FRANCE
GRAND LYON

SPAIN
ZARAGOZA

ITALY
LOMBARDY

INNOVATIVE BUILDINGS for LOW-ENERGY cities

THROUGH PHASES OF APPROPRIATION

HIGH QUALITY CONSTRUCTION PROCESS & STAKEHOLDER APPROPRIATION : LESSONS LEARNT

SIXTH FRAMEWORK PROGRAMME

CONCERTO

RENAISSANCE

CONTENTS

What is CONCERTO ?

Presentation of the district 3D model of one CONCERTO project (Lyon)

CONCERTO is a European Commission initiative within the 6th European Research Framework Programme which aims to demonstrate that the optimisation of the building sector of whole communities is more efficient and cheaper than optimisation of each building individually. It started in 2005 and supports 22 projects all over Europe.

Within CONCERTO programmes, 58 communities in 23 countries integrate innovative energy efficiency measures with a substantial contribution from decentralised renewable energy sources (RES), smart grids, district heating/cooling systems and energy management systems in large groups of buildings. CONCERTO demonstrates good examples for sustainable district development as well as for refurbishment of buildings.

The results so far have been very encouraging: CONCERTO cities and communities have shown that through implementation of renewable energy sources, innovative technologies and an integrated approach, existing buildings can **cut their CO_2 emissions by up to 50 %, at acceptable costs.**

The results will pave the way for future European legislation in the form of energy policy recommendations for the 2020 **energy and climate change targets and the 2050 Energy Roadmap.**

Via community-based awareness raising actions and the size of demonstration sites, CONCERTO is an intermediate step between a building oriented approach and an approach looking at the city as a whole, the later subject being addressed in the **"Smart Cities & Communities initiative".**

EUROPEAN FRAMEWORK

In June 2010,

European Union (EU) leaders adopted the "Europe 2020 strategy for smart, sustainable and inclusive growth" for the coming decade.

To this end, the so-called

20/20/20 EU targets

were set to be met by the year 2020, through:

- **a reduction in greenhouse gas emissions of at least 20 % below 1990 levels;**
- **20 % of final energy consumption to come from renewable sources;**
- **a reduction in primary energy use of 20 % from projected levels to be achieved by improving energy efficiency.**

By March 2011,

more than 3,700 local authorities have joined the Covenant of Mayors (www.eumayors.eu) – committing to go beyond these targets! Such a voluntary commitment of local decision-makers to support a European policy is probably a first in the history of the EU.

FURTHER INFORMATION ▸▸ WWW.CONCERTO.EU

What is RENAISSANCE ?


Biomass fuel supply (Lombardia)


CUS, Valdespartera (Zaragoza)


Confluence (Lyon)

RENEWABLE ENERGY ACTING IN SUSTAINABLE AND NOVEL COMMUNITY ENTERPRISES

RENAISSANCE project has demonstrated that ambitious urban regeneration programmes in two large communities of contrasting character, **Grand Lyon** (France) and **Zaragoza** (Spain), can benefit from an integrated energy approach.

The Region of Lombardy (Italy) took part as an observer partner and carried out several research activities on technical, legal and social issues related to fuel wood supply.

The ambitious energy efficiency goals applied to the project, coupled with a high contribution of renewable energy, demonstrated that drastic reductions in conventional energy consumption (up to 70 %) are achievable at reasonable costs and acceptable financial risks on energy saving investments.

As showcases, RENAISSANCE included a comprehensive programme of Research and Technical Development (RTD) as well as active and widespread dissemination activities. **RTD activities addressed all phases of the construction process from planning, building design, construction, building operation and maintenance to building usage.** They can be classified in five main categories :

- **Innovative eco-building solutions,** built on with thermal simulations
- **Renewable energy sources** (mainly wood fuel and photovoltaics)
- **Commercial and fiscal solutions** such as ESCo
- **Socio-economic activities** mainly focusing on inhabitants behaviour
- **Comprehensive monitoring** to assess actual energy performance of buildings and to improve knowledge regarding energy efficiency

In addition, several activities have been carried out to encourage local and national energy policies and regulations to leap-frog in terms of energy efficiency and renewable energy targets, by exploiting the unique opportunities for innovation offered by demonstration projects of this size.

Last but not least, the project focused on strengthening the capacity of project stakeholders involved at each stage of the building process (from design to commissioning), through training and expert technical support.

Confluence (Lyon)

Valdespartera (Zaragoza)

In both cities, strong political commitment to sustainable development, social involvement and public-private partnerships have been the main factors of success.

RENAISSANCE project produced hard data and new knowledge regarding public attitudes to new energy futures, planning policy development, building design, monitoring energy systems, commercial energy services structures and local fuel supply chains. Main lessons learnt and recommendations to policy makers and practitioners are consolidated in the present document in the form of case studies.

RENAISSANCE AT A GLANCE

7,700 m²
of refurbishment (residential & school)

1,220 m²
of solar thermal panels

143,300 m²
of new buildings (residential, offices, exhibition centre)

225 kW
of gas and geothermal heat pump

350 kWp of photovoltaic systems

In total the project achieved
a reduction of 67 % of conventional final energy consumption[1].

2,200 kW of biomass wood boilers

[1]Not taking into account energy saving introduced by heat pump.

In total, 19 organisations participated in this project, involving a large range of diverse stakeholders, from local authorities to technical and socio-economical experts, non-profit organisations, universities, energy services companies and real-estate developers.

RENAISSANCE project demonstrated that practical solutions to local energy needs, applied in highly innovative ways, have a large and immediate potential for replication across the rest of Europe, **paving the way towards Post-Carbon Cities.**

FURTHER INFORMATION ▸▸ WWW.RENAISSANCE-PROJECT.EU

GRAND LYON, France

Grand Lyon Community is an urban community which includes Lyon, the second largest city in France, and 57 peripheral towns.

The Confluence area is a 150-hectare site located at the southern tip of Lyon's peninsula, *on land which was originally reclaimed from the surrounding waters in the late 18th century. Cut off from the rest of the city by the railway tracks and highway, the site is currently home to a lively, working-class neighbourhood, originally established in the 19th century, as well as a vast expanse of industrial wasteland (70 hectares).*

The Lyon Confluence project is one of the most ambitious ***city-centre urban regeneration*** *projects in Europe. It will* ***extend the centre*** *of Lyon to the very tip of the peninsula by means of* ***high-quality development projects*** *that meet stringent quality criteria in terms of urban planning, architecture, environmental impact and landscaping. The aim of the project is to create a vibrant, bustling neighbourhood that is both economically and socially diverse.*

RENAISSANCE project in Confluence

West view of the blocks A, B and C

Three construction zones (named blocks A, B and C) within the Lyon Confluence urban development project were chosen as the demonstration site for Grand Lyon's European CONCERTO project, RENAISSANCE. Real estate developers were selected early in 2005, a little before the CONCERTO-RENAISSANCE programme was signed, and construction took place between 2007 and 2010. All these construction projects had to respect the specific criteria laid down for energy efficiency and the use of renewable energy sources, derived from CONCERTO specifications. They also had to comply with High Environmental Quality ("HQE®") criteria amongst which were specifications of reinforced insulation, careful selection of materials, rainwater management and natural ventilation.

ENERGY EFFICIENCY AND RENEWABLE ENERGY OBJECTIVES

All constructions are now finished: in total, 670 new apartments and 15,400 m² of office space complying with the RENAISSANCE objectives were built. RENAISSANCE objectives for the Confluence project were very ambitious compared to the thermal regulation (RT 2000) in place at the time of design as the following table shows. The very high coverage of energy demand by renewable energy sources at such an urban scale remains very innovative today.

(kWh/m²/year)		Housing	Office
Heating	RENAISSANCE targets	< 60	< 40
	RT 2000	110	-
Domestic Hot Water (DHW)	RENAISSANCE targets	< 25	< 5
	RT 2000	40	-
Electricity	RENAISSANCE targets	< 25	< 35
	RT 2000	50	-
Air Conditioning	RENAISSANCE targets	0	< 10
	RT 2000	-	-
Renewable energy share	Heating consumption + Hot water	80 %	
	Electricity concumption of commons property	50 %	
Summer comfort		0 Inside temperature must be equal or inferior to 28 degrees C except 40 h per year	

HOUSING

- Luxury properties : 44 %
- Standard and mid-price rental : 33 %
- Social housing schemes : 23 %

SAÔNE PARK (Block A)

- 8 buildings,
- 225 dwellings,
- 19,900 m² of flats

Expected* energy performance : 26 - 42 kWh/m²/year

- **1 x 540 kW** Pellets with gas boiler for peak demand
- **79 kWp** Building integrated (BIPV)
- Heat pumps on extracted air from dwellings and on water from cooling floor in summer

LYON ISLANDS (Block B)

- 12 buildings,
- 300 dwellings,
- 27,400 m² of flats

Expected* energy performance : 35 - 68 kWh/m²/year

- **2 x 540 kW** Pellets with gas boiler for peak demand
- **121 kWp**
- **239 m² of solar thermal panels** and gas boiler

MONOLITHE (Block C)

- 1 building
- 150 dwellings
- 12,600 m² of flats and 15,400 m² of offices

Expected* energy performance : Offices : 21 - 37 kWh/m²/year Housing : 36 - 52 kWh/m²/year

- **1 x 540 kW** Fuelled with wood chips, with gas boiler for peak demand
- **65 kWp**
- **250 m² of solar thermal panels** and gas boiler

Wood fuel boiler · Photovoltaics · Domestic Hot Water (DHW)

(*)These energy consumption values have been obtained through dynamic thermal simulations. However, the actual performance values will be verified by the monitoring campaign ending in summer 2012.

STRATEGIES USED TO MEET A HIGH LEVEL OF ENERGY EFFICIENCY FOR HEATING, COOLING AND ELECTRICITY DEMAND

- **Passive solar design**
  Passive gains, natural lighting and sun protections
- **Envelop insulation**
  High performance windows and several types of insulation : exterior, single-wall insulating brick or interior with thermal bridge breakers
- **Strict specifications on airtightness**
- **Insulation of hot water distribution networks**
- **Ventilation** with heat recovery or with humidity sensors on the inlet and outlet
- **Cross-ventilation for natural cooling**
  Flats with double orientation
- **Demand side energy efficiency and conservation**
  Standby power interruption switch, low electricity consumption light bulbs, occupancy sensors in commons, flow restrictor to limit DHW demand and water consumption, etc.

LOCAL PARTNERS APPROACH to meet project challenges

At each step of the project, different technical support and building competency to meet the challenges of the expected final energy performance of building.

BUILDING DESIGN PHASE

Technical support was put in place in the form of monthly meetings to provide assistance **on the design of low energy consumption buildings, sizing and positioning of renewable energy systems and defining technical solutions to meet the High Environmental Quality criteria.** RENAISSANCE experts provided technical support to promoters and their energy-engineering consultants.

Dynamic thermal simulations were made to estimate energy consumption of one dwelling per building in order to evaluate the technical design choices made by architects and engineers, and adapt the design if necessary.

A study on short rotation coppice was realized to assess the feasibility of an energy crop supply chain from short rotation coppice in the surroundings of Lyon that would serve to fuel the whole Confluence district.

A study tour was organised in the Netherlands in order to show building designers and promoters large-scale innovative photovoltaic building integration techniques.

CONSTRUCTION PHASE

Construction site visits by energy efficiency experts to closely follow the implementation of insulation and airtightness techniques and the installation of energy efficient and renewable energy systems in order to ensure that technical specifications agreed on during the design phase were respected. These visits were pursued even after the delivery of dwellings to verify that detected defects had been corrected.

Training for craftsmen of different professions were provided on the subject of airtightness. This educational program was later extended to training of trainers.

Analysis of the impact of improved energy performance of buildings on the level of rents and charges in social housing.

BUILDING USAGE AND OPERATION & MAINTENANCE

Residents were involved in the project once flats were put up for sale. RENAISSANCE experts, promotors and developpers joined to organise **information sessions to promote and explain building particularities and residents contributions to energy savings.**

A very detailed monitoring campaign on energy demand and wood fuel delivery and consumption was planned with the installation of hundreds of sensors. After one full year of measurements, it will be possible to draw some conclusions on the actual energy performance of buildings and on building operation.

A study of operation and maintenance (O&M) contracts has initiated a reflection on main elements and special clauses to integrate in O&M contracts to guarantee targeted energy performance.

With the same objective, **training on the operation and maintenance** of energy efficient buildings, ventilation and renewable energy systems were organised **for O&M companies.**

ZARAGOZA, Spain

Zaragoza is the fifth largest city of Spain, situated in the northern part of the country. ***The RENAISSANCE project has been carried out in two districts with two different but complementary approaches.***

"Valdespartera" district *is an ancient military precinct in the Zaragoza outskirts that has been transformed into a bioclimatic neighbourhood with 9,650 social housings. The RENAISSANCE project is involved with the construction of social housing and an interpretation centre.*

The "Picarral" neighbourhood *was planned in the 1940's during the rural-urban migration with very poor quality construction. The neighbourhood, ageing and occupied by the working class, has been the second area of intervention of the project, involving refurbishment works for residential buildings and a public school.*

In addition, considerable work on energy performance monitoring, socio-economical studies and software design has been carried out in parallel, making RENAISSANCE not only a building construction project but also ***providing a holistic approach to integrate rational use of energy at a neighbourhood scale.***

RENAISSANCE project in Valdespartera & Picarral

Valdespartera new buildings

VALDESPARTERA

The RENAISSANCE project includes specific actions on 616 apartments, with 64 027 built square meters. An interpretation centre on urban sustainability (CUS) has been designed, constructed and set up.

The neighbourhood was designed from the beginning with a sustainable urban design plan, which improves the efficiency of the bioclimatic buildings. The participation of public institutions has been very important. Ayuntamiento de Zaragoza (Municipality), which has a strong commitment to sustainable development, promoted the idea of the eco-neighbourhood, creating Ecociudad Valdespartera Zaragoza. This institute managed the design and construction of the neighbourhood and the interpretation centre. The initial bioclimatic buildings (4 blocks) were developed by Sociedad Municipal Zaragoza Vivienda. The Universidad de Zaragoza assisted their design phase, set up the monitoring campaign and developed the social work with the neighbourhood residents. New technologies have been integrated in the neighbourhood. In the interpretation centre a tele-controlled net is monitoring water supply, irrigation, sewage, lighting... allowing control and measurement.

Renewable energies have been integrated in the project, with a selection of the most appropriate for each building. In Valdespartera **654m² of solar thermal panels** for DHW have been integrated on the project buildings (reaching a total amount of 9,000 m² in the neighbourhood). In the interpretation centre, a **45kW geothermal and reversible water-water heat pump** has been installed and integrated with a **biomass boiler of 37kW.** One of the most innovative solutions is the one designed by URBIC, which consists of a collective energy efficient gas heat pump for cooling and heating integrated in an ESCo model.

PICARRAL

Picarral was involved in the project through the **refurbishment of 196 apartments** (14,422 m²). Being a pilot experience not only for Zaragoza but for Spain, the project attracted the interest of many municipalities. **A public school** (Cándido Domingo), built in 1971, **has been refurbished, with a total area of 1,914 m²,** work led by Ayuntamiento de Zaragoza. All the refurbishment plans have been evaluated by CENER, a national public institution specialized in renewable energy.

In Picarral, **renewable energies also play an important role.** In the public school Cándido Domingo an **18 kWp photovoltaic system** has been installed on the roof of the building. Also, **photovoltaic panels** have been integrated in refurbished buildings with an innovative economical solution designed by Sociedad Municipal Zaragoza Vivienda: the economical benefits of the energy sale will be invested in the building refurbishment. Also **240 m² solar thermal panels** have been integrated in the Picarral buildings.

Cándido Domingo School after refurbishment works (Picarral)

PUBLIC PRIVATE PARTNERSHIP

The participation of private companies in the project enables the development of commercially innovative solutions. The engineering company URBIC has set-up the previously-mentioned ESCo and has played an important role in the design phase of the building's systems. ENDESA, an international company, has contributed with its experience on gas and electricity consumption and management at the district scale.

(kWh/m²/year)	New buildings	Refurbished buildings	Refurbished school	Interpretation centre
Heating	25	52	51.5	79
Domestic Hot Water (DHW)	9.5	14	-	-
Cooling	11	1.4	13.9	61
Share of renewable energy	64% (*)	70% of solar thermal for DHW	40% of electricity consumption	90%(**)

* It combines the passive solar gain (average 50% of heating demand) plus thermal solar for DHW (70%)
** Heating and cooling energy is renewable except heat pump with geothermal energy

The monitoring campaign, with **more than 750 probes installed and 220 apartments monitored,** when combined with the feedback of the social work with the neighbours, has proved to be very important in improving building efficiency. The project enabled a combined study of the analysis of energy system performance plus the **identification of construction problems with improper user behaviour** resulting in extra consumption of energy. Thus, a characterization of user types and events which result in extra consumption has led to the creation of a **web based system to provide users with specific recommendations** in order to avoid these energy consuming behaviours.

STRATEGIES USED TO MEET A HIGH LEVEL OF ENERGY EFFICIENCY FOR HEATING, COOLING AND ELECTRICITY DEMAND

- **Urban planning** to ensure solar gains and cross ventilation, and to create a temperate microclimate
- **High performance windows:** double-glazing and frames without thermal bridge and double windows on North and West sides façades
- **High insulation** of the buildings coupled with massive walls to ensure inertia
- **Insulation of thermal distribution networks**
- Strict specifications on **air tightness**
- Night **cross-ventilation** coupled with **thermal inertia** to get a reduction in diurnal temperature

LOCAL PARTNERS APPROACH to meet project challenges

URBAN DESIGN PHASE

The urban plan was designed according to the Zaragoza climate. **A "right to the sun" has been granted** through fixing a maximum height to buildings and optimizing distances between buildings. All the buildings are rectangular and face south for more efficiency and to optimize solar gains and cross ventilation.

Streets are designed **to allow inner cross ventilation in buildings and to stop the cold and dry wind called "cierzo".** Gardens and roads have been designed to promote quiet streets.

Vegetation regulates the local microclimate. Deciduous trees allow the sun to heat streets and façades in winter, while in summer they stop solar radiation. Vegetation has been **selected according to the climate** and to minimise irrigation needs.

BUILDING/REFURBISHMENT DESIGN PHASE

VALDESPARTERA NEW BUILDINGS

Municipal regulations specifically defined for Valdespartera establish **specific envelope parameters** (U values, % of glazing, dimension of the overhangs, etc.).

Prior to the construction phase, the Universidad de Zaragoza conducted a thorough review of the project to **verify compliance with the defined bioclimatic rules.**

PICARRAL REFURBISHED BUILDINGS

It was necessary **to convince inhabitants to engage refurbishments** as they are often reluctant. Improvements in energy consumption and economical savings have to be explained, bank loans must be managed and all of this requires significant fieldwork.

CONSTRUCTION PHASE

Construction site visits were carried out by RENAISSANCE experts to check for potential air leaks or poor insulation. Infrared images and blower door tests revealed some defects that were corrected.

A control of renewable energy systems to identify defaults in installation and maintenance was carried out. training technicians and monitoring facilities is necessary to ensure optimal efficiency.

Inefficient design and improper maintenance combined with excessive use of heating leads to excessive losses (46,3 %). The analysis carried out shows that heating needs correspond to 42.6 % and DHW to 11.1 %

Better control during the construction process and after occupation is required. New laws could make this possible and inexpensive in the overall process.

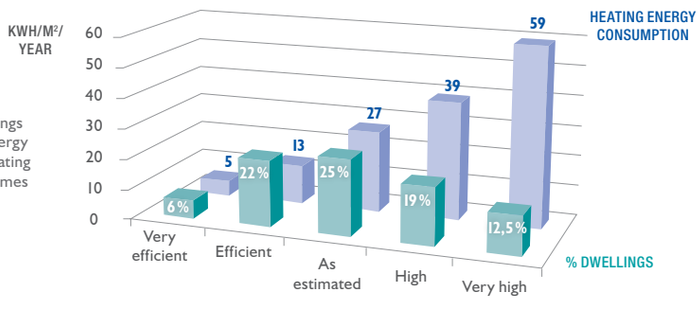
BUILDING USAGE, OPERATION & MAINTENANCE

A widespread monitoring campaign coordinated with **public awareness** and **training activities** has been one of the most important tasks: without adequate information and training of inhabitants, energy consumption of bioclimatic buildings can be higher than consumption in standard buildings.

Users heating demand is in general lower or equal to simulated value (53 % of the 1,600 houses analyzed), this is positive. However, despite the intense campaign developed with monthly articles, meetings, posters, etc., there are still 31.5 % of dwellings that consume up to three times the targeted performance (cf. Figure below)

First data shows that for most of dwellings the summer air conditioning is not required with proper use of bioclimatic design (heat island effect mitigation, night cross ventilation and thermal mass reducing temperature peaks). More precise data will be available after the summer 2012 and compared to the low cooling loads obtain from simulation (11 kWh/m^2/yr).

Number of dwellings as a function of energy consumption in heating (15 % of vacant homes not included)



LOMBARDY REGION, Italy

The Region of Lombardy, *whose capital is Milan, is situated in the northern part of Italy. The Region expressed its strong interest in participating in the RENAISSANCE project as* ***observer Community*** *at the beginning of 2006.*

No urban demonstration project was financed in Lombardy. Rather, the Region of Lombardy actively took part to the research and development activities of the project. With the support of the Regional Agency for Development of Agriculture and Forestry (ERSAF), they were responsible for the ***research activities related to the wood fuel supply chains in urban district.***

The Region of Lombardy carried out several studies on valorising zones on the periphery of big infrastructures in order to produce wood fuel using short and medium rotation forestry techniques. The feasibility of ambitious projects has been assessed, namely the creation of green belts along BREBEMI highway and Malpensa airport.

In addition, Lombardy carried out ***studies regarding the socio-economic impacts*** *of such projects and on the* ***feasibility of a rural-urban ESCo*** *to promote agro-forestry solid biomass through combined heat and power installations (CHP).*

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RENAISSANCE methodology

Avoiding disappropriation

The main objective of RENAISSANCE was to demonstrate that high levels of energy performance in new and refurbished buildings can be achieved at a significant scale and at reasonable costs, with existing technological solutions, if appropriately planned. RENAISSANCE project has been designed to address each step of the building process.

For any project aiming at constructing highly energy efficient buildings, the main challenge lies in overcoming the risk of disappropriation in the construction process. In other words, it is essential to focus on the appropriation of energy issues by all the stakeholders involved in the design and construction of a building as well as throughout its lifetime in order to guarantee that targeted energy performances will not progressively deteriorate along the process and building lifetime.

URBAN PLANNING AND POLICIES :

Town planning, energy policies and regulation

DISTRICT, SITE AND BUILDING PLANNING :

Ground plans, preliminary studies, networks and equipment design, buildings design

CONSTRUCTION, EQUIPMENT INSTALLATION, AND DELIVERY :

Land commercialisation, construction works

CONSTRUCTION, EQUIPMENT INSTALLATION, AND DELIVERY :

Commissioning, occupancy, O&M and users' behaviour.

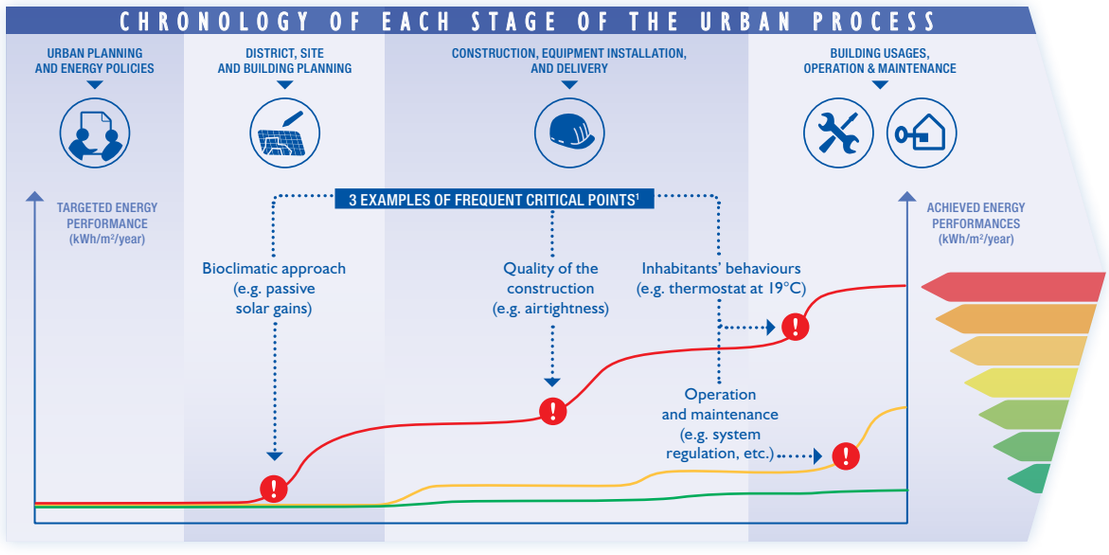
The graph below shows possible evolutions of energy performance over the building process. Exclamation points highlight common elements that impact the final energy consumption: bioclimatic techniques including building orientation and volume definition to optimise passive solar gains, quality of construction techniques, users' energy saving habits, operation and maintenance aiming at satisfying users' comfort with the most efficient energy conversion from final demand to useful consumption. Three contrasted situations are considered, each one depicted with a different colour.

3 EXAMPLES

— A building that is properly designed with ambitious low-energy objectives (i.e. through dynamic thermal simulation software) can perform poorly if successive stakeholders do not take into sufficient consideration the risk of critical points.

— Even if a project anticipates all disappropriation risks during design and construction phases, problems may appear during operation and maintenance and jeopardise targeted energy performances.

— Good energy performances are achievable by paying special attention to energy issues all along the design, construction and operation processes.



[1] Please note that the actual impacts of breaking points on the overall energy performance are not necessarily proportional to the one represented on the graph .

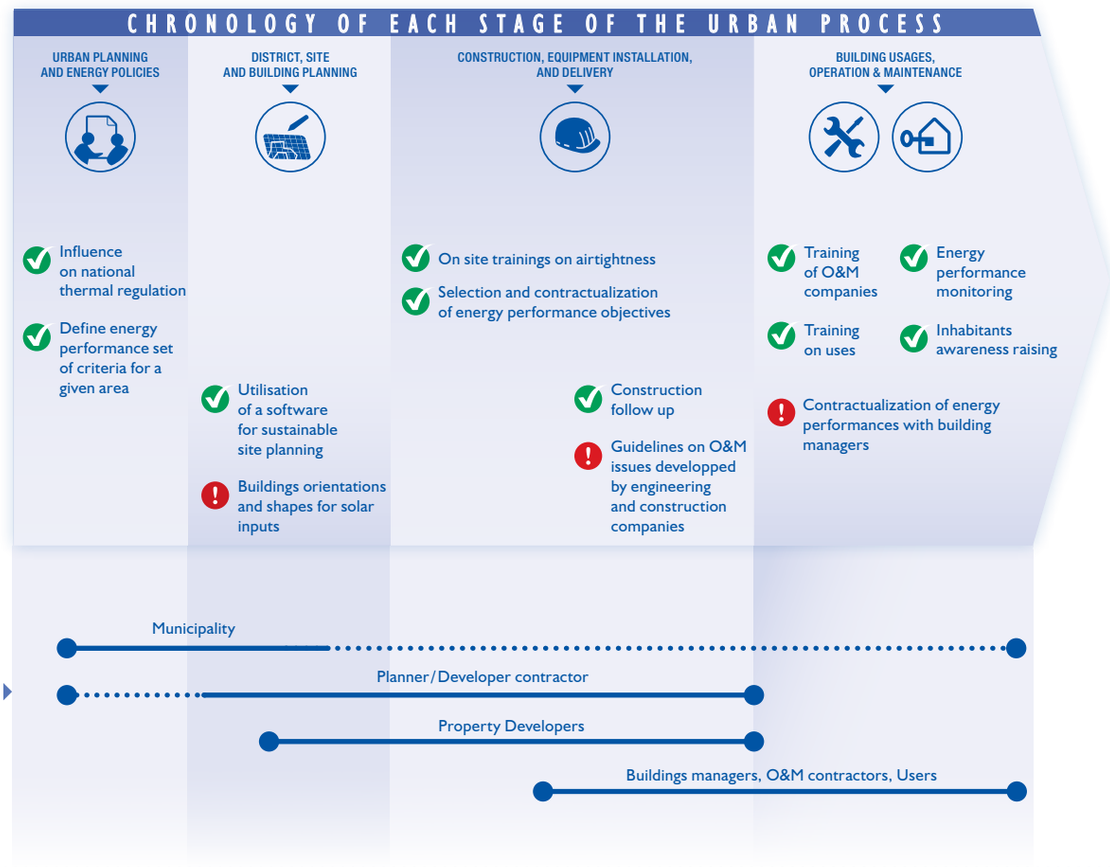
by building process stakeholders

RENAISSANCE project was clearly designed with the aim of **tracking disappropriation risks all along the building process** through 3 leverages tools :
I / Contractual objectives
II / Expert support to project stakeholders
III / Awareness raising and training of enterprises and users

The graphic below shows the actions which have a positive impact on the final energy performances of the buildings. Some of them have been well anticipated and realized under the RENAISSANCE project.

✓ Some of the RENAISSANCE activities undertaken to avoid breaking points in the appropriation process are listed in the following scheme.

! Some of important points that had not been sufficiently anticipated by the project partners, affecting the overall energy performance of the building.

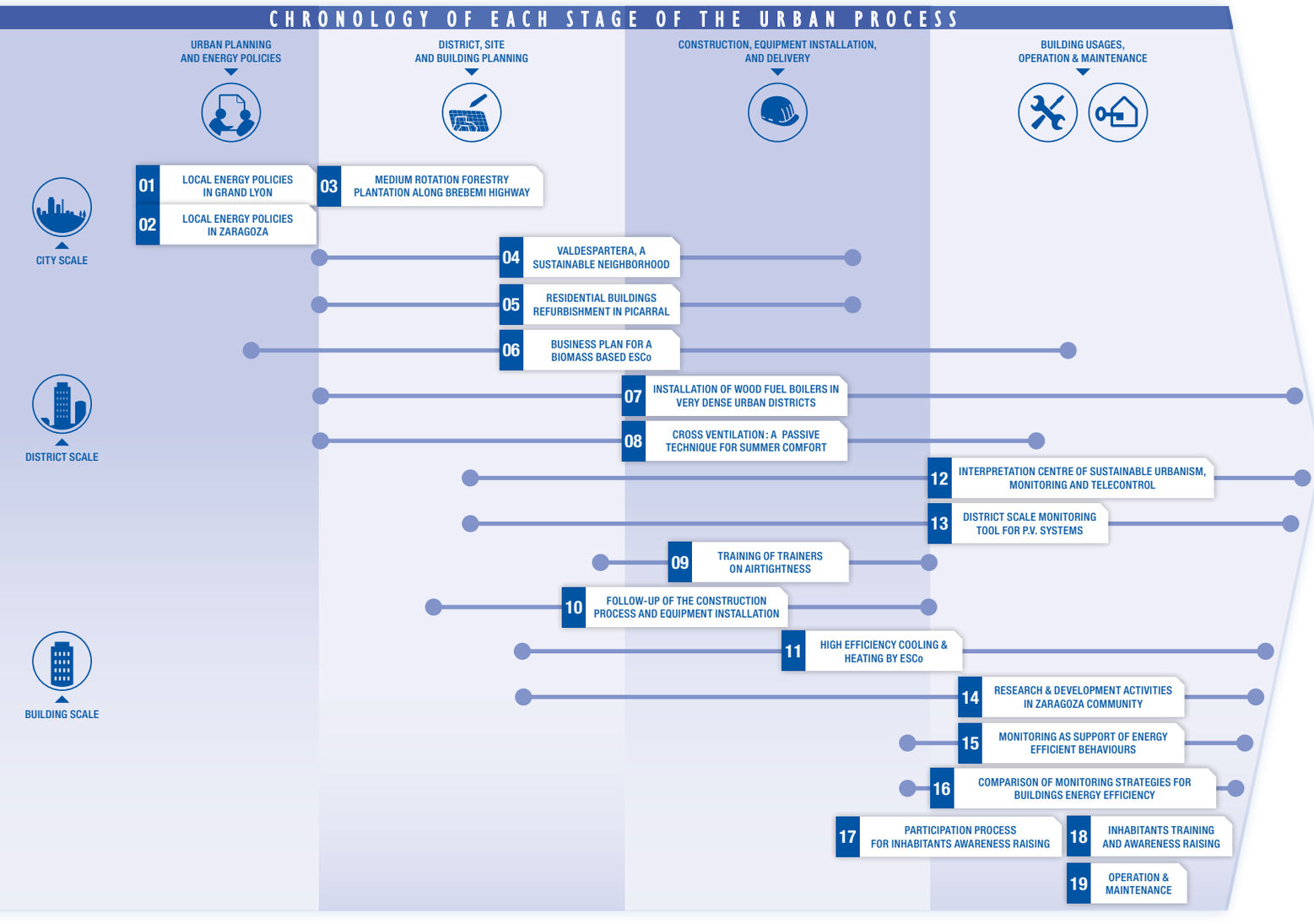


19 CASE STUDIES TO DEMONSTRATE THE LESSONS LEARNT IN THE RENAISSANCE PROJECT ALL ALONG THE CONSTRUCTION PROCESS

Case studies described in the annex of the present document detail the main lessons learnt during RENAISSANCE project and attempt to provide consistent recommendations, based on activities carried out by RENAISSANCE partners in France, Spain and Italy, and aiming at addressing the whole appropriation process as presented here. At the end of each case study, links to further information on the subjects are provided as well as contact details.

These case studies provide useful guidance for municipalities, urban planners, property developers and energy agencies on how to set up a favourable environment for constructing sustainable buildings.

However they also demonstrate that work remains to be done before energy issues are fully integrated at the earliest stage of the planning process (e.g. urban composition and building shape, criteria for selecting architects and developers, etc.) and before all stakeholders in the construction process are aware of what low-energy performance actually means for them in their professional or personal practices.



THE RENAISSANCE CONSORTIUM

19 PARTNERS IN 3 EUROPEAN COUNTRIES

FURTHER INFORMATION ▸▸ WWW.RENAISSANCE-PROJECT.EU

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Local ENERGY POLICIES in Grand Lyon

LOCAL POLICY AS REGULATION PROGRESS ENABLER

The case study of the CONCERTO-RENAISSANCE project in Grand Lyon clearly shows how a combination of political commitment at local level in energy sustainability with financial and methodological support from European Commission can strongly and positively influence policies at national and regional levels.

BACKGROUND

The French energy policy framework was set up just after World War II and suffered very few modifications until 2000. The first thermal regulation in buildings was introduced in 1974 and was reinforced by including insulation performance. Yet in 2003, the ongoing thermal regulation "RT 2000" did not include any energy performance objectives except for insulation. The national plan for greenhouse gas emissions was approved only in 2004. **Thus, when RENAISSANCE project was being designed in 2003, binding energy objectives to developers were seen as a real breakthrough regarding existing practices.**

DESCRIPTION OF THE ACTIVITIES

Given local and national context, RENAISSANCE partners took the unique opportunity of the demonstration project (scale of the project, strong political commitment) **to innovate and enhance existing energy policies and practices at local, regional and national level by:**

- **transforming project experience** into municipal policy, regulation and practices, thus ensuring immediate replication of the results,
- **proposing evolution** for regional and national policies and regulations,
- **making the lessons learnt available** to others via development of policy guidance notes thus facilitating mainstream adoption and use of this innovation by other municipalities and urban planners.

Grand Lyon implication in the project as official coordinator proved to be highly beneficial. It provides credibility and legitimacy to the project actions, while taking one step forward the internal reflection regarding **the leading role of municipalities for the development of sustainable urbanism and energy efficiency.**

RESULTS AND LESSONS LEARNT

LOCAL DEMONSTRATIVE EFFECT

The project demonstrates that high-energy performance buildings are achievable even for big scale operations, implying a strong demonstrative effect at local level. The real estate developers that were involved in the project became convinced of the feasibility and relevance of setting ambitious energy performance. RENAISSANCE energy specifications have been subsequently applied to other developments in La Confluence area. Several low energy consumptions buildings have been built with no public funding or a public funding envelope much smaller than what real estate developers in RENAISSANCE obtained, and some Energy Plus buildings are currently under construction in the neighbourhood of CONCERTO buildings.

The momentum generated by the RENAISSANCE project deeply contributed to the development of sustainable neighbourhoods within La Confluence area and therefore to WWF's choice to select this district as a pilot site for testing their sustainable district label.

MUNICIPAL ENERGY PERFORMANCE CRITERIA FOR NEW HOUSING AND OFFICES BUILDINGS

Grand Lyon has developed in 2003 a set of reference criteria for the construction of sustainable housing buildings ("Référentiel habitat durable"). The "Housing sustainable energy reference framework" is applicable to all urban planning or construction development led by the Municipality, or located on Municipality owned land, or subsidised by the Municipality (social housing operations). The second

version (2006) benefited from the RENAISSANCE experience in terms of energy performance requirements. The third version published in 2009 had the objective to mainstream low energy consumption buildings by **anticipation of the future new French thermal regulation (RT 2012).**

Following positive feedbacks from the introduction of energy performance criteria in housing, Grand Lyon decided to expend it to the office and services sector with the creation of a new set of criteria for sustainable offices ("Référentiel bureaux durable"), **setting energy performance objectives based on those applying to offices built under the CONCERTO-RENAISSANCE project.**

PILOT OPERATION FOR THE MAINSTREAMING OF ENERGY EFFICIENT REFURBISHMENT OPERATIONS

Taking opportunity of the momentum accelerated by the RENAISSANCE project, Grand Lyon partners extended their cooperation for defining a refurbishment strategy on a pilot residential district, the district of Saint Blandine. The objective of the study was to define an operational strategy replicable to the whole conurbation in order to mainstream thermal refurbishment of existing building stock while maintaining the social purpose of the district and designing innovative financial mechanisms. The study concluded that the most interesting financial model would be to combine zero interest loans for the property manager with local incentives. However, the juridical framework for applying for zero interest loans to co-owned building does not exist. **The results of the study has enabled Grand Lyon, associated with other French cities, to pressure the government for introducing needed regulation adjustments.**

HEATING AND COOLING NETWORKS

The pre-study carried out during the first steps of RENAISSANCE project about the construction of a heating network supplied by wood-fuel boilers at the district scale led the Grand Lyon to revisit Heating and Cooling (H&C) networks as a whole. Even if the solution chosen for RENAISSANCE building was individual wood-fuelled boilers at block scale, numerous studies in other districts followed. The project contributed to impulse a strategic vision inside Grand Lyon's departments concerned by the subject, **leading to a political decision to include H&C networks within its jurisdiction and to design an H&C master plan.**

PROJECT IMPACT REGARDING REGIONAL AND NATIONAL POLICIES

- In 2006, the Rhône-Alpes Regional Council decided to develop a "sustainable housing reference framework" similar to the one developed by Grand Lyon. **RENAISSANCE project provided technical inputs to the regional approach regarding energy systems and construction specifications.**
- Two RENAISSANCE partners participated to a working group in the so-called "Grenelle de l'Environnement" at national level. **RENAISSANCE's first results and lessons learnt strongly contributed to the definition of the energy performance objective of the new thermal regulation (RT 2012).**

RECOMMENDATIONS

1. For such large scale and ambitious project, it is essential to focus on the appropriation of energy objectives by all stakeholders involved along the whole process from the design to the occupation and maintenance phases. To do so, municipalities need to identify the leverages they have at disposal for ensuring targeted energy performance objectives will be actually achieved once the buildings will be occupied. RENAISSANCE project worked on some of the leverages but significant work remains to be carried out for strengthening French municipalities capability in this topic.

2. At national level, RENAISSANCE partners are promoting an evolution of the regulation so as to enable zero interest loans for thermal refurbishment of co-owned residential buildings, as a main leverage to mainstream the refurbishment of the existing building stock.

3. From a more general point of view, RENAISSANCE partners are strongly convinced of the importance for municipalities to take up energy issues and include them in town planning activities to have a comprehensive energy strategy at the conurbation level. Municipalities also need to consider energy networks (electricity, gas and H&C) as any other network (e.g. water distribution) and therefore take back the lead and management of these network infrastructures. To enable municipalities and other local Authorities to carry out ambitious and effective energy policies, a law on energy decentralisation is required.

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SIXTH FRAMEWORK PROGRAMME
CONCERTO
RENAISSANCE

Local ENERGY POLICIES in Zaragoza

Juan Alberto Belloch, Major of Zaragoza

Cándido Domingo School after refurbishment works

POLITICAL CONSENSUS AND INSTITUTIONAL SUPPORT

The RENAISSANCE project has been an important contributor to the change of direction in the energy administration policies of Zaragoza. The success of this project made us adopt a new kind of bioclimatic construction and experiments for rehabilitations with ambitious energy saving and energy efficiency criteria.

BACKGROUND

Zaragoza was already recognised before this project as source of exemplary energy saving and efficiency experiments, and the project success is related to this. Parque Goya neighbourhood is a previous experience with social housing using bioclimatic criteria that provided the municipality with a first set of significant results.

- **RENAISSANCE offered a new opportunity to boost and improve other aspects not yet studied.**

DESCRIPTION OF THE ACTIVITIES

On 17th of April 2009 the City of Zaragoza endorsed the **Strategy Against Climate Change and for Air Quality of Zaragoza,** a strategy that has established two great goals for the year 2015: improvement of air quality and reduction of dependence on fossil fuels. The objective is to obtain a 30% reduction in CO_2/person by the end of 2015 as well as acting on polluting gases (CO, SO_2, NOx, COV, COVNM, NO_2) and suspended particles for improving air quality by EC directives.

The actions have been grouped in five priority fields. **The actions addressed to reduce energy consumption in the building sector are one of the priority mainstays of the Plan.**

RENAISSANCE project in Zaragoza has proved that significant savings in this sector are achievable.

The RENAISSANCE project in Zaragoza have demonstrated that housing planned with bioclimatic characteristics can obtain spectacular results. In the dwellings constructed and monitored by Eco-ciudad Valdespartera, a consumption rate per dwelling between 20-25 kWh/m^2/year has been obtained, whereas in conventional dwellings the rate is between 80-110 kWh/m^2/year. In other words, a reduction of 75% has been achieved. As far as rehabilitated dwellings are concerned, the rate obtained is between 50-60 kWh/m^2/year.

Photovoltaic system
of "Colegio Domingo" School

RESULTS AND LESSONS LEARNT

These results of these different experiences has allowed the City of Zaragoza to endorse on 24 July 2009 the **"Municipal Bylaw on Energy Ecoefficiency and Use of Renewable Energy in Buildings and its Facilities",** and the **"Municipal Bylaw on Rehabilitation"** on 25 June 2010. Zaragoza now has a regulating and legal tool compelling every new building and fully rehabilitated dwellings in the municipal area to comply on energy saving, energy efficiency and use of renewable energy guidelines. This is a landmark municipal regulation as it is only through collective community decisions and behaviour that a better, sustainable, use of resources can be obtained.

RENAISSANCE has made possible the exploration of new construction techniques and design materials. In short, this project has been **a booster for following a path towards more sustainable construction models.**

As far as specific buildings such as the Cándido Domingo School are concerned, an energy reduction of 52% has been obtained coupled with the installation of a photovoltaic system (18 kW) that produce 40% of the electrical needs of the building.

Taking as a starting point this demonstration action, **we have the possibility of using this knowledge and experience in every municipal building and equipment,** a task we are right now focusing on.

Aggregated information on building groups, through the planning and construction of a real time monitoring system with over 200 control points for housing, allows us to evaluate the different architectural solutions as well as the daily energy habits of people living in the area, a key point for planning information and environmental public awareness on this field.

RECOMMENDATIONS

1. **A political consensus is necessary on construction, energy saving and efficiency politics. In the municipal framework it's important to boost political changes that affect private property using and urban planning approach. It's necessary to implement environmental criteria in urban plans and general regulations on construction and refurbishment.**

2. **This political consensus must be based on scientific facts and economical studies. Short and long term benefits for citizens' lifestyle quality must be explained and demonstrated to prove investment security.**

FURTHER INFORMATION ▸▸

RENAISSANCE KEY DOCUMENTS :
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SIXTH FRAMEWORK PROGRAMME
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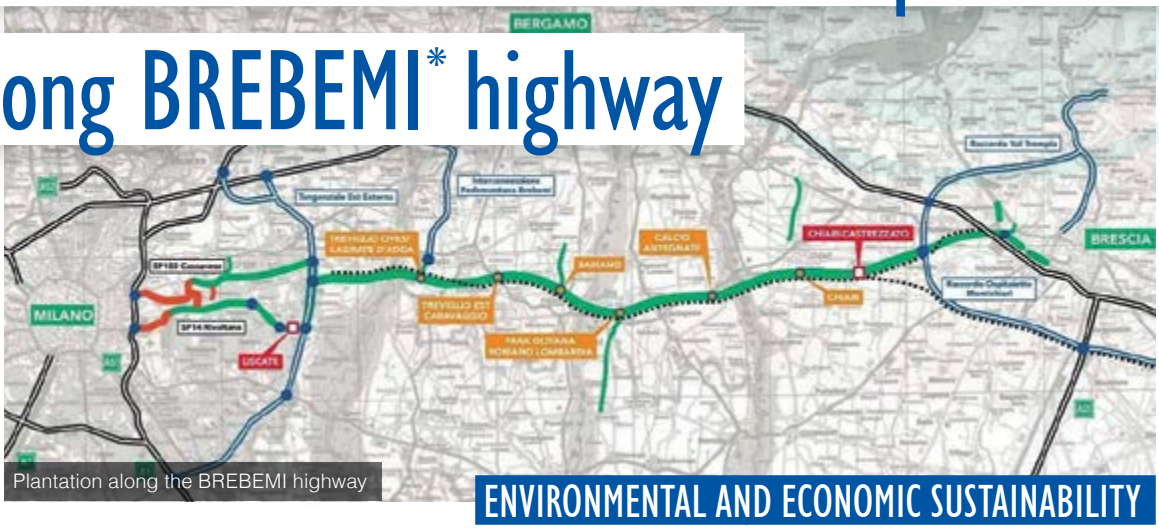
Medium ROTATION FORESTRY plantation along BREBEMI* highway



Plantation along the BREBEMI highway

ENVIRONMENTAL AND ECONOMIC SUSTAINABILITY

Infrastructure mitigation is a key factor for transport linear infrastructure. A new approach to the problem was developed during the project. Implementation of Medium Rotation Forestry (MRF) can reduce the environmental impact and increase economic sustainability of mitigation systems since the expenditure in the system can be balanced by the reduction of energy costs for the road infrastructure.

BACKGROUND

Today many mitigation techniques are used in the case of construction of new linear transport infrastructures in order to increase social acceptance of these projects. One of the techniques most appreciated by the public is the concept of "green quint", where plants and other elements of agricultural landscape form the barrier to achieve a very small caesura and changes with the existing landscape. Nevertheless this type of barrier is quite opposed by infrastructure management due the high maintenance costs.

To solve this dichotomy it is necessary that green quint generates additional services to compensate for its additional costs.

DESCRIPTION OF THE ACTIVITIES

A new approach to the problem was studied during the European project RENAISSANCE, taking into account the energy consumption for infrastructure operation and proposing to substitute fossil energy sources with renewable ones (like biomass). The proposal merges naturalization techniques with agricultural techniques as Medium Rotation Forestry (MRF). The implementation of MRF can reduce the environmental impact and additionally increase economic sustainability of mitigation systems by reducing energy costs for the road infrastructure.

The first step of the work was to design a cultivation module that included the addressed objectives and was compatible with safety road issues. This module was then repeated along the whole BREBEMI highway track using a simulation tool to obtain raw data about production and greenhouse gas fixing. The second step of simulation regarded the power plant localization, the logistic and the legal framework of renewable energy production in order to produce a feasibility study of the whole concept.

* BreBemi : Brescia-Bergamo-Milano

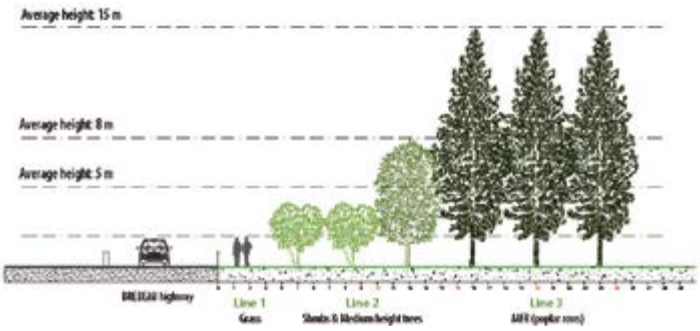
RESULTS AND LESSONS LEARNT

The module is organised in three strips detailled in the figure below. Each one carries out a specific function.

The first line: From the border of the land to the motorway there is an area with grass of 5 metres tall to assure the crossing and the possible maintenance intervention.

The second line of trees is made of 2 rows of different species of trees that represent:

- **Safety factor.** The shrubs reach a height of 3-6 metres and do not create any problems in case of strong wind since they are very stable.
- **Environmental factor.** A double row located nearby can capture the pollutants that spread within the first 3-6 metres, assure a thick covering and work also as a barrier against the noise and as a shelter for animals.



The third line is the MFR cultivation area, made of a number of biomass poplar rows. The distance between the lines is 4 m and the distance between the trees in the lines is 2 m, for a density of 1,250 plants per hectare. So the woody covered area is 5 m on each side, 100 m total for each highway point. For the simulation, this area is considered as continuous in order to compensate major surfaces around and inside link roads with minor surfaces near houses, other buildings or other infrastructures. The designed motorway route is 62 km long, so the total mitigation surface is or 620 hectares. With an average production between 30-35 tons per hectare (using a humidity content of 50%), this MRF cultivation has a potential production between 18,600 and 21,700 tons of wood biomass per year. Considering that 1 g of dry substance (wood biomass) 1,83 g of atmospheric CO_2, the annual production of wood biomass anhydrous (15-18 tons) will fix between 27-33 tons of atmospheric CO_2 per hectare. That means that the 620 hectares can fix between 16,740 and 20,460 tons of CO_2 per year.

An annual availability of 18,600-21,700 tons of wood biomass can produce through the combustion a net power corresponding to 39,200-45,700 MWh per year (PCI chipped at W50% = 2.11 kWh/kg). If we consider the use of a co-generation plant with an electric efficiency of 20%, the output power is 1 to 1.3 megaWatts.

The localization of power plant around the middle of the route imposes a maximum transport distance inferior to 40 km, that is compatible in the 85% of the tracks with short chain legal definition (< 30 km from power plant).

STRENGTHS

The system carries out many environmental functions: noise barrier, green belt, renewable energy production, landscape conservation.

WEAKNESSES

The system is less productive than a noise barrier with PV modules, in terms of energy. The surface seems quite high but its use must be compatible with safety, environmental, health and expropriation rules.

RECOMMENDATIONS

1. On technical side, future action should be additional research and experimental activity to find new association of species with higher productivity in order to reduce the surfaces involved.

2. For the economic side, because this technique is strongly related to local legal framework, a deep evaluation of all feedbacks connected to the infrastructure issues will enforce its applicability.

FURTHER INFORMATION

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SIXTH FRAMEWORK PROGRAMME
CONCERTO
RENAISSANCE

Valdespartera, a sustainable NEIGHBOURHOOD

OPTIMIZING ENERGY CONSUMPTION IN SOCIAL HOUSING

Valdespartera is one of the greatest actions as far as social housings are concerned in Spain, in terms of environmental sustainability. Public administrations support has allowed to create an urban development with housings quality over the standards, reaching savings around 70% in heating comparing to conventional housings.

BACKGROUND

Valdepartera Partial Plan shaped a design assuming since the beginning the objectives of housings energy saving. To achieve this, a strict urban normative was set, under principles of urban regulation, constructive design and constructive materials quality.

Thanks to the effort of the implied agents and the resources contribution for the urbanization in terms of public subventions, the project has included **improvements that have arisen the urban standards.** Apart from defining a double water supply net, one for irrigation and the other one for rain and fecal waters, the project includes some significant innovations such as recycled street furniture and fictures, WiFi nets in public spaces, pneumatic garbage collecting system, etc.

DESCRIPTION OF THE ACTIVITIES

With the support of RENAISSANCE project, Sociedad Municipal Zaragoza Vivienda (City Council Housing Society) has arisen housing standards constructing 616 housing in four ground lots over normative standards both at the beginning of the process and after the approval of the Construction Technical Code ("Código Técnico de Edificación") in 2006. These buildings have allowed to essay **different insulation systems in buildings envelopes** and carrying out **high efficiency centralized heating and refrigeration systems,** which are extraordinary in the district.

Moreover, financing in the project has allowed the **monitoring of some dwellings,** with continuous measuring of their thermal comfort. This monitoring process in Valdespartera obtains every 15 minutes temperature and relative humidity for different housing rooms (bedroom, living-room and glazed balcony). As collected data are collated to climatic data from different meteorological stations which are spread in the district, both graphs are analyzed in order to detect anomalies in each housing energy demand.

RESULTS AND LESSONS LEARNT

Project execution has also meant the **application of a large amount of technical innovations** (solar captation solutions, ventilated walls, thermal and acoustic insulations with "Termoarcilla" ™) that were maxed since the beginning. In that sense, it is important to say that "Código Técnico de la Edificación" (2006) constructive standards were applied since the beginning of the Partial Plan in 2002.

Thus, it is important to point out that the **strictness in Valdespartera Partial Plan in terms of energy efficiency has created, as well as low energy consumption housings, some constructive projects which are excessively uniform.** Nevertheless, the efforts that were carried out by the municipal housing society have allowed the creation of quality housings improving even the mean neighbourhood consumptions. Also, thanks to the great concurrence in the projects contest that was organized, a great architecture quality joined the energy savings.

RECOMMENDATIONS

1. **It is essential to set a continuous communication channel to neighbours, since sometimes they don't carry out an adequate installations use, increasing unnecessarily their energy consumptions. In order to achieve neighbours' awareness, social work and tracking are a must and these tasks are carried out by means of the tele-control centre and the monitoring that was financed by RENAISSANCE project.**

2. **Ground lots centralized heating systems were evaluated although not installed, and mean one more of the aspects to keep in mind for designing future similar projects.**

3. **Researching lines on energy self-sufficient neighbourhoods must be strengthened in order to achieve resources rational consumptions, since many inhabitants focus just on the economical component when evaluating the implementation of alternative heating and refrigeration installations.**

FURTHER INFORMATION ▸▸

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SIXTH FRAMEWORK PROGRAMME
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Residential buildings REFURBISHMENT in Picarral

Gral Yague buildings (Picarral) before and after refurbishment works.

BETTING ON SUSTAINABILITY IN NEIGHBOURHOODS BUILT IN THE 50'S & 60'S

The RENAISSANCE project demonstrates the social and economical feasibility of refurbishment works for buildings which were erected in 1950-1960, basing on over 50% energy savings and integration of renewable energies at the district scale. In order to achieve this, 70 housings in different buildings were refurbished in "El Picarral" neighbourhood, bringing these housings to current comfort criteria and achieving great reductions in their energy consumptions. 100 more housings projects in the same zone are already finished.

BACKGROUND

The RENAISSANCE project bet on an integral refurbishment for already constructed housing in Picarral neighbourhood, improving their insulation and installing renewable energy systems. The goal was to prove that urban sustainability is possible not only through new bioclimatic buildings but also through pioneer actions on existing ones, that represent most of the building stock and have a high level of energy consumption.

- **To achieve this, the Picarral working class neighbourhood was selected, with buildings that were erected between 1945 and 1965 with a fragile population that can not move to better quality housing for economic reasons who must stay in their housing although they do not meet current comfort criteria.**

DESCRIPTION OF THE ACTIVITIES

Zaragoza Vivienda (Municipal Housing Agency), through the Municipal Management Technical Office has carried out the following activities in the Picarral refurbishment process:

- **Information meetings** with neighbours explaining the integral refurbishment studies and proposals, which may be applied in their kind of buildings.
- **Information collection on pilot dwellings and training** of the interested neighbours as well as the creation of Neighbour Communities in the Municipal Management Technical Office.
- **Agreements** signed between Neighbour Communities and Zaragoza Vivienda.
- **Assistance** to Neighbour Communities in their **decision process** for the selection of materials and techniques and during the refurbishment works.
- Requesting and obtaining **Work Permit Licenses.**
- **Tracking and supervision** of works, cooperating with neighbours.

RESULTS AND LESSONS LEARNT

STRENGTHS

- **To significantly improve inhabitants quality if life.**
- To transform obsolete neighbourhood buildings (D level certification) into energy efficient neighbourhood buildings (level B)
- **To renew the neighbourhood placing it once again in the property market and regenerating the neighbourhood and the city.** The size of refurbished dwellings (40 up to 70 m^2) provides great opportunities for old and young people. Their location is also a favourable factor, since, although the buildings were situated in the outskirts of the city when they were erected, the city has spread and they are now close to the centre
- To optimize urban soil use, and fight urban sprawl by reoccupying already constructed soil (positive environmental and social impacts)
- To contribute to the **revitalisation of traditional neighbourhoods**
- To turn high energy consumption housing into energy efficient housing leading to a **significant reduction of greenhouse gas emissions** (up to 71.36 kg.CO_2/year per m2 of refurbished buildings).
- To reduce architectural barriers

WEAKNESSES

The existing co-property system, that requires **unanimity of all neighbours,** implies significant difficulties for the mainstreaming of refurbishment works. In order to help in these tasks, the Municipal Management Technical Office was created in order to assist the neighbour communities and to facilitate consensus and decision-making. Spanish laws about co-property, that implies great majorities for any decision, makes these actions difficult.

- **The absence of regulations** requiring minimum thermal insulation is another barrier.
- **Administrative processes for work permits** have been very slow since some urban planning barriers had to be broken.
- **Economical difficulties** created along the project: Works are co financed by public administration (75 %) and housings owners (25 %). In the current economical crisis context, the initial refurbishment process, which had a waiting list, had to be stopped due to the impossibility of the inhabitants to obtain bank credits in order to finance their 25% of participation. There are no adequate private financing instruments for this kind of action.

In Zaragoza there are more than 75,000 dwellings over 40 years old and specifically 8,500 with similar characteristics to Picarral ones. The project demonstrates that ***it is possible to successfully extend this operation to other neighbourhoods and to the city centre*** *as well as to cooperate with economical revitalization zones to maintain families in their neighbourhoods.*

RECOMMENDATIONS

1. Due to the co-property regime derived difficulties, one essential stage in this process was the technical and social role played by the Municipal Management Technical Office in order to boost private refurbishment and support the creation of organizational structures among neighbours, as well as to simplify project works.

2. On a second stage in refurbishment project, a Joint Management Entity was created by means of an Agreement among housings owners and Zaragoza Vivienda. This model, basically applied to older population zones with limited economical resources, manages the necessary economical help and social support and finally owners promise to carry out the works and co-finance them (around 20 or 30 %).

3. Preliminary results are ready and the population recognizes the technical possibilities for housing refurbishment. But the new challenge is the financing of the operations. In the current economical situation, urban refurbishment cannot be conditioned to public subventions (they presently financed around 75%) or to vulnerable private credit system.

4. We must take one more step after proving that social and technical feasibility is a fact, in order to explore economical ways to allow existing buildings sustainable refurbishments to be economically feasible. Only then will sustainable refurbishment become an actual practice and will be replicable in other cities.

5. Last but not least, several regulations have to be created in order to foster the mainstreaming of refurbishment works:

- Protection of these buildings by means of the declaration of Interest Urban Group (Conjuntos Urbanos de Interés)
- Disaffection of public soil, a pioneer measure that makes possible an installation of elevator out of the existing envelope.

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SIXTH FRAMEWORK PROGRAMME
CONCERTO
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Business plan for a BIOMASS BASED ENERGY SERVICES COMPANY (ESCo)

ANALYSIS OF TWO POWER GENERATION MODELS

The valorization of solid biomass involves both the renewable energy sector and the agriculture sector. The comparison of business plan for a centralized combined heat and power (CHP) plant versus one individual heating system is an important step to achieve economic and environmental sustainability of biomass valorization.

BACKGROUND

The directive 93/76/CEE defines the so-called interventions of a third party, and in the meantime **foresees the role of ESCo.** Many studies were carried on ESCo business model in urban or industrial context, using energy efficiency techniques. Feas knowledge was available about the integration of renewable energy sources in ESCo business model, and in particular there was a **lack of knowledge in the valorization of solid biomass**. For these reasons, RENAISSANCE project focused one of its activities in the **write-up of a business plan** for both the options of ESCo based on solid biomass centralized CHP plant and distributed heat plants.

DESCRIPTION OF THE ACTIVITIES

Two different types of ESCo were investigated during the study: the first one with a classical CHP plant connected with heat users through a heat district grid; the second one based on individual heat service through wood pellet and heater supply. In both cases the data for business plans write-up were available and no simulations or extrapolations were necessary. Both business plans cover a 10 year period.




RESULTS AND LESSONS LEARNT

IN THE FIRST CASE HYPOTHESIS ARE:

- Biomass CHP plant
- 1 MW of electric power output
- Natural gas grid
- Heat district grid of 2 km long
- All the heat users connected by 1st year at the same time
- The heat price is cheaper than the natural gas price
- After 10 years all the infrastructures (CHP plant and heat district grid) will become municipality property

This kind of ESCo exhibits higher complexity and costs but it is always profitable.

The key factor for the profitability is the feed-in tariff for the electric power sold to the grid.

IN THE SECOND CASE HYPOTHESIS ARE:

- No natural gas grid
- The ESCo manages 15 "energy plants"
- Each energy plant is composed of 6 wood pellet boilers (1*40 kW boiler, 2*100 kW boilers, 3*350 kW boilers)
- During the 1st year, 3 energy plants are installed
- During the 2nd year, 5 energy plants are installed
- During the 3rd year, 7 energy plants are installed
- After 10 years all the energy plants will no longer belong to the ESCo
- The ESCo will provide the fuel

The second one exhibits a very low profitability notwithstanding the lower fixed costs and complexity.

RECOMMENDATIONS

1. As the economic sustainability of the two models is strongly related to incentive policies. So we recommended stability for a certain period in order to support the market developing for these technologies.

2. Large efforts in research and real scale demonstration action are necessary to develop small CHP plant based on solid biomass to make them more competitive with centralized plants.

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SIXTH FRAMEWORK PROGRAMME
CONCERTO
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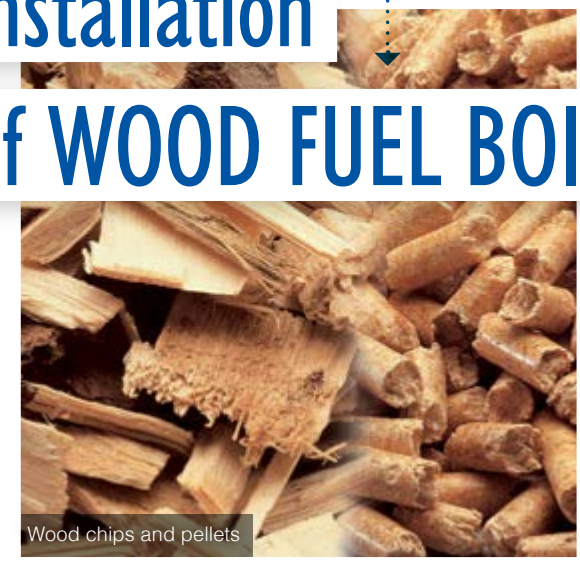
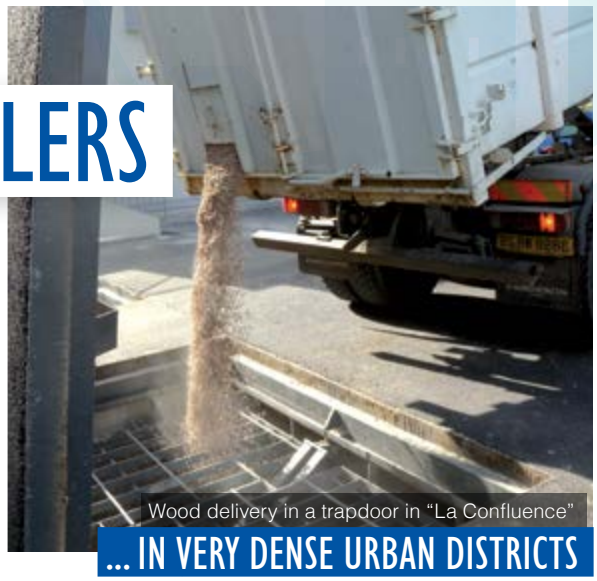
Installation of WOOD FUEL BOILERS



Wood chips and pellets



Wood delivery in a trapdoor in "La Confluence"

... IN VERY DENSE URBAN DISTRICTS

Wood fuel boilers are not well developed in urban areas where wood supply presents a challenge, although it is also where density of population increases the economic interest of a wood heating plant project, through economies of scale. However, wood fuel boilers also require more space then fossil fuel burners, in large part due to the necessity of having on site storage, thus causing land occupation issues. This case study details recommendations regarding the implementation of such systems in urban areas using the example of Lyon CONCERTO district.

BACKGROUND

Wood fuel boilers were chosen to cover the greater part of the 80% of space heating and hot water demand that had to be covered with renewable energy, a smaller part being covered by solar thermal. Implementation of wood fuel boilers in France remains scarce and for this reason this operation is innovative.

- **Initially, the installation of a district-heating network covering the three blocks ABC had been studied. However this subject was not enough mature and the complexity of finding an arrangement between actors led to abandoning this solution in favor of one wood boiler room per block.**

DESCRIPTION OF THE ACTIVITIES

The three blocks mount to more than 75,000m² of area to be heated. Amongst the four wood boilers, three use wood pellets and the third wood chips. The three boilers amount to 2.16 MW in power (4*540kW). All of them have been integrated in the development of the blocks, with a dedicated space in three buildings. Installed in the basement or at ground level, they are connected mini private district heating networks, each feeding all buildings on one block.

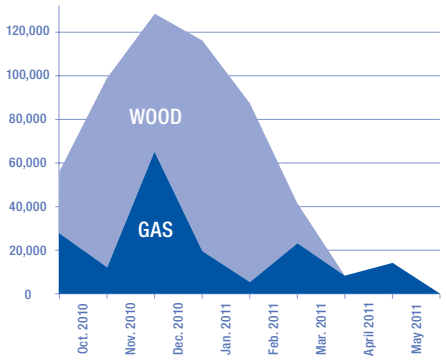
The technical support providing to promoters concerned:

- advices in the design of wood boiler rooms, in particular silos and truck access for fuel delivery,
- revising the special technical specifications,
- visiting the construction site.

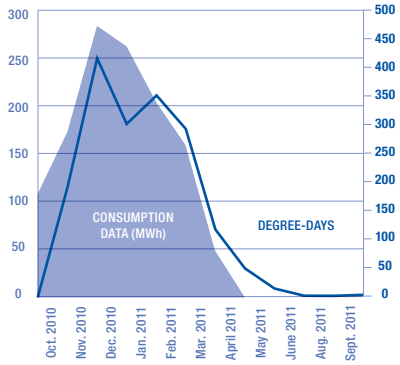
Once the construction and equipment installation were finished, the activities continued with:

- communication with the building operators to gather energy consumption data in order to compare with the expected results and to communicate to users on these values
- support during a few wood deliveries and verification of the fuel quality
- analysis of operation and maintenance contracts when they could be obtained in order to study how energy performance can be integrated in contracts.

RESULTS AND LESSONS LEARNT



Contribution of different fuels – gas and wood – to heating demand in Block A.



Monthly heating demand on Block C and degree days per month.

It is difficult to draw conclusions on consumption data from the first year of usage since the occupation of building is still incomplete, not well documented and thus not representative of building operation. On the left, the two graphs are showing consumption data of block A and C, based on information provided by property managers and building operators. For the winter 2010-2011, heating demand represents 969 MWh for block A and C 1,050 MWh for block.

STRENGHTS

- **Good integration of boilers** in the urban context and the building architecture.
- **Good design of silos, with facilitated fuel delivery.** For Blocks A and B, the access to the storage room is from the road with a gravitational delivery (it is unloaded directly into the silo). The silos' access is in the travelled portion of the road.
- **Use of a regional wood supply,** according to the information provided by building operators.
- **As a whole, the choice of fuel** appears appropriate and contributes to the good operation and maintenance of the boilers.

WEAKNESSES

- **Communication and transmission** of energy performance objectives and renewable energy targets between actors has been difficult, and appropriation by the actors has not been simple.
- **In face of the growing concern of particle emissions,** the question of the evacuation of gas and smoke has not been appropriately addressed. The evacuation is not controlled and there is no particular treatment for particles (PM10) and other pollutants. The good performance and maintenance of the boiler and the quality of the fuel are the only guaranties of low pollution.
- **On one block, certain deliveries presented a high content in bark,** which led to a high level of ash (unburned products from combustion process). This leads to a higher maintenance time.
- **Building operator skills development has been difficult to put in place** (cf. Case study n°19 on "Operation and maintenance").
- **Contracts and methods of property managers have not been adapted** to the characteristics of buildings and equipment installed.

RECOMMENDATIONS

1. A solid work must be put in place very early in the project on the preparation of future building operators and property managers on the way of operating installations with the objectives of energy efficiency and satisfaction of the comfort of users.

2. Coordination of actors of the project concerned by operation and maintenance – promoter, energy engineer, installer, operator and property manager – should be fostered in order to ensure a quality approach from the design to usage of an installation (see case study n°19 on "Operation and maintenance").

3. Optimising the operation of wood systems should be done over 2 to 3 years. Indeed, the building operator takes control of the installation the first year and makes sure that all dwellings are heated. The next step is to maintain or decrease the consumptions so as to respect the low energy consumption targets. For the step to be successful, the cooperation of the building operator, property manager and inhabitants is crucial.

4. Building operators should take the habit of sampling and communicating energy consumption data on a monthly basis.

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SIXTH FRAMEWORK PROGRAMME
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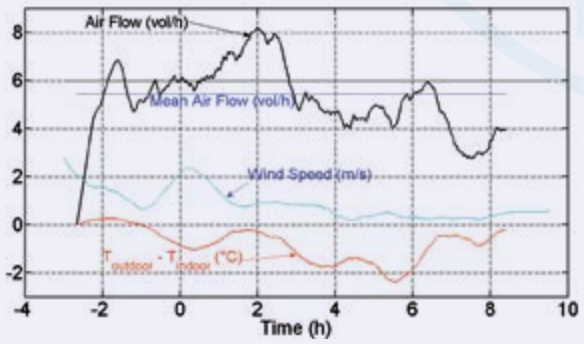
CROSS VENTILATION strategies


Experimental setup in Lyon Confluence



Measurements from the 18th of July at 9:20pm to the 19th of July at 8:45am. Time 0 is midnight.
During this night, until 4am, the relation between flow rate and wind speed is not obvious and one may suppose that the wind direction is not aligned with the opened windows. After 4am wind speed drops and the flow seems to be thermally driven with a mean value around 4 Vol/h between 4 and 8 am.

A PASSIVE TECHNIQUE FOR SUMMER COMFORT

To match summer thermal comfort criteria, passive solutions based on night cross-ventilation combined with thermal mass of walls are promising solutions. This case study presents thermal comfort strategies and it addresses the main open questions related to natural ventilation rate.

BACKGROUND

The buildings of the Confluence site were designed to match the summer comfort criterion defined by an indoor temperature greater than 28°C less than 40h/year by using night cross-ventilation. To test the ability of the technical solutions to match the summer comfort criterion by using night cross-ventilation, numerical simulations of the building were done with a mean value of the flow rates of 6 vol/h. meaning that the volume of air that flows through the apartment during one hour is 6 times the volume of the apartment.

Such mean flow rate value is an empirical value since no data were found in the scientific literature due to the difficulty to do such a measurement.

DESCRIPTION OF THE ACTIVITIES

To improve the reliability of night-cross ventilation as a passive cooling solution, accurate measurements of mean flow rate values are needed. Measuring such flow rates is a tricky problem as it involves small air velocities in large sections and in some cases the flow may be not unidirectional in the same section. **To overcome this problem, a new air direction sensor was built at INSA-Lyon.** Associated with a classical hot wire anemometer, the magnitude and direction of the velocity of air are measured. **By using several sensors, the air flow and its direction can be measured.**

During July 2010, this system was tested in an empty apartment in Lyon Confluence. To measure cross-ventilation, two selected windows were opened and the doors are opened or closed in such way that all the flow is forced to pass through one door opening. Several scenarios were tested. For example, all windows were closed during the day and two selected windows were opened in the evening until the morning. **In the same time, the main climatic data were recorded on the top of a building in Lyon Confluence.** Then data were post-processed to highlight the main correlation between the cross-ventilation flow rate and the numerous parameters of influence such as the configuration of the apartment and the climatic data.

RESULTS AND LESSONS LEARNT

For the technical solutions chosen for the building construction, the numerical simulations showed that a free cooling of 6 vol/h from 8:00 pm to 8:00 am allow to reach the thermal comfort criterion. This mean value is an empirical one and measurements first show that the air flow is a highly fluctuating quantity; therefore the mean value must be handled carefully.

The wind drives the cross-ventilation when the wind speed exceeds a threshold. In the configuration of the measurements, this threshold can be estimated at 0.5 m/s. For low values of wind speed, air flow in the apartment results from a competition between wind effects and natural convection (i.e thermally driven flows). In our measurements, one experiment exhibits a typical case with and without wind during the same night. It is clearly shown that the mean value of 6 Vol/h is exceeded when the wind speed is around 2 m/s but is no more reached when the wind speed drops. Therefore, even if most of the measurements show a mean air flow greater than 6 Vol/h, this is often due to a windy weather.

▸ Following the numerical simulation scenario, inhabitants are required to open at least two windows during nights even with a windy weather. A realistic scenario would take into account that the opening of the windows is restricted to little or no wind periods.

Concerning the indoor temperature, it must be kept in mind that the apartment was empty and therefore indoor temperature is not representative of real values. The evolution of the indoor temperature is driven by the wall temperature and by the air flow crossing the apartment. When all windows are closed during the day, **the rate of increase of indoor temperature is smaller if the thermal mass of the walls is large than if the walls have little inertia.**

The experiment clearly shows some wind-driven flows showing that the indoor temperature evolves rapidly to match the outdoor temperature. Unfortunately, there are not enough experiments with low wind to observe thermally driven air flow. **However it can be expected that air flow generated by the difference between indoor and outdoor temperature will lead to a smoother decrease of the wall temperature than in the case of wind-driven air flows.**

RECOMMENDATIONS

1. Night cross-ventilation associated with large thermal mass of walls is a promising passive solution to maintain thermal comfort in summer in double-oriented flat. Nevertheless, more researches are needed to assess this method and this work is the first attempt to supply experimental data.

2. During the design of new buildings or during refurbishment of old ones, two characteristics must be taken into account: the ventilation potential of the building and the acceptability of the solution by the inhabitants.

The potential of ventilation is directly related to the mean air flow through the apartment during the night. On one hand, the flow rate is driven by wind when its value exceeds a threshold (0.5 m/s in our case), so the efficiency of the night cross ventilation highly depends on the orientation of the openings with respect to the prevailing wind. On the other hand, during exceptional weather conditions like heat waves or in very dense districts the effect of wind is much restricted; cross-ventilation has to be efficient without the powerful driving force of wind.

When the wind speed is low, air flow is thermally driven and the measurements done in the RENAISSANCE project show that the mean value of 6 Vol/h may be not reached. To overcome this problem, it could be interesting to account for different scenarios relating the ventilation flow rate to the climatic condition in the numerical simulations of the buildings. For example, a basic scenario could take the classical ventilation flow rate of 6 Vol/h when the wind speed exceeds a given value (say 0.5 m/s) and a lower ventilation flow rate when wind speed drops. The different values of flow rates and wind speed thresholds are highly dependent on the specific configuration of the building. In our measurements, wind speed is lower than 0.5 m/s during 10% of the time during the nights of July 2010 in Lyon Confluence.

3. Fixing the value of the mean air flow to use in numerical situation is still an open question. For now, the value is a compromise between technical solutions and thermal comfort criteria. More research is needed to assess the respect of thermal comfort criteria especially in no-wind cases.

FURTHER INFORMATION ▸▸

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SIXTH FRAMEWORK PROGRAMME
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Training of trainers on AIRTIGHTNESS

AN ACTION TO PREPARE THE FUTURE

Reaching a low level of energy consumption implies a high insulation level and an efficient ventilation system. For this, an excellent airtightness is an essential element. Workers must therefore be trained to the techniques and products that allow reaching such a performance. This should be the case for teams working today but also for youth people learning the profession.

BACKGROUND

In July 2009, a first session had allowed to train around fifteen workers and foremen from various enterprises from construction sites of blocks A, B and C. This training session had been designed by ALE in collaboration with AREF, which is specialized in financing and conceiving trainings for construction workers. This collaboration allowed adjusting precisely the training to the constraints and expectations of builders: a session taking place entirely on-site, with a very concrete approach with a blower door test and work on a real façade, and mixing different professions.

- **It appeared that the logical step forward was to train trainers in training centers, which host each year several hundreds of future professionals, to exert a real leverage effect.**

DESCRIPTION OF THE ACTIVITIES

The 20 hour training for trainers was designed for trainers in training centers for profession in the building sector, to anticipate future thermal regulation. Led by practitioners specialized in energy performance, the objective was **to help trainers integrating airtightness in their own training session sequence.**

This action was made possible thanks to the partnership with the Training institute in building and public works (IFBTP Rhône-Alpes), National association for training Lyon-Sud (AFPA Lyon-Sud), and adult training centers, and the collaboration of the promoter of block B, Bouwfonds-Marignan.

The skills that have been transmitted through the training are the following:

- Understand why clients demand a good airtightness in buildings.
- Identify and understand methods to evaluate airtightness.
- Know the most frequent leakage areas in a building.
- Identify defaults that can lead to a bad airtightness.
- Use and know the most appropriate products and materials.
- Understand the importance of coordinating different professions on the construction site.
- Prepare to implement the main products necessary to a successful airtightness.
- Integrate the knowledge acquired through the training in its own training sessions.
- Identify educational ressources available and those that have to be realized.

RESULTS AND LESSONS LEARNT

This action is the first of its kind in the Rhône-Alpes Region. A survey of satisfaction was sent to trainees giving an overall satisfaction rate of 75%, which can be considered to be a success. Through the questionnaire, the trainees put forward :

- **The relevance of the educational tools.**
- **The skills of practitioners providing the training sessions.**
- **The positive aspect of the diversity of the group and constructive exchanges.**

All participants expressed the desire to integrate the knowledge acquired in their practices, either in initial training or in specific modules. One year after the training, several trainees have been successful in doing so. One teacher has even purchased a blower door in order to do the test with his students.

STRENGHTS

The correspondence to expectations and the satisfaction of participants is certainly linked to a good preparation of the training sessions which associated very early the employers of the trainers and permitted to identify 20 trainers from different professions (carpenter, wood builder, plasterer, drawer, …) in need of this training. Later exchanges had then led to the adjustment of the format and content. The training was divided in 3 sequences of 6 h spread over 2 weeks to favor an appropriation of the subject by trainees and a great flexibility in their work agenda.

Practitioners have realized the greater part of the training. This contributed to the credibility and efficiency of the training. Practitioners were the following :

- **Energy engineer,**
- **Engineer from a research centre,**
- **Architect specialized in low energy consumption buildings,**
- **Specialist in blower door test,**
- **Trainer in insulation techniques,**
- **Expert in training.**

WEAKNESSES

A consensus had emerged concerning the necessity of prepare the future of the profession and on the need for methods and educational resources. On this last point, the creation of shared resources had been considered but this action has not been achieved expect for the CD-ROM edited by ALE following the training.

The reason of aborting this action is that training centers are constantly competing with each other, which makes any action of cooperation or sharing of resources practically impossible.

RECOMMENDATIONS

1. **Very wide gaps exist between different professions and types of training centers. The training session design should anticipate including the possibility of individual training.**

2. **The completion of a guide on air-tightness trainings would be fruitful.**

3. **It should be kept in mind that the partnership with training centers is an essential factor of success and should be treated carefully.**

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SIXTH FRAMEWORK PROGRAMME
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FOLLOW-UP of the construction process and equipment installation

Lyon Confluence during construction works

IMPLEMENTATION OF HIGH PERFORMANCE BUILDINGS

Despite a perfect design, a building may not demonstrate the expected energy performance if the quality of implementation is not ensured throughout the construction process, requiring a high level of implication of engineering consultants specialized in energy. The case study presents recurrent implementation errors and suggests recommendations to avoid them in other projects.

BACKGROUND

Buildings constructed under the RENAISSANCE project were subject to a certain number of technical specifications conserving energy efficiency and renewable energy integration, amongst which :

- Heat transfer coefficient of the building : U-Value [W/m².K] < 0.7
- Renewable energy (RE) contribution to the coverage of heating and domestic hot water (DHW) demand : 80 %
- RE contribution to the coverage of electricity consumption in common parts in housing buildings : 50 %, and to cooling demand and other sources of electricity consumption : 30 %,
- Maximum final demand [kWh/m2.yr]
- For apartments : heating (60), DHW (25), domestic electricity (25), electricity in common parts (10)
- For offices : heating (40), DHW (5), cooling (10), all other electricity usages (35).

DESCRIPTION OF THE ACTIVITIES

Enertech, an energy consultant specialized in energy efficiency and expert in the RENAISSANCE team, led **numerous construction site visits between March 2009 and July 2011.** These visits were all the more necessary since energy engineering consultants associated with promoters for the design phase did not have the responsibility of following construction works. This type of contract, which is often used by promoters, used to be sufficient when thermal regulations were less stringent.

During the construction phase, Enertech sent **regular reports to promoters regarding the state of the works.** When finished buildings were delivered to promoters, Enertech **evaluated their quality through thermographies of the facades and airtightness tests.**

Following the delivery of apartments and offices to their owners, Enertech pursued its work through **post-delivery visits of buildings in order to verify that all previously stated recommendations had been actually taken into account.**

RESULTS AND LESSONS LEARNT

During its site visits, Enertech assessed that the quality of installations did not match the expected level, that certain works were left unfinished and that **in certain domains, such as airtightness and controlled ventilation, enterprises did not have sufficient skills to realize the works appropriately.**

It appeared that, even when energy engineering consultants had the responsibility of following the works, they had not been rigorous enough to prevent important implementation errors. **RENAISSANCE has therefore allowed establishing the current state of skills of building design professionals and construction enterprises.**

STRENGTHS

- **Site visits allowed identifying numerous problems** which would have been source of over consumption and equipment failures, and demanding that they be corrected by enterprises.

WEAKNESSES

- **Enertech did not have the official responsibility of monitoring the construction works in place of the project management team.** In consequence, sufficient funding should have been allocated to compensate for the weak monitoring of the works. Some problems persist today for different reasons, such as the impossibility to verify every single detail or to impose modifications, and the delay in identifying problems that become impossible to correct (since the cost of the modification is much too high in face of the expected energy savings).
- In addition, promoters did not take into account all the elements that were required by RENAISSANCE experts, in their contracts with enterprises. Thus, RENAISSANCE experts never definitively validated the special technical specifications.

RECURRENT IMPLEMENTATION FLAWS SPECIFIC TO LOW ENERGY CONSUMPTION BUILDINGS

SPECIALIZATION	ELEMENTS TO BE MONITORED CAREFULLY DURING CONSTRUCTION AND EQUIPEMENT WORKS
AIRTIGHTNESS	▸ Door and window thresholds ▸ Connection between window frames and frame walls ▸ Sleeves for power supply cables
EQUIPMENTS	▸ Water leakages ▸ Variable speed pumps often not adjusted and not properly sized ▸ Thermometers to mesure temperatures of incoming and outgoing water flows of solar thermal hot water storage tanks ▸ Labelling errors, incoherent and work information posted in equipment rooms ▸ Ventilation operation schedule in parking and offices
DHW DISTRIBUTION NETWORK	▸ Continuous insulation on all water pipes and equipment along the domestic hot water distribution network ▸ Temperature too high at the output of the boiler
INSULATION	▸ Installation (continuity, anticipation of the passage of sleeves for power supply cables, etc.)
DOMESTIC ELECTRICITY	▸ Energy saving light bulbs ▸ Power switch that can be activated to turn off all standby power of audiovisual equipment ▸ Occupancy sensors in parkings
THERMAL BRIDGES	▸ Thermal bridges for balcony

RECOMMENDATIONS

1. **The difficulty in reaching originally stated objectives originates from an unequal power relationship where promoters are ultimately owners of the land they have bought from the municipality and land developer have little levers beyond the validation of the construct permit. The land developer must have the legal tools to stop a project in case rules are not respected during the conception phase. However, the land developer often faces objections from the promoters on the basis of economical arguments.**

If the special technical specifications are to be negotiated with enterprises, the land developer's expert assistant must validate changes. Specifications in the consultation documents for the selection of promoters should not only include obligation of results but also obligation of means that are non negotiable.

2. **To ensure the continuity between conception and construction, the contract between energy engineering consultant and promoter should include design, works' monitoring, evaluation visit before delivery to owners and a one-year control of the building operator after delivery.**

3. **To ensure the quality of the works, enterprises should be selected according to a list of criteria beyond cost, which include experience in the techniques and equipment installation specific to the project. The contract between an enterprise and a promoter may also include the obligation to participate to on-site trainings. Enterprises must put in place a rigorous self-control approach for ensuring quality.**

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SIXTH FRAMEWORK PROGRAMME
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High efficiency COOLING & HEATING by ESCo

FOR A RESIDENTIAL BUILDING IN ZARAGOZA

A natural gas heat pump has been added to the existing heating installation of a 96 dwelling residential building, for supplying cooling to 20 of them, and also heating and Domestic Hot Water (DHW) for the entire building. Heat recovery from the gas engine allows the simultaneous production of hot water with a combined performance of about 180%.

BACKGROUND

This installation is the successful end to a long preparation that started in 2005 with the RENAISSANCE project. Many technical, economical and commercial analyses were carried out in Valdespartera on the thermal installations for CONCERTO buildings in order to improve energy efficiency.

Finally, in 2010, we found one building susceptible for incorporating technological improvements. It is **a 96 dwelling social housing building built in 2009 in Valdespartera eco-neighbourhood which, only one year after its construction, proved to have bad work in thermal installation and high gas consumption.**

DESCRIPTION OF THE ACTIVITIES

URBIC engineers visited the selected building and its heating installations, collecting data with heating and DHW meters, gas bills and inhabitants opinion. Seasonal efficiency (heating and DHW) was checked to be around 50%, which is extremely low for a modern gas boiler installation.

Going into a detailed data check and after several visits to the boiler room, **several serious maintenance errors were detected.** The most important one implied a wrong positioning of the bypass valves of the hot water storage tank, resulting in the thermal solar energy system in dissipating, during the night and cloudy days, the heat produced by the boilers. Moreover, the maintenance company had cancelled the automatic regulation system, stepping into manual mode.

In addition, many inhabitants complained about excessive heat in the summer inside their flats, so several individual refrigeration systems were installed. Nevertheless, the building project included the necessary pre-installation for centralized refrigeration through the distribution and fancoils network used for heating. Thus, **the installation of a centralized cooling system with heat pumps on the roof for chilled water proved to be feasible.**

After negotiating one contract of energy services with the 96 inhabitants, an agreement was reached for installing one natural gas heat pump with 84/81 kW (heating / refrigeration) thermal power, plus 25 kW of recoverable heat from the engine for DHW production. The total power (105 kW) allows to supply cooling for 20 flats (out of the 96) and the heating and DHW needs of the building, with a combined average efficiency of 185% compare to the inferior calorific value of natural gas. **The contract includes the maintenance tasks for the whole thermal installation (heating, cooling and DHW).**

RESULTS AND LESSONS LEARNT

On July 2011, the heat pump was brought into service in order to supply cooling for 15 flats (in a first phase), using engine waste heat for supplying DHW to the whole building, complementing the production of solar thermal panels.
After the first working summer, gas consumption for DHW production was reduced by 62% compared to the previous summer, due both to solar thermal installation improvements and to the heat pump engine energy recovery.
Cooling consumption reached an average value of 14.5 kWh/m^2 with an average efficiency of 72% (not including engine recovered energy), that is significantly lower than the theoretical nominal efficiency (134%) display by the manufacturer. The difference is mainly due to thermal losses in the pipes.

STRENGTHS

- By combining adequate maintenance and with an energy-efficient heat pump, **gas consumption for DHW production was drastically reduced, resulting in high satisfaction from inhabitants.**
- This work has laid the foundations for a second phase of extension in 2012 in order to increase the installed power and extend cooling services to 40 additional flats, avoiding individual electrical systems. The district electrical infrastructure is not designed to supply the peak power required for cooling needs during the summer, so this technology is particularly adequate in this case, in addition to allow a **great financial saving (around 60%) and CO_2 emission reductions (around 30%).**

WEAKNESSES

- Although the heat pump installed in 2011 is capable of serving refrigeration to a maximum of 20 flats, only 15 of them have signed the contract. **Due to the limited amount of clients, energy losses in the distribution system are relatively important, penalizing efficiency in the first summer.**
- URBIC is working on integrating all 20 flats into the first phase and planning to install a second identical heat pump in 2012, in order to provide cooling to a total amount of 40 flats (out of 96).
- URBIC has financed installations costs over a 5 year term, including a guarantee for the same period, so there is a high risk of incidental expenses (machines breakdown, clients insolvency, etc.) that might drastically reduce investment feasibility. Thus, CONCERTO program support was of vital importance in this initiative.

RECOMMENDATIONS

1. In Spain, cooling needs are increasing every year with a significant impact on energy dependency and CO_2 emissions. As most of residential buildings are designed with centralized heating systems, it is possible to adapt them in order to provide high efficiency centralized refrigeration, using natural gas and solar thermal panels based systems. Planning such installations in the design phase is always better than later adaptation, since alteration works, costs and nuisances are saved.

2. Absorption systems with solar energy are still not fully profitable, whilst gas engine heat pump has an intermediate cost which might be interesting in some applications. This is a quite simple technology that is not very widespread in Spain, mainly due to its greater investment costs comparing to conventional electrical systems.

3. Natural gas heat pumps are very appropriate in residential buildings since the heat recovery from the engine is used to produce DHW, increasing the overall efficiency of the system. In addition, heating mode efficiency is quite steady even with external temperatures of -20ºC, what is quite useful in continental climate zones such as Zaragoza, where temperatures are extreme both in the summer and in the winter.

4. Recently, Zaragoza City Council has voted for regulations that make it mandatory to analyze the feasibility of centralized cooling system for residential buildings over 2,000 m^2 useful surface.

5. Thanks to the RENAISSANCE project experience, it was possible to check strengths and weaknesses of centralized cooling systems on residential buildings.

6. Energy losses in the piping are significant impacting the overall efficiency of the system. Thus, a special attention has to be paid to the distribution network by increasing thermal insulation and improving regulation systems.

7. Last but not least, important efforts are required to convince users about the relative advantages of centralized solutions compared to individual ones. In this sense, "shared savings" or energy services contracts may be an important resource to promote this kind of innovations to residential buildings.

FURTHER INFORMATION

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SIXTH FRAMEWORK PROGRAMME
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RENAISSANCE

INTERPRETATION CENTRE of sustainable urbanism

SOCIAL AWARENESS VIA MONITORING AND TELECONTROLLED NET

Thanks to an optical fiber network that covers the whole area and a series of check points (tele-controlled net), the new Valdespartera neighborhood is able to measure daily generated consumptions and disseminate the results in a didactical way in the Center of Sustainable Urban Planning (CUS).

BACKGROUND

Usually, the concept of "Bioclimatic Architecture" has been defined around the concepts of architectural distribution and design. Nevertheless, **all monitoring campaigns have demonstrate that it is indispensable due make citizens aware of the importance and impact of their daily behavior on energy consumption.** In order to achieve this objective, we need to understand everyday practices and quantify them in a comprehensible way, so that citizens may consider themselves as important actors in the fight against climate change.

DESCRIPTION OF THE ACTIVITIES

With the support of the RENAISSANCE project, Ecocuidad Valdespartera de Zaragoza (EVZ) manages the **Telecontrol and Telemanagement** project for the urban services nets of Valdespartera district. **This tool allows its managers to easily compare, evaluate, disseminate and manage in an optimum way the consumption of the networked services** (water supply, irrigation, rain waters, drainage, lighting, etc.) of the district.

This net consists of several elements spread around the whole area, collecting data from the different services networkss (levels, flows, consumptions, water supply quality, rain water control and tanks level, wastes volume and classification, meteorological parameters, environment temperature and relative humidity, etc.), linked by means of an optical fiber network that centralizes them at the CUS, one demonstrative building co-financed by the RENAISSANCE Project.

Scientific entities, mainly represented by University of Zaragoza and its Energy and Construction Research Group (Grupo de Energía y Edificación), find at **CUS a participative space for dialogue and for interacting with local inhabitants and show the results of studies** carried out by means of the monitoring system installed in Valdespartera. **This space has**

DESCRIPTION OF THE ACTIVITIES (CONTINUED)

a permanent exposition link to urban planning in cities, building energy efficiency and current environmental innovative technologies.
Together with guided visits, CUS proposes a variety of recreational and didactical activities for locals (e.g. competitions, film projections, festive days, etc.). Word of mouth communication produced by these activities boosts the message and increases the number of people receiving it. The activities carried out by the CUS and the neighbourhood awareness programmes are reinforced by a survey program on consumption habits that is analyzed together with monitoring data.

RESULTS AND LESSONS LEARNT

The tele-controlled network is an important cost saving tool from an economic point of view, allowing incidence detection before they generate serious consequences, and initiating actions automatically. Infrastructures maintenance costs will be the heaviest economic charge for taxpayers and the introduction of control instruments in public networks and their extension to private consumptions will lead to public and private savings and consequently a greater sustainability. Both social and economic sustainability is guaranteed. **This net also implies environmental costs savings** since, for example, the system is automatically setup to interrupt irrigation in case of rain.

The individualization of the data related to building energy consumption provides a didactical point of view that reinforces the message of environmental co-responsibility, a message that is made explicitly to the CUS visitors.

The feedback process evaluation and dissemination that was carried out at CUS is optimized since the building is located inside the neighbourhood that is evaluated: **citizens can link the measured data to their own sensorial experience in the local neighbourhood.**

Thanks to monitoring activities, awareness raising campaigns and training sessions offer to the neighbours, some improper practices in homes have been reduced, such as the inadequate use of glazed balconies (passive solar collectors). At the same time, the impact of the results that are displayed at CUS proves the benefits of betting on high energy efficiency goods and materials and the economic benefits brought by citizens' environmental awareness.

The building has also become a training space. Apart from conferences on daily energy consumption (heating, refrigeration, ventilation, etc.), CUS has organized other conferences for different stakeholders in the construction sector (e.g. neighbour communities' administrators, developers, constructors, maintenance companies).

Since the CUS opening, neighbourhood awareness has gradually increased. Some surveys carried out amongst locals shows that most of them did not know how the main principles for optimum energy consumption in housing worked when they started living there. A total amount of **5,000 people have participated in the different activities promoted directly or indirectly by CUS,** but it is essential to keep a fluid communication channel with neighbours in order to pay attention to the everyday questions related to domestic use in a continuous and permanent way.

RECOMMENDATIONS

1. The replicability of this activity also demands a highly mechanization degree since tele-control and monitoring systems advance very quickly.

2. Creating high awareness in the neighbourhood is a must, since local participation often snowballs (a small crowd will generate more interest than an individual).

3. To achieve this awareness, a consolidated permanent working group is required to carry out the work assigned to University of Zaragoza and to give a boost to sociological and advising tasks, which are indispensable for the success of such actions.

4. Last but not least, the presence of social media significantly contributes to the mainstreaming of energy efficient behaviours.

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SIXTH FRAMEWORK PROGRAMME
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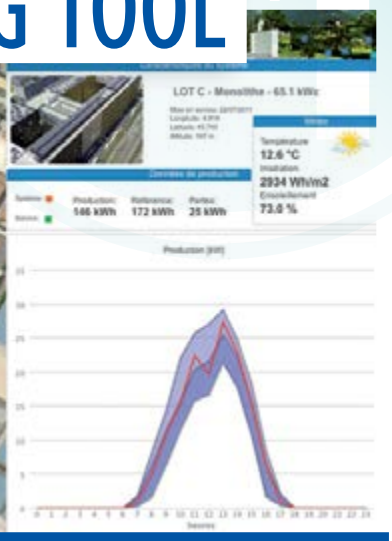
District-scale MONITORING TOOL for PV systems



LESSONS LEARNT FROM LYON CONFLUENCE PROJECT

In order to make sure that all photovoltaic (PV) systems installed within the RENAISSANCE project in the Confluence area will operate properly in the long term, a specific district scale PV monitoring tool has been designed on purpose. It detects automatically any kind of failures and is easy to use.

BACKGROUND

Although PV is a reliable technology with little maintenance needs, experience of large urban scale projects installed in Europe shows that **when large numbers of small photovoltaic (PV) systems are installed on buildings in urban areas and then left for ordinary building occupants to operate with no or little professional support, this can lead to loss of performance in the longer term.**

This is why, in order to make sure that all PV system installed in the Lyon Confluence area within the RENAISSANCE project will operate properly for years, it has been decided to design a urban scale PV monitoring tool.

DESCRIPTION OF THE ACTIVITIES

Within the RENAISSANCE project, several PV systems have been installed in the Lyon Confluence area by private developers. **In order to make the Local Community and the SPLA Lyon Confluence sure that all PV systems perform well and are in operation, it has been decided to explore the possibility to install a large scale monitoring tool for PV.** Although there are good products suited for single PV systems on the market, there is no product available for monitoring a large group of technically non-homogenous PV systems in an easy, time-effective and convenient way.

Therefore **a specific district scale PV monitoring tool has been designed in order to make possible the monitoring of all PV system of the area with the following features:**

- Compatible with all kind of inverters
- One single platform to monitor a large group of PV systems,
- Automatically detection any kind of failure,
- Generate an alarm to the PV owner in case of failure.

This tool has been first tested in 2009 on a 13 kWp existing PV system in order to test the level of complexity to install such a system, the reliability of data transfer by GSM and also the sensitiveness of the automatic failure detection algorithm. As, the conclusion of this experiment was quite premising, this tool has been further developed and installed on all PV systems installed within the RENAISSANCE project in Lyon.

RESULTS AND LESSONS LEARNT

PV systems of the RENAISSANCE project in Lyon are all monitored automatically everyday with daily performance available on one single Internet website. The challenge was to collect and consolidate all the data of the 11 PV systems for a total power of 250 kWp installed by 3 different installers and thus made from a variety of inverters.

Most PV systems perform well but, from time to time, a failure is automatically detected by the monitoring tool which generates an alarm to inform the company in charge of maintenance. Among the failures detected, one can mention a problem with one residual current switch that made one system trip or a defect inverter.
This monitoring tool has proven to be efficient to detect quickly a failure but it has been observed that the delay to fix the failure could be much longer since it also depends on the reactivity of the person or the company in charge of the defect PV system. The education of those stakeholders is also a success factor of the long term operation of urban scale PV systems and should not be neglected.

STRENGTHS

The strengths of this urban scale PV monitoring tool come from the fact that **it is a direct outcome of two international groups of experts that have analysed the success factors of the main urban scale PV projects :**

- PV UP-SCALE, a EU funded project under the Intelligent Energy for Europe programme related to the large-scale implementation of PV in European cities
- TASK 10, an international collaborative project on Urban-scale PV Applications of the International Energy Agency PV Power Systems Programme (IEA PVPS)

Such feedbacks made possible the design of a reliable and powerful tool which can detect automatically several kinds of PV system failures. This tool is also easy to use so that everyone with no technical knowledge can use it and understand whether or nor one system is operation well or not.

WEAKNESSES

If the decision to connect a PV system to the urban scale PV monitoring tool has not been taken before the design and the installation of the PV system, it may be complicated to make it compatible with this tool. This generally requires the installation of a logger and a communication device which is easy if done during the installation of the PV system but complicated if done afterwards.
The tools is detecting the failure rapidly, however it has been observed that, **in some cases, the person or the company in charge of maintenance is not willing to fix the failure rapidly,** perhaps because they were not correctly trained and or that the maintenance contract is not convenient.
The operating cost of this tool after the demonstration period, necessary to fulfil the long term objective, **may also be a weakness** except if all PV owners see the benefit to pay a fee, which should not be important compared to the annual revenues.

RECOMMENDATIONS

1. **A district scale PV monitoring is not a exciter, it is something compulsory for the success of the project to make sure, in the long term, that all PV systems will go-on with producing their expected energy output which is the actual goal of all urban scale PV projects.**

2. **A district scale PV monitoring should be planned at an earlier stage in order to avoid extra installation cost and unnecessary complicated work. The most efficient way to do it is to draw up the system specifications (type of data needed, communication protocol, …) and to ask the PV installer to supply and install the suited devices (datalogger and communication system).**

3. **Even if the operating cost a district scale PV monitoring tool can be minimized, to make it operate for many years will cost a little bit. It is important to detail such costs in the yearly operation costs that PV owners will have to pay and to make sure that PV owners will go-on with paying this annual fee so that the district scale PV monitoring can stay in operation in the long term.**

4. **There is a need to train the tenants or the company in charge of operation and maintenance of the PV systems to make sure that, once a failure is detected, the failure will be fixed without any unnecessary delay due to a lack of knowledge on PV.**

5. **If you are involved in a urban scale PV project with a large group of PV system to monitor, we would be happy to share with you our experience gained from this project. So feel free to contact us !**

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SIXTH FRAMEWORK PROGRAMME
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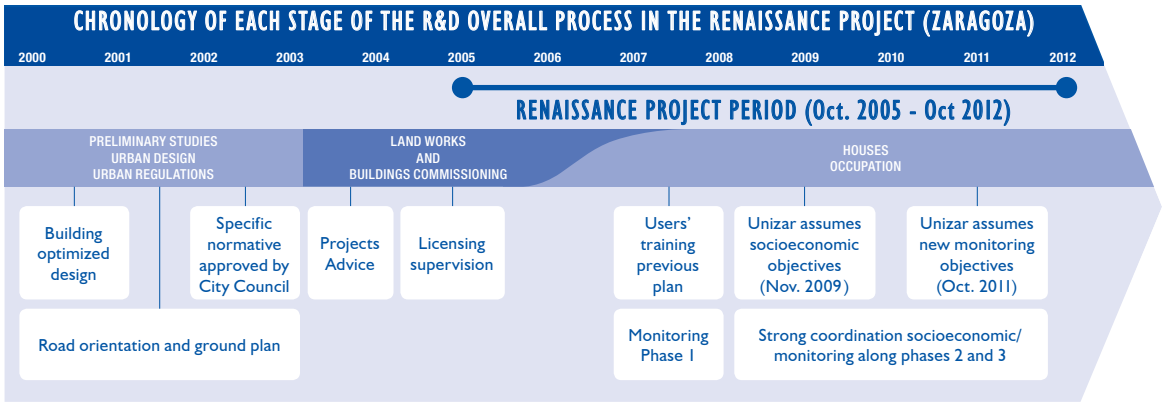
RESEARCH and DEVELOPMENT activities in Zaragoza community

A REVIEW OF MAIN R&D RESULTS IN ZARAGOZA RENAISSANCE PROJECT



Combination of socioeconomic tasks and the analysis of monitoring on almost 220 homes has led to operational conclusions on cases of excessive energy consumption as well as to prioritize new objectives for futur R&D activities (e.g. analysis of urban sustainability in URSUS, studies on heat island effect, etc.).

DESCRIPTION OF THE ACTIVITIES

Research and Development (R&D) activities in a new urban development that incorporates housing rehabilitation and new homes involves the complex interaction of various actors and factors. In the case of the RENAISSANCE project in Zaragoza, it has required **significant changes affecting both partners and responsibilities in the field of R&D.** The process, as far as concerns Valdespartera, begins **in 2000** with the **simulation phase of building** (ground plan and road orientation, shapes and sizes buildings, energy demand conditions) and continues with the supervision of buildings construction between 2004 and 2008.

The RENAISSANCE project starts in this construction period (2005) and with a set of actions in different buildings consisting of **various thermography and infiltration studies** in order to identify possible deviations of the evaluations studied from the rules defined in the Partial Plan derived from the first simulations.

Comfort data monitoring begins after the occupation of the first buildings. These initial steps confirm the good performance of the buildings according to the assumptions made. However, significant deviations were detected mainly connected with the improper use of the housings. **Socioeconomic activities** have therefore been adapted and strengthened so as to achieve a high degree of coordination with monitoring in order to influence inhabitants behavior.

This process has been developed in a wide range of buildings: schools, public buildings and refurbishment. The experience has led to develop a methodology linking information, monitoring and relevant feedback to correct habits and save energy.

Simultaneously **R&D activities have been extended to other related issues** keeping in mind necessity to foster the replication of the initiatives. Some of the issues addressed by R&D activities are:

- Web data base for users communications
- Efficiency analysis of auxiliary systems
- URSUS software to evaluate urban sustainability
- Heating island effects on energy consumption.

RESULTS AND LESSONS LEARNT

Valdespartera is an unprecedented living lab and deserves to continue the work begun with users to identify effective actions to extend into other spaces. The results of R&D activities are numerous. Among others :

- Identification and quantification of causes that increase energy consumption.and that are not attributable to users. **About 30 % of the excess is attributable to construction defaults :** thermal bridges, excessive air infiltration, inadequate design of auxiliary systems, insufficient use of solar hot water systems by improper maintenance.
- Identification and relative quantification of **users behaviours** that increase the thermal energy demand (between 10% and 300% increase)
- **Reduction in electricity consumption** around 20 % thanks to training and awarness raising campaigns (in the experimental group that uses intelligent meters)
- Validation of **bioclimatic design** for residential buildings combined with an appropriate urban plan which facilitates the solar gain on south-facing facade, shaded in summer, and use of cross ventilation.

IMPLICATION OF ZARAGOZA LOCAL STAKEHOLDERS IN THE MAIN R&D ACTIVITIES	UNIZAR /GEE	HOUSEHOLDS MONITORED	ENERGY BILLING COMPANIES (i.e. ISTA, ULLASTRES, ...)	URBIC	ENDESA	AYTO. ZARAGOZA, SMVZ AND EVZ
VALIDATION OF BIOCLIMATIC DESIGN	✓					
ENERGY CONSUMPTION DEVIATIONS: WHERE, WHY, HOW MUCH?	✓	✓	✓		✓	
USERS MOTIVATION ANALYSIS: DWELLINGS, SCHOOL AND CUS	✓	✓	✓	✓	✓	✓
WEB DATA BASE FOR USERS COMMUNICATIONS	✓					
EFFICIENCY ANALYSIS OF AUXILIARY SYSTEMS	✓			✓		
URSUS SOFTWARE ABOUT URBAN SUSTAINABILITY	✓					
HEATING ISLAND EFFECTS ON ENERGY CONSUMPTION	✓					

- Evaluation of the positive effect of thermal mass combined with night cross ventilation **to reduce the demand for mechanical cooling.**
- Identification of a set of indicators for **assessment and optimization of urban planning,** also apply to rehabilitation processes.
- Identification of urban settings that reduce or nullify the increase in energy consumption due to the **heat island effect.**

RECOMMENDATIONS

1. Monitoring should be coordinated with dissemination and user awareness activities. The use of web resources is essential for that but it is insufficient without other actions (posters, brochures, seminars).

2. Monitoring solutions supported by sensors and wireless systems can significantly reduce investment.

3. Although excessive energy consumption is mainly due to inadequate user habits (i.e. excessive temperatures in winter or unnecessarily low in summer), the effects of improper construction techniques, or insufficient maintenance of auxiliary systems including the solar hot water system, deserve specific actions of the administration.

4. Changing attitudes on the users is greatly complicated by their lack of involvement and interest. Only action that will multiply the opportunities for interaction combined with stimulus actions have real impacts.

5. Replication on public buildings and schools may be very efficient in order to change attitudes. This extension is particularly appropriate in the current situation.

6. In order to avoid simplistic considerations about the sustainability of urban actions based on little more than improved insulation of buildings is essential to use appropiate evaluation tools which also optimize designs.

7. Normative is rather insufficient without the support of serious control that is considered essential in view of the results. This is particularly necessary in the case of solar water heating system. Therefore, it is necessary to develop regulations that give a new character to the current certification and to incorporate phases of control over the maintenance of energy facilities.

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SIXTH FRAMEWORK PROGRAMME
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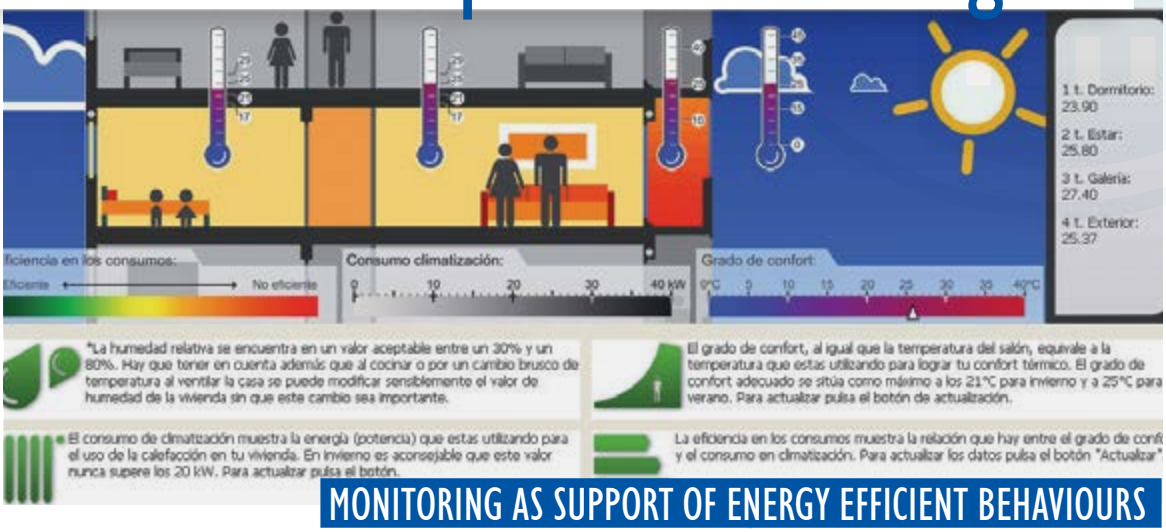
MONITORING experience in Zaragoza



MONITORING AS SUPPORT OF ENERGY EFFICIENT BEHAVIOURS

The innovative monitoring system tested in Zaragoza combines both socio-economic activities and remote wireless monitoring to improve social acceptance of the monitoring campaign and raise awareness on energy consumption in communities. The case study presents the work of monitoring as a result of coordination between the communication activities with users and various processes involving monitoring in Valdespartera, Picarral, the CUS and Candido Domingo school.

DESCRIPTION OF THE ACTIVITIES

Along the project development, **the University of Zaragoza (UNIZAR) group has been researching several alternatives for monitoring,** always seeking for the best practice to achieve the project objectives. Finally, an energy monitoring system was implemented and adapted according to users profile, characteristics and digital connectivity. In order to collect data and send it to the UNIZAR central server, these systems are able to concentrate all neighbours information in one building main point and to send this information individually using neighbour's internet connection. All this takes to **three different monitoring systems** in the project: wire monitoring, wireless centralized monitoring and wireless distributed monitoring. **All information is processed and real time analyzed, creating feedback with the neighbours,** who are informed instantaneously about their housing and consumption state, using real time graphs, tables and data. Users may check their historical data by means of a customized web site or using new technologies such as tablets or smartphones. **Results are used by the socio-economical group for developing training and awareness** tasks among users, what produces more feedback with new variables for monitoring system optimization. More than **220 dwellings are being monitored,** including electricity consumption, temperature in three rooms plus exterior temperature, comfort, humidity, heating consumption and solar radiation.

RESULTS AND LESSONS LEARNT

Housing and ground lots collected data analysis has allowed to characterize buildings, detect incidences, design problems and good and bad housings uses which would have been hard to obtain under normal circumstances. Just by implementing **real time variables tracking,** it could be **possible to make distinctions from specific user's behavior and thermal systems to general analysis and balances.** Energy monitoring results prove the necessity to maintain a constant tracking of building energy variables, including inner comfort, thermal systems and energy demands, so that building energy certification process is improved. Thus, continuous improvement in construction quality is stimulated by means of the presentation of actual data and troubleshooting to be used

RESULTS AND LESSONS LEARNT (CONTINUED)

in training or shown to professionals involved in construction processes (e.g. developers, constructors, technicians, etc.) **Monitoring allowed to verify the existence of good buildings thermal envelopes** with adequate tightness conditions and well installed thermal systems, **so that actual thermal behavior will depend on users.** Thus, **neighbours who are currently aware of their behavior consequences are achieving greater savings,** even greater than those estimated in initial simulations, proving that construction quality makes much of a social and economic impact on communities.

The development and improvement of energy and comfort monitoring has proved that these systems must be more and more flexible and adaptable depending on the user and his personal and socioeconomic characteristics. There is no ideal monitoring, but it needs to respond to socioeconomic group requirements. Thus, wire **monitoring system was defined for new housing** due to its robustness and high data collecting frequency, while **wireless systems were installed in old buildings** since they are non invasive.

Results must be clear, precise and useful and new technologies use allows reaching people in a better way, according to current technological changes.

We must put a special emphasis on the great interest arisen by monitoring obtained analysis and data among periodical publications, setting people (administrators, services companies, neighbours and university) discussing about these matters and attaching importance to project results and their replicability in other communities.

STRENGTHS

- Monitoring system strength lies on its capacity to be **robust, flexible and low invasive,** what allows obtaining immediate feedback for actions of information, dissemination and continuous training with users.
- The system allows carrying out **statistical and trending analysis,** characterizing the different construction aspects such as envelopes, inertia, inner comfort and thermal system work. Results classification in templates and tables is a main tool in order to understand constructions process in an integral way, joining technical and social aspects.
- The results and later analysis turn into a **main support for training, awareness and dissemination** activities, all of them carried out by socioeconomic group.

WEAKNESSES

- Under technical terms, one **monitoring system which uses electric and electronic components needs to be regularly maintained and checked.** If there is no one in charge of these tasks, monitoring might turn to be obsolete and lose its initial effectiveness.
- From a social point of view, monitoring may be used (among other uses) for detecting some problems in buildings, which may be vary from bad installations to housings bad use. These **results may be interpreted** not as quality improvement assistance but **as an obstacle** by companies which develop or construct urban plans.
- **Some people might feel watched and controlled,** even up to the point of leaving monitoring and bring other neighbours to this attitude.

RECOMMENDATIONS

1. **Monitoring systems must contain a previous study on technical and social conditions for the location in order to define the most adequate system according to monitoring time and buildings and inhabitant's characteristics. Chosen system must reach an optimum in terms of costs and flexibility, always keeping in mind one context combining data and user interactivity.**

2. **As far as possible, monitoring must be included in energy certification process, so that this process is not based only on theoretical building evaluation but on a continuous tracking valid for new buildings, refurbishment or public buildings. At public buildings, some information screens must be placed, fed with real time or historical data, in order to show to the community buildings behavior and allow comparisons among different rooms and developing performance indexes (KPI) that may be included in City Councils energy management planning.**

3. **Energy monitoring and socioeconomic work must not be independent, since they are related aspects and depend on each other. Monitoring depends exclusively on the cooperation and involvement of users on efficiency and saving measures, while work with users is reinforced by monitoring results in order to achieve proposed objectives.**

4. **All plans on energy saving and efficiency awareness must be accompanied by measuring and tracking systems of energy variables, in order to make reports to neighbours about improvements and actions to be carried out for economic and energy saving.**

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SIXTH FRAMEWORK PROGRAMME
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Comparison of MONITORING STRATEGIES for buildings energy efficiency

OBJECTIVES, STAKEHOLDERS AND TECHNIQUES

Monitoring techniques serve to assess the actual performance of the buildings. Monitoring activities are classified in terms of stakeholders involved, technologies and feedbacks to actors, based on experiences in Lyon and Zaragoza, in order to provide guidance on the choice of a particular solution.

BACKGROUND

The RENAISSANCE project included an important task on the monitoring of the global performances of the buildings such as energy consumption, comfort criteria and quality of renewable energy systems. As no standard exists for such large scale monitoring activity, a reflection on the methodologies was needed to highlight the strong/weak points of each of them depending on the initial objectives of the monitoring.

With different monitoring activities in Lyon and Zaragoza community, the RENAISSANCE project was a good frame to lead such an analysis.

DESCRIPTION OF THE ACTIVITIES

The main work was to define a standard way to carry through a monitoring activity. In RENAISSANCE, different kinds of monitoring activities were conducted. During the construction, a certain number of visits, airtightness tests and thermographies were conducted in Lyon and Zaragoza for a direct feedback to the builders. In occupied dwellings, the monitoring was based on autonomous sensors (dataloggers) with internal memory able to store data during 18 months. In Zaragoza, a wired network of temperature and humidity sensors connected to a host computer was implemented in new and refurbished buildings. This network was later completed with a wireless subnetwork of autonomous sensors, which allowed for the possibility to compare these two techniques.

First, the global objectives of a monitoring activity were identified as well as the involved stakeholders. Then each stage of the monitoring process was described, leading to a standard frame for monitoring activities. Because the technologies used the two communities were different (autonomous sensors Lyon and wired/wireless network in Zaragoza), comparison between them were possible.

Moreover, because eco-buildings address some new problems like summer comfort: an innovative technique was developed in Lyon to measure night cross-ventilation in an empty dwelling and Zaragoza used statistical analysis of temperature measurements to determine the effectiveness of night cross-ventilation in occupied dwellings.

RESULTS AND LESSONS LEARNT

A STANDARD FRAME FOR MONITORING ACTIVITIES

To conduct a monitoring activity, it is necessary to clearly identify the objectives that motivate the monitoring: to promote good practice; to improve the building quality; to check bioclimatic design; to checkout limits of current certification. These objectives will involve one or more stakeholders: inhabitants; builders; manufacturers; maintainers; promoters; politician decision-makers.

THE PREFERRED TECHNOLOGY TO IMPLEMENT FOR A MONITORING ACTIVITY DEPENDS ON SEVERAL PARAMETERS

The objective of the monitoring, the recipient of the feedback, and the acceptance of the stakeholders. After or during the monitoring, data are processed and presented in a convenient way together with the whole monitoring conditions (period, reliability of the samples, etc). Then a feedback of the results to the concerned stakeholders is necessary to fulfill the objectives of monitoring.

▸ The opposite table summarizes the advantages and drawbacks of each technology:

TECHNOLOGY	ADVANTAGES	DRAWBACKS
WIRED NETWORK	▸ Data are collected in real time. ▸ Real time feedback ▸ The Centralized Technical Management (CTM) system can be used to collect information on the operating conditions or on the maintenance needs of the systems (boilers, solar collectors ...).	▸ Must be planned before the building construction ▸ May be not accepted by inhabitants (May be seen as a surveillance)
WIRELESS NETWORK	▸ Data are collected in real time. ▸ Real time feedback ▸ Adaptable technology: ▸ Number or location of the sensors may be adapted depending on the acceptance by inhabitants ▸ Possibility to measure other quantities (pollutants...)	▸ Necessity of a system to transfer data: ▸ ADSL box for measurements in dwelling ▸ GSM connection for systems like PV production or centralized monitoring
DATALOGGERS	▸ Small size ▸ Well accepted by inhabitants ▸ Low cost	▸ No real time feedback ▸ Limited in time
SPECIFIC MEASUREMENTS	▸ Estimation of the main features of a dwelling during or after the construction (blower door test, thermography) ▸ Possibility to correct some defects in the construction	▸ Measurement is done once. ▸ Necessity for some measurements to be synchronized with the construction stages ▸ Acceptance of the builders

RECOMMENDATIONS

1. During RENAISSANCE project, an essential point was highlighted regarding the sensors implemented on the systems (pumps, boilers…) during the construction: these sensors have to be included in the specification document of the building.

2. Monitoring techniques have an interest if proper feedback is done on the activities of different stakeholders. Real time monitoring using autonomous sensors that send information to a web interface or to personal systems (smartphone, tablet) can help to guide inhabitants' energy saving behaviours.

3. A detailed implementation of sensors in dwellings and in the common parts of the building must be planned at an early stage. All changes done after the construction are difficult (or even impossible) to achieve and always very costly.

STAKE-HOLDERS	MONITORING OBJECTIVES	RECOMMENDED TECHNOLOGY
INHABITANTS	▸ Knowledge of their energy consumption ▸ Behaviour changes ▸ Promotion of good practices ▸ Involvement of inhabitants	▸ Wired or wireless networks ▸ Dataloggers when networks are not applicable
BUILDERS MANUFACTURERS OPERATORS	▸ Improvement of the quality of building (Feedback to builders) ▸ Information on the quality and the reliability of the systems (solar panels, mechanical ventilation, boilers...) (Feedback to manufacturers) ▸ Improvement of the maintenance of the systems » Feedback to building operators	▸ Specific measurements for builders ▸ Wired/wireless network including the use of the CTM for building operators and manufacturers
PROMOTERS	▸ Improvement of the bioclimatic characteristics of the building ▸ Quality of the investment	▸ Dataloggers
POLITICIAN DECISION-MAKERS	▸ Improvement of certification (certification of systems, normative of construction...) ▸ Energy savings evaluation ▸ Launch of information campaigns	▸ Wired or wireless networks

FURTHER INFORMATION »

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SIXTH FRAMEWORK PROGRAMME
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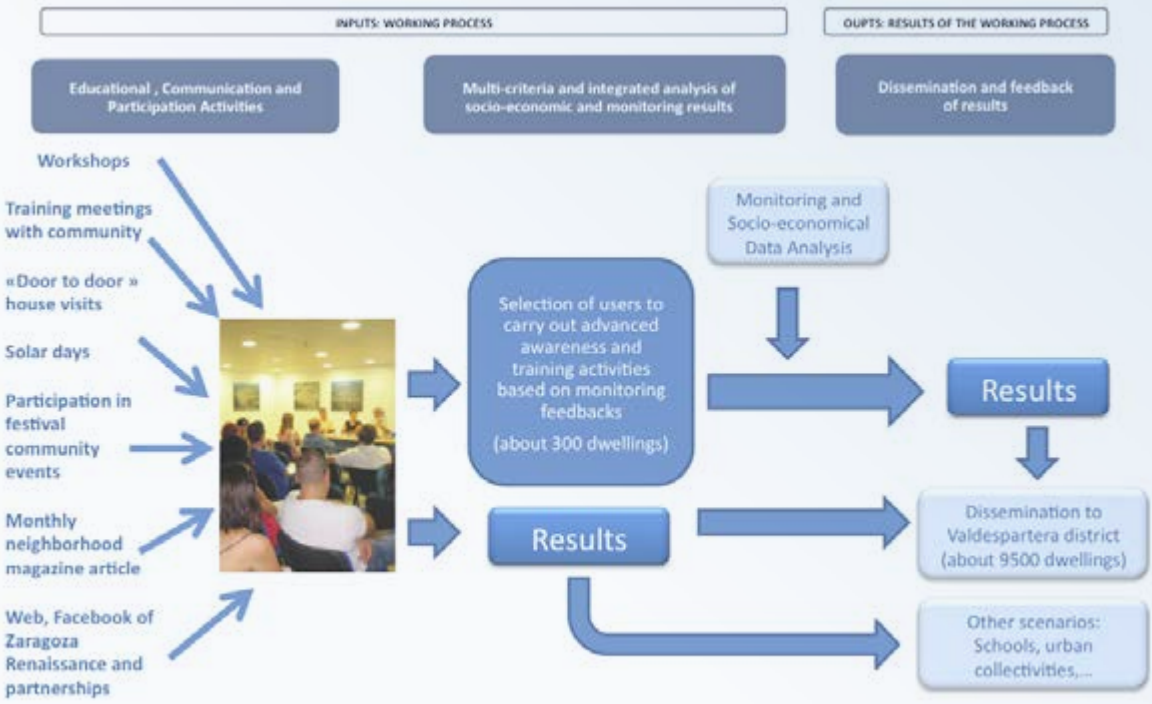
PARTICIPATORY PROCESS
for inhabitants awareness raising
A KEY FOR ENERGY SAVING

Participatory process with inhabitants have two goals: to complete the energy consumption research on dwellings with socio-economic data, and to train inhabitants in energy saving, efficiency and good practices in their homes.

DESCRIPTION OF THE ACTIVITIES

It is challenging to change the role of the inhabitants, from a passive one, as a plain information-receptor, to a proactive one, who is able to provide information and to change their habits. To do so it has been necessary to involve all the stakeholders of the neighbourhood in order to carry out the work on energy consumption awareness and dissemination energy efficiency and saving measures.

METHODOLOGICAL APPROACH OF SOCIO-ECONOMIC ACTIVITIES :



RESULTS AND LESSONS LEARNT

Efficient feedbacks with inhabitants have been established thank to the efforts dedicated on the fieldwork and study of the users behaviour. This is the key to promote best practices on energy saving. To be successful, fieldwork methodology has to integrate different activities like **socioeconomic data gathering, monitoring devices installation and trainings.** Also the communication plan was very important. This plan has integrated different strategies: door to door visits, open meetings on an specific topic of interest for the inhabitants, workshops and participation in activities in coordination with other neighbourhood stakeholders.

STRENGTHS

- **Coordinated work among socio-economic studies group and monitoring work group** allowed to carry out an exhaustive tracking, both in terms of housings appliances and interaction with inhabitants.
- **Carrying out activities as close as possible to people** allowed us to achieve good results for data collection and users training as well as high participation of neighbours (streets and children oriented activities were carried out at the same time).
- On the work group side, **collaboration with agents working for the same objectives** (CUS and City Council) was extremely useful due to efforts joining, synergies search and learning interchanges, leading to more creativity and effectiveness for designing the users work methodology.
- On the neighbourhood agents side, **working with a great amount of different groups** has been a key point for the project promotion and its acceptance in the community.
- Success in the preparation of the summer and winter good practices poster, where environmental, economical and comfort related benefits can be visualized.
- **The use of social networks and mass media articles** about the neighbourhood allowed to reach a greater amount and diversity of users.
- **Very important engagement when users receive an electricity instant energy consumption monitor to check out how energy is used in the housing.**

WEAKNESSES

- **Door-to-door work is very expensive** in terms of staff and time.
- Active work with neighbours demands tracking along time.
- Social fieldwork, as well as, selection criteria for the housings to be monitored should have been considered since the beginning of the project.
- **Difficulties to bring people into participation on several topics such as environmental problems or energy crisis.**
- Valdespartera as a dormitory district does not favor social life and the creation of a solid social network to carry out users collective activities.
- Technical problems (data collection system related and others) delayed neighbour oriented activities and generated much door-to-door work.
- **Working with a large group means sometimes low effectiveness.** In order to avoid it, setting deadlines and responsible people, as well as periodical meetings are considered a must.

RECOMMENDATIONS

1. To consider social field as a main element since the beginning of the project, to create, if possible, an specialized staff with neighbourhood agents in order to involve users in the monitoring and awareness process.

2. To give incentives to users for their efforts on good practices in bioclimatic housings by means of a collective process for energy good management, visualizing environmental, economical and comfort related benefits.

3. To seek for user motivations such as home comfort, healthy homes and money saving.

4. To provide clear and simple messages to users and ask them for a minimum compromise to provide data and to adopt the advices they receive.

5. To have professionals with social and communication skills in order to work with neighbors and ensure their commitment the monitoring process and bioclimatic buildings use.

6. To innovate in communication channels with users by means of information and communication technologies: web messages, smart phone applications, social networks, all together with personal communication.

7. To carry out coordinated work among all monitoring and social work groups in order to keep a right tracking of monitored users and get as many conclusions as possible.

FURTHER INFORMATION ▸▸

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SIXTH FRAMEWORK PROGRAMME
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Inhabitants TRAINING and AWARENESS raising

USING LOW ENERGY BUILDINGS

Low energy consumption buildings demand high quality design and construction. The use of the buildings is the last critical piece that may impact the actual final building energy consumption. Here are presented awareness raising actions such as tools created, trainings and visits organized for the residents.

BACKGROUND

An awareness raising campaign was designed to ensure that final energy consumptions would be in phase with initially stated objectives. This local action plan, build in 3 steps, aimed at:

- **1. "Buying my house":** knowing what motivates buyers and future inhabitants and their perception of the rational use of energy (RUE) and renewable energy systems (RES), through interviews of sales agents.
- **2. "Preparing my arrival":** raising awareness amongst future inhabitants on RUE, RES and high performance buildings.
- **3. "Living in my house":** surveying and assessing the appropriation of high performance building by future inhabitants and verifying actual energy consumption in apartments.

DESCRIPTION OF THE ACTIVITIES

Welcome and Orientation booklet: A booklet has been edited for users of the three blocks and more particularly inhabitants. Certain pages are dedicated to good practices concerning green behaviour. The topics developed are ventilation, heating, rational use of water, lighting, recycling, electricity.

Training sessions and visits: Trainings have been organized for inhabitants in order to inform them on their new dwelling and all subjects related to energy consumption treated in the booklet such as insulation techniques, heating systems, regulation of inside temperature. Sessions were organized by block in order to target the provided information to the audience. Trainings were complemented with a visit of a wood fuel boiler room to facilitate inhabitant's understanding of equipment operation.

Building factsheets: These documents describe the buildings in terms of energy efficiency and renewable energy (solar thermal and photovoltaic, wood fuel boilers) and have been distributed to the inhabitants during the training sessions.

Interactive monitoring: Some inhabitants have been involved in an interactive monitoring campaign to measure and identify energy consumption and thermal comfort of the dwellings. Data are collected and analyzed, and then inhabitants are informed via an Internet platform in close to real time on their electric consumption and inside temperature. Advices sent to them correspond therefore to their actual situation.

RESULTS AND LESSONS LEARNT

As statistical results:

- 1.000 booklets printed and distributed
- 4 sessions organized and 1 technical visit of a wood fuel boiler room
- 55 inhabitants attended the training sessions
- 27 inhabitants attended the visit

In addition, the city of Lyon, Grand Lyon and the land developer SPLA Lyon Confluence have worked on the organization of a forum on green practices for the inauguration of the neighbourhood CONCERTO. A blog has also been created on the thematic of energy for inhabitants of the three blocks.

STRENGTHS

- **Short sessions** (2h) organized in the evening or on week-ends
- **Sessions led by an independent partner,** the local energy agency, offering a space of free exchanges for inhabitants
- **Site factsheets** have been appreciated since they provide information targeted to specific buildings.
- Satisfactory participation of owner-occupants, which represent 50 % of inhabitants in CONCERTO district.

This awareness raising campaign has allowed :

- Inhabitants to better understand their building (energy efficiency) and the equipments using renewable energy sources (wood boilers, solar thermal and PV)
- Inhabitants to better grasp the necessity of a good regulation of temperature in their dwelling
- The integration of training sessions within the events organized by the city.

WEAKNESSES

- **Difficulty of involving social and private landlords** because they have a logic of investment and management. They are not occupying themselves the dwellings and have no culture of energy and energy savings.
- **Difficulty to involve tenants** in the private and public sectors because they do not plan to stay in the dwelling on the long term and do not have a sense of belonging. Since they are not owners, they are not involved in the decisions concerning the building life.
- **During the first year of occupation, inhabitants are not ready to receive advices on energy savings** and their priorities are rather on the logistics of moving in and holdings they have concerning the quality of the dwelling.
- The first year is also dedicated to the starting up and adjustment of heating systems. Thus, priorities are oriented towards identifying and solving problems due to defects of installation and other troubleshooting, rather than monitoring energy consumptions.

Difficulty of working with property managers since they are finance managers.

RECOMMENDATIONS

1. Work very early with promoters, be more present during the sales and accompany sales agents with training on energy performance so that they have the right arguments to present to a potential client.

2. Consider the creation of a club of inhabitants on the thematic of energy savings.

3. Work on energy savings with inhabitants one or two years after dwelling delivery, the first year being occupied by moving in and the second to equipment adjustment.

4. Identify a partner that can make the link between the construction, delivery and usage phases so that the arrival of inhabitants is anticipated as early as possible.

5. Promote the creation of an energy commission within the group of building representatives.

6. Accompany the group of building representatives in :

- **Choosing a property manager**
- **Setting up the building operation & maintenance contract**
- **Obtaining training and advices from specialized associations in co-ownership.**
- **Informing property managers on the possibility of accurately monitoring energy consumption**
- **Adopting a more general approach with inhabitants, that does not focus only on energy consumptions in dwellings but widen the perspective to their daily life in link with associations specialized in eco-consumption.**

7. Improve the communication with inhabitants by reaching to experts to better understand the concerns and needs of inhabitants and tailor the message to the audience.

FURTHER INFORMATION

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RENAISSANCE KEY DOCUMENTS :
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SIXTH FRAMEWORK PROGRAMME
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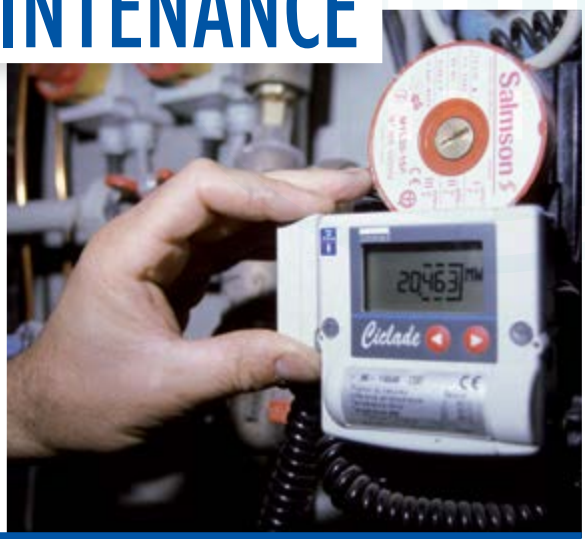
OPERATION and MAINTENANCE



HIGH ENERGY EFFICIENCY AND RENEWABLE ENERGY SYSTEMS

Operation and maintenance (O&M) of equipment is crucial to a building's final energy consumption. The case study lists recommendations to improve management of installations. Particular attention must be paid to maintenance contracts, as well as the training of O&M companies and energy engineers' support.

BACKGROUND

Blocks A, B and C buildings in RENAISSANCE are equipped with high energy efficiency installations such as heat pumps on extracted air for domestic hot water (DHW) production in summer, heating floors serving also to slightly cool inside air in summer using recovered energy for preheating DHW, and heat recovery ventilation, as well as installations using renewable energy such as wood fuel boiler and solar thermal and photovoltaics. On average, each block had to cover 80 percent of final energy demand for heating and DHW with renewable energy. O&M is a key step to ensure high performance ratios.

DESCRIPTION OF THE ACTIVITIES

Prior to the start-up of equipments, the energy expert **Enertech conducted a number of visits to evaluate the quality of finished works** (cf. case study n°10 "Construction follow-up"). Some of the defects observed were corrected only after dwelling delivery thereby affecting building energy performance in the initial year of O&M.

Prior to dwelling delivery, **ALE,** Grand Lyon's local energy agency, **had attempted to accompany building managers in the write-up of O&M contracts** to include specific clauses to guarantee energy efficiency objectives. Faced with building managers' lack of interest and time to collaborate, **ALE compiled a list of legal recommendations on O&M contracts** and a guide with technical advice specific to wood fuel boilers (refer to the "Installation of wood fuel boilers" case study, n°07).

In addition, HESPUL, photovoltaic expert, **installed and operated a tool for monitoring production and detecting defects for photovoltaic systems,** on the three blocks (see case study n°15 "District-scale monitoring tool for PV systems".)

RESULTS AND LESSONS LEARNT

During the monitoring of the construction process at the time of building delivery, Enertech noticed that equipment operation parameters and schedule were not properly adjusted. Operation and maintenance companies may not be entirely responsible for these errors.

Indeed, part of the problem comes from the **absence of essential information display in equipment rooms,** for example, list of operation setpoints, schematic diagrams, and values programmed in regulators. Another issue is the fact that **engineering consultant for promoters were not mandated to support O&M companies** during the first year of building operation. The transfer of knowledge from the equipment installation company and energy engineering consultant to the building operator was insufficient, knowing that O&M companies don't have much experience with the innovative technology that had been installed and with low energy buildings in general. These issues pertain to a common confusion concerning the responsibility of each party during the first year of operation and more precisely a difficulty to distinguish guarantee of completion owed by the construction company from ordinary maintenance born by the O&M companies.

Building managers do not have the technical skills to identify problems pertaining to operation and maintenance. Building managers have rather an expertise on legal issues. During the first year of building use, building managers and representatives elected by the general meeting of co-owners were overloaded with basic problems such as goof finishing of works, heating regulation, overheating in summer, water leaks, etc, that are not specific to low energy buildings. This may explain the lack of vigilance concerning solar thermal and photovoltaic failures and necessary filter changes in heat recovery ventilation equipment.

Analysis of monitoring results will allow drawing conclusions on the state of operation and maintenance in blocks A, B and C during the second year of dwelling occupation.

RECOMMENDATIONS

1. Promoters must include in their contract with engineering consultants that the latter proceed to the verifications of equipment operating settings done by the company installing the equipment, before delivery of the building. These requirements must be included in the specifications of the contract between the land developer and the promoter.

2. The engineering consultant first (in the consultation documents of construction enterprises) and then the construction or equipment installation company must establish a list of precise technical specifications for the O&M company.

3. The engineering consultant, according to its duty of project manager, must verify and supplement if needed, the list of maintenance tasks with their frequency as suggested by the equipment installation enterprise.

4. The first year of building occupation, it can suggested that the O&M enterprise be the construction company that has completed the works so as to have only one actor to exchange with thereby eliminating the confusion between guarantee of completion and ordinary maintenance, and facilitate the dialogue with the property manager.

5. Engineering consultant can have a complementary duty after the delivery of buildings, which would consist in verifying proper equipment operation and make the construction company proceed to all setting adjustments that are necessary. The engineering consultant would also be in position to verify the quality of maintenance tasks and the relevance of the task frequency put in place.

6. Property managers should be supported by a local energy agency, the promoter or the engineering consultant for the write-up of contracts with the O&M company. Co-owners representatives may also gain from receiving training on low energy building characteristics.

7. Trainings should be required for O&M companies. Low energy consumption buildings demand that maintenance of equipment be made with a logic of energy performance that goes well beyond what is done currently, especially knowing that failures or defects of certain equipments are difficult to detect by users (e.g. solar photovoltaic inverter disconnection from the grid, obstructed filter in an air treatment centre, etc).

FURTHER INFORMATION

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RENAISSANCE KEY DOCUMENTS :
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