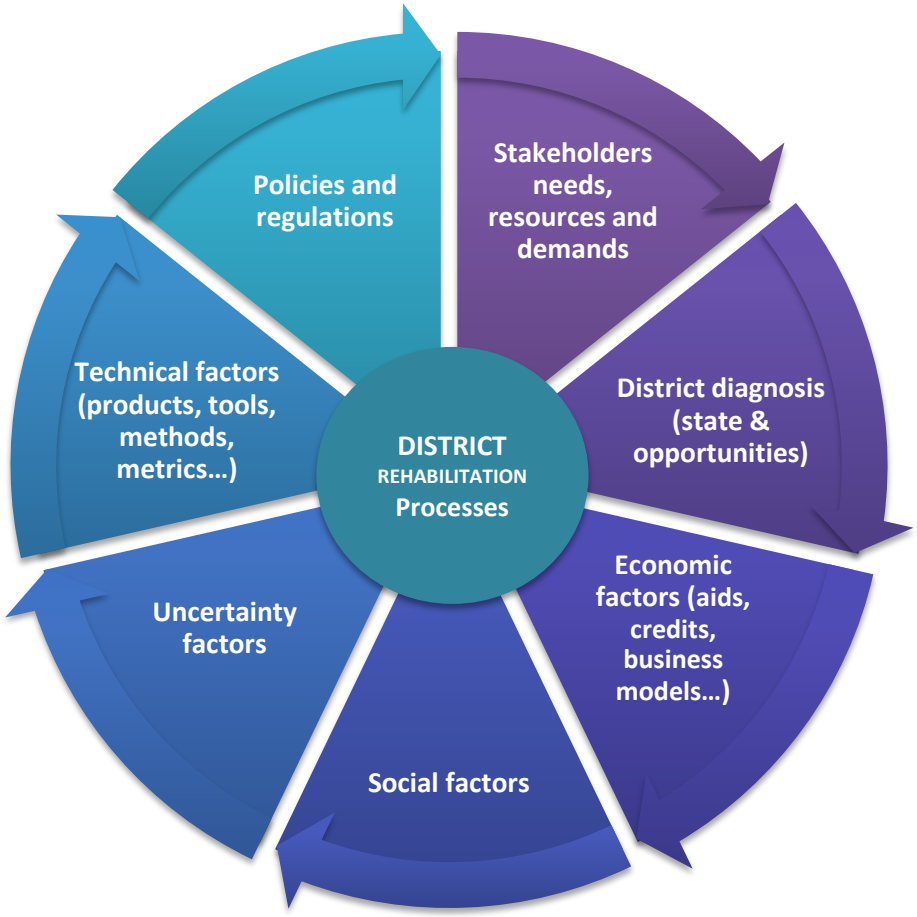

Figure 10: Key strategies for district rehabilitation processes

The experience gained in the project is to generate new knowledge as a basis for pose more general strategies or new challenges assumable at much higher level management which may involve state governments, major industry players and the representatives of the collective.

7. References

The following references have been used as a reference for this deliverable. They are shown by each section as follow:

SECTION 2:

RUBIO DEL VAL, J. 2011 *"Urban rehabilitation in Spain (1989-2010).Present challenges and recommendations to overcome them".* ISSN: 0020-0883, Informes de la Construcción Vol. 63, EXTRA, 5-20

SECTION 3:

Section 3.1

RODRÍGUEZ ALONSO, RAQUEL
2009 *"La política de vivienda en España en el contexto europeo"*
Madrid, España. Boletín CF+S 47/48. Sobre la (in) sostenibilidad en el urbanismo.

Section 3.2.

RUBIO DEL VAL, J.
2011 *"Urban rehabilitation in Spain (1989-2010). Present challenges and recommendations to overcome them".* ISSN: 0020-0883, Informes de la Construcción Vol. 63, EXTRA, 5-20

INTERNATIONAL GREEN CONSTRUCTION CODE
Available in http://www.iccsafe.org/cs/IGCC/Pages/default.aspx

ISO/TC 59/SC 17 SUSTAINABILITY IN BUILDINGS AND CIVIL ENGINEERING WORKS
Available in [1]http://www.iso.org/iso/iso_technical_committee?commid=322621

EUROPEAN COMMISSION. ENTERPRISE AND INDUSTRY

- Available in http://ec.europa.eu/enterprise/sectors/construction/legislation/index_en.htm
- Regulation 305/2011 of the European Parliament and of the Council of 9 March 2011.

Section 3.3

ACCIONA, (2011-2012): *T3.1 Barreras de integración arquitectónica de fotovoltaica en obras nuevas y rehabilitación*. Private report of national project ATON "CEN-20091009"

Section 3.4

RODRÍGUEZ ALONSO, RAQUEL

2009 *"La política de vivienda en España en el contexto europeo"*
Madrid, España. Boletín CF+S 47/48. Sobre la (in) sostenibilidad en el urbanismo.

Section 3.5

[1] TRIMBLES'S INFORMATIVE AND EDUCATIONAL NEWSLETTER FOR MEP CONTRACTORS

Available in
http://www.trimbleextensions.com/i_i/industryinsights/bim_present_and_future/#

ACCIONA, (2011-2012): *T3.1 Barreras de integración arquitectónica de fotovoltaica en obras nuevas y rehabilitación*. Private report of national project ATON "CEN-20091009"

BPIE, (2012): *D1.1 Identification of barriers*. Public report of EU project EASEE.

SECTION 4.

RODRÍGUEZ ALONSO, RAQUEL
2009 *"La política de vivienda en España en el contexto europeo"*
Madrid, España. Boletín CF+S 47/48. Sobre la (in) sostenibilidad en el urbanismo.