EBC
Energy in Buildings and Communities Programme

Coronación district, Vitoria-Gasteiz (Spain)

Country: **Spain**

Name of city/municipality: **Vitoria-Gasteiz**

Title of case study: SmartEnCity Vitoria-Gasteiz

Year and duration of the renovation: 2016-2021

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Link(s) to further project related information/publications, etc.:
https://smartencity.eu/about/lighthouse-cities/vitoria-gasteiz-spain/
https://www.vitoria-gasteiz.org/wb021/was/contenidoAction.do?lang=en&locale=en&idioma=en&uid=u429d47a_151cd43bd4d__7f10

Schematic figure or aerial overview

Figure 1. Aerial view of Coronación district, Vitoria-Gasteiz (Spain).

Figure 2. Detailed aerial view of the buildings that are part of the intervention.

Figure 3. Apartment block before (left) and after renovation (right).

Figure 4. Apartment blocks after renovation.

Introduction and description of the situation before the renovation

Vitoria-Gasteiz is the capital of the Basque Country in the north of Spain, and with 240,000 inhabitants a Europe-leading municipality investing in green economy (Green Capital 2012).

Coronación district is located in the north-west edge of the old town of Vitoria-Gasteiz. The district was built to accommodate mainly migrants from rural areas of other parts of Spain that were moving to the city during 1950s and 1960s to work in the industry. Coronación can be considered as the first neighbourhood of the first city ring built before 1980. The majority of the buildings were constructed during 1960s and 1970s (85% of dwellings were built before 1970), presenting minor urban changes after that period.

After a thorough field study analysis developed by project partners concerning the intervention area, some relevant numbers and conclusions were extracted:

- In terms of building accessibility, 68% of the buildings have an elevator (vertical accessibility), and 49% of buildings have an accessible entrance (horizontal accessibility). However, just 40% of buildings are completely accessible (both horizontally and vertically). Thus, there is a large number of buildings where an intervention in the building entrance and/or the elevator may imply a significant accessibility improvement. Five buildings with accessibility problems accommodate more than 50% of elderly residents.
- Regarding building typologies and energy efficiency aspects, 51% of the buildings have individual heating, their facades are double-layer without insulation and between 50% and 70% of their windows have been replaced. Hence focusing on the energy efficiency, a wide range of buildings present potential retrofitting improvements, especially in the envelope due to their non-insulated facades.
- Concerning structural security, most of the buildings are in good condition, only 2 buildings are in critical situation and 20 buildings can be slightly improved in structural terms.

As a result of this analysis, a proposal of building intervention priority has been developed in order to point out which buildings need a more urgent intervention, considering the building situation and the opportunity that entails each of them (Figure 4).

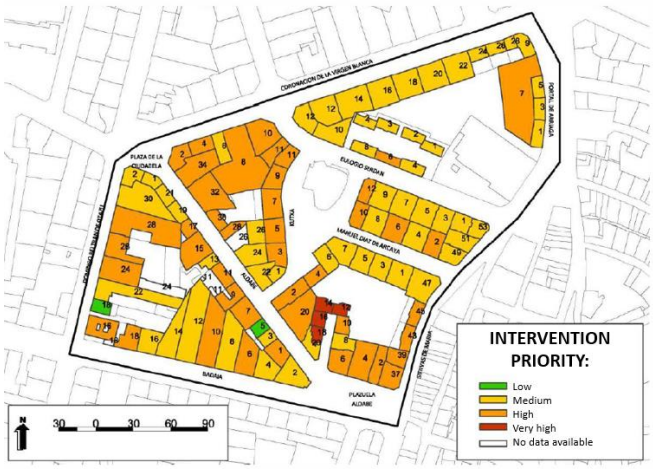


Figure 5. District plan of priority intervention per building (red: very high; orange: high; yellow: medium; green: low; white: no data available).

Description of the renovation goal

The city of Vitoria-Gasteiz has a clear strategy to become greener promoting energy efficiency, renewable energy, low carbon mobility and smart infrastructures.

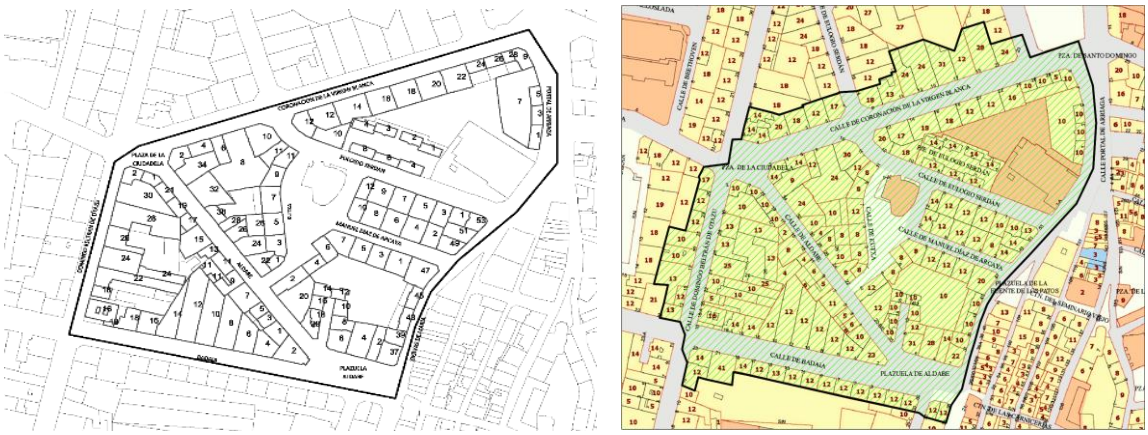
Coronación district renovation is part of SmartEnCity, a project funded under the European Union's Horizon 2020 in which Vitoria-Gasteiz is one of the three lighthouse demonstrator cities. Within the project SmartEnCity, Vitoria-Gasteiz seeks to:

- Demonstrate efficient building retrofitting: 655 equivalent dwellings in Coronación district are being retrofitted (envelope), and their energy systems replaced with a connection to the district heating.
- Integrate new infrastructures: a new biomass (wood chips) district heating network will be deployed, and an integrated energy management system will optimise efficiency at dwelling, building and district level. Before the renovation, each dwelling/building had individual heating systems.
- Promote sustainable mobility: acquisition of electric vehicles (EVs: taxis and private cars) will be granted, and the charging network will be extended.
- ICTs: an Urban Management System (UMS) will be developed and deployed.

The building renovation intervention consists mainly of envelope retrofitting, which involves the intervention in the facade and cover, improving insulation and air tightness and installing new low energy windows and doors, if needed. Coronación neighbourhood was chosen in Vitoria- Gasteiz for this intervention as it was identified as the city's most vulnerable neighbourhood in terms of social aspects, stability, habitability, accessibility and energy efficiency.

This district presents major challenges in terms of retrofitting and implementation of smart city concepts: very high density, low-medium income families and relevant social dimension.

Following the diagnosis of the residential buildings in the demo area (1,913 dwellings), six main typologies of buildings (from the energy point of view) have been identified. The refurbishment of up to 750 dwelling could be co-financed by the SmartEnCity project. Finally, the number of to be refurbished buildings reaches 655 equivalent dwellings (equating the tertiary buildings to housing buildings).



108 eligible buildings (1,305 dwellings) 147 eligible buildings (1,913 dwellings)

Figure 6. Initial intervention area (left) and extended final intervention area (right).

Description of the renovation concept

The renovation measures include:

- Envelope: ETICS or ventilated facade (Upon tenants' decision) + double-glazing windows (if necessary) + roof insulation.
- supply system: district heating network powered with biomass (wood chips)
- Renewable energy system: biomass for Heating and DHW.
- Building energy management system (BEMS): consumption data and energy saving recommendations will be provided to the neighbours through a digital platform and a smartphone app.
- Optional improvement of accessibility: assistance in the step of removing any accessibility barrier.

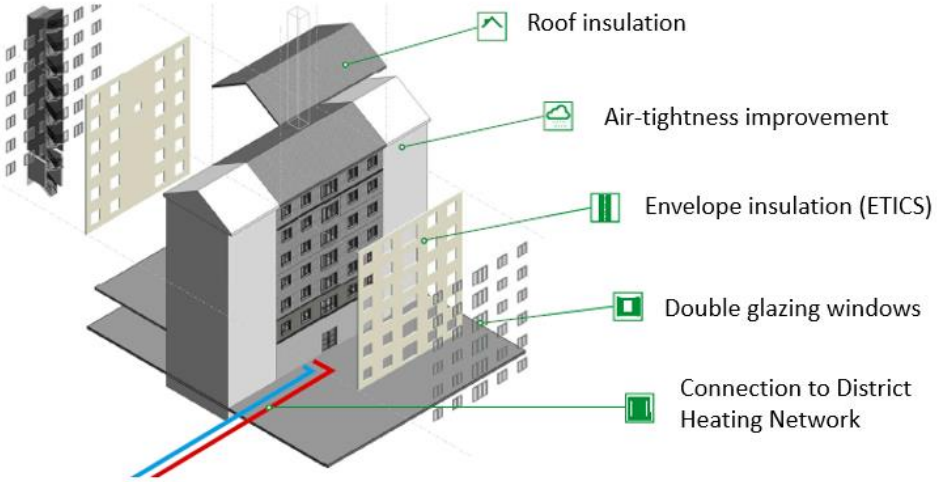


Figure 7. Diagram of the renovation measures undertaken.

Table 1 summarizes the thermal transmittance values of the different components of the envelope before and after renovation.

Table 1. U-Values of the building envelope before and after the renovation.

U-value summary	Before renovation U-values (estimated)	After renovation U-values (calculated)
Facades	1.69 (air cavity)	0.21 (ETICs or Ventil. facade)
Roofs	2.56 (non-ins. pitched or flat roofs)	0.21 (ETICs)
Ground floor slab	1.89 (non-insulated slab)	0.40 (ETICs)
Windows	Variable from 2.40 to 4.00	1.60 (replaced or added windows)

Project Fact Box (I)

General information

Parameter	unit	before renovation	after renovation
Urban scale of area:	m²	89,100	(the same)
Population in the area:	-	1,870	(the same)
Number of buildings in the area	-	152 in total 3 MFH 144 AB 5 tertiary Buildings	152 in total 3 MFH (3 renov.) 144 AB (24 renov.) 5 tertiary Bd (DH)
Heated floor area of all buildings	m²	49,187	(the same)
Building mix in the area:			
Single family homes (SFH)	% of heated floor area of all buildings	-	-
Multi-family homes (MFH) - up to three stories and/or 8 flats		3.5%	(the same)
Apartment blocks (AB) - more than 8 flats		65.4% (1'913 dwellings)	(the same)
Schools		-	-
Office buildings		12.6% (church, offices)	(the same)
Production hall, industrial building		-	-
other (please specify)		18.5% (gym, civic center)	(the same)
Consumer mix in the area:			
Small consumers: SFH + MFH – < 80 MWh/a	in % of annual heat demand	2.4%	1.0%
Medium consumers: AB, schools, etc. – 80-800 MWh/a		55.8%	34.0%
Large consumers: industrial consumers, hospitals, etc. > 800 MWh/a		44.2%	65.0%
Property situation of buildings:			
private	% of heated floor area	84.1%	(the same)
public		15.9%	(the same)
Property situation of energy supply system (district heating):			
private	% of heated floor area	80.9% (private systems)	41.9%
public		19.1%	58.1%

Project Fact Box (II)

Specific information on energy demand and supply:

Parameter	unit	before renovation	after renovation
heating demand (calculated)	kWh/m²a	151.0	70.0
domestic hot water demand (calculated)	kWh/m²a	unknown	unknown
cooling demand (calculated)	kWh/m²a	0 in dwellings, variable in other uses	(the same)
electricity demand (statistical)	kWh/dwell·a	3,487	(the same)
heating consumption (measured)	kWh/m²a	unknown	unknown
domestic hot water consumption (calculated)	kWh/m²a	unknown	unknown
cooling consumption (measured)	kWh/m²a	unknown	unknown
electricity consumption (measured)	kWh/m²a	unknown	unknown
(Thermal) energy supply technologies:			
decentralized oil or gas boilers	% of heated floor area	69.8%	28.1%
decentralized biomass boilers		14.9%	0.0%
decentralized heat pumps		3.7%	3.9%
decentralized portable heaters		5.8%	4.9%
building central gasoil boilers		5.8%	5.0%
centralized (district heating)		0.0%	58.1%
renewable energy generation on-site:			
solar thermal collector area	m²	0	0
photovoltaics	kWp	0	0
other (biomass)	kW	0	to be defined 90% biomass (10% gas)

Financial issues:

Parameter	unit	before renovation	after renovation
total investment costs of the renovation	Euro/dwelling	-	21,000
- building envelope renovation costs	Euro/dwelling		15,750 (75% of total cost)
- heating/cooling supply costs	Euro/dwelling	unknown	5,250 (25% of total cost)
- renewable energy production costs	Euro/m^2	-	under design
LCC available	yes/no	no	no

Description of the technical highlight(s) and innovative approach(es)

Innovative business model to foster the renovation of buildings.

Innovative role of the public company VISESA (VIS) as delegate promoter of the retrofitting actions, on behalf of the Communities of homeowners.

Through agreements signed between both parties, VIS manages, contracts, supervises and finances the correct design and execution of the refurbishment works, delivering the final product “turnkey” to its owners and charging them the total cost minus subsidies received.

VIS also manages the different administrative tasks to receive the subsidies (application, justification, etc.) as "one stop shop agency“, relieving the neighbours of these cumbersome tasks.

The project also involved:

- Assistance with the barrier-free improvements such as elevator installation or removal of other accessibility barriers, and any other work needed derived from the technical building inspection (compulsory for buildings older than 50 years). Even though these works were not included in the energy retrofitting, the direct help with them became a positive outcome.
- a citizen engagement toolkit, which includes multiple events and activities (See Table 2)
- The design of district heating in a consolidated urban area where there was no such an infrastructure before.
- Large scale monitoring of indoor conditions (T^a, RH%, CO_2) and energy consumption (electricity and heat) in around 200 dwellings out of the renovated 320 dwellings.
- A protocol to identify and prevent moisture related pathologies in renovated buildings.
- The use of ICT and BIM to engage citizens through energy efficiency awareness and improvement campaigns, etc.
- Medium scale retrofitting solutions for a heterogeneous neighbourhood (buildings from 5 to 62 apartments).
- Compressive management of local and regional grants compatible with European grants.
- Adaptation of taxes regulation for European grants, taxes exemption for energy-efficiency based retrofitting.
- Adaptation of urban planning regulation to impulse energy-efficiency based retrofitting.
- Impulse quality energy-efficiency based retrofitting to get A or B energy performance certificate.

Table 2. Number of citizen engagement actions and neighbors reached by different means.

Radio campaigns	2	Meetings with Owner’s Communities	> 320
Informative events	10	Telephone calls to owners	> 400
Mailing campaigns	4	“Door to door” campaign visits	650
Informative videos	2	District Information Office visits	1600
Informative tours to similar projects	2	Meetings with Owner’s Communities	> 320

Supplementary information: https://www.youtube.com/watch?v=vLI09ytbfU0

Decision and design process

General/organizational issues:
SmartEnCity started as a top-to-bottom project, where some public institutions at local and regional level thought that it would be positive that certain impoverished districts of the city went through a process of renovation of both buildings and services with the aim of improving citizens life conditions and reduce CO_2 emissions produced the city. After this decision was taken and an analysis of necessities of city districts was performed, Coronación was selected as a suitable neighbourhood and the project consortium applied to an EU call for obtaining some public funds in order to carry out the drafted project.

Stakeholders involved

- Policy actors:
    - Vitoria-Gasteiz municipality
    - Basque Government, through its Housing Department
- Users/investors:
    - VISESA, Basque Housing development Organization
    - Individual owners of dwellings
    - EVE, Basque Energy Agency
    - Shop owners and commercial companies located in ground floors
    - Building administration companies
- District-related actors
    - Errota Zaharra Neighbourhood association
- Energy Network Solution Suppliers:
    - GIROA VEOLIA
    - LKS KREAN (ESCO and engineering company), design of DH network and boiler room adaptation
    - ACCIONA
    - Public tender for construction of the DH and boiler room adaptation
- Renovation Solution Suppliers:
    - Basque Government Housing Department
    - Vitoria-Gasteiz municipality, Urban Department
    - Architecture & design studios:
        - ESPARZA Arquitectura y Rehabilitacion Sostenible, Sueslan Aquitectos, Arquiplan Arkitektura, MUP ARQ Servicios Integrales de Arquitectura, Grupo VMA, AKTUA Rehabilitación Integral, AA Estudio, Abitura Arquitectos, RDL Arquitectura, Luis Lopez de Armentia, MMMST, O+A Arquitectos, RF Arquitectura, VG4.
    - Renovation companies:
        - Kursaal Rehabilitacion SL, KAMY Vertical, Basabide, Indenor Proviser, Teusa.
- Other intermediaries:
    - TECNALIA technology partner, consultant
    - Mondragon corporation, technology partner, consultant
    - H-Enea, communication cooperative and citizen engagement
    - ATARI consultants (Door to door campaign)

Main steps

Three main steps were performed:

1. Preliminary renovation projects definition
   Based on the identified building typologies, six basic renovation projects were proposed

2. Offer adaptation
   Detailed projects according to local conditions, available grants and cost affordability.
   Meetings with involved agents to listen and implement their needs.

3. Project placement / marketing strategy

Resources available before the project

There used to be very few resources before this project. Only a brochure with general information about building renovation and occasional meetings about future urban improvements in the neighbourhood association.

Drivers and barriers (opponents)

The main drivers were:

- Building managers. They were a key agent to carry on or reject the renovation (their involvement was very heterogeneous, with some considerable issues that actually stopped the renovation in some cases).

The main barriers were:

- Spanish national and local regulations. The mandatory steps in order to approve every building renovation was delaying greatly the project, from 3 to 10 months. This was an important risk for the project success and thanks to this project; the local regulation simplified all the required verifications and reduced this delay.

Stakeholders' role and motivation

Main stakeholder	**Specify which organization(s) was (were) involved**	**Role (decision maker, influencer, technical advisor, delivery)**	**Driver/motivation**
Policy actors (municipality department, government body, innovation agency, etc.)	Vitoria-Gasteiz Municipality Basque Government	Decision makers and influencers	Improving citizens life
Users/investors (individual owner, housing association, building managers, asset manager, project developer)	VISESA Individual owners of flats EVE Shop owners Building admin.	Decision makers Influencer	Improving their comfort conditions and energy consumption
District-related actors (Community/occupants organizations, etc.)	Errota Zaharra neighbour association	Influencers	Improving district conditions
Energy network solution suppliers (Distributor system operator, energy supply company, energy agency, ESCO, renewable energy companies)	GIROA VEOLIA LKS KREAN ACCIONA Public tender DH construction	Project partners and decision makers Delivery	Providing a profitable and quality district heating service to the district inhabitants
Renovation solution suppliers (Planning and construction parties, urban planners, architects, design team general contractors, products suppliers, ESCO, contractor, energy monitoring, facility manager, installation provider, one-stop-shop, etc.)	Basque Gov. Housing Dpt. Municipality urban Dpt. Architectural firms (from a previously selected list) Construction companies awarded in the public tenders	Decision makers and influencers Technical advisors	Carrying out a profitable and good quality retrofitting work on the selected buildings
Other intermediaries (public bodies, trade organizations, NGO's, consultancies, research institutes)	TECNALIA Mondragon corporation H-enea ATARI consult.	Decision maker and influencer Technical advisors Technical advisors Social advisors	Providing methodology, partner coordination and communication with stakeholders

Design approach:

The design target was based on CO_2 emissions reduction in order to reach an energy performance certificate (EPC) grade A in each community (building).

Once the compulsory basic solution was granted communities could decide to go further with the renovation works or even choose a more expensive constructive solution.

The main challenges in the design phase was that each community was different so they required particular attention. At the beginning, some designers were not fully prepared to fulfil all the design challenges required. Additionally, there was a lack of district heating systems knowledge.

Technical issues:

The major technical challenges/constraints regarding system design/implementation have been:

- In relation to the renovation: the main challenge has been to design and implement ETICS systems and other technical solutions within a constrained budget. Project's target is very sensitive to unexpected expenses due to its financial/economical weak position (high percentage of low incomes households among the district inhabitants).
- In relation to the district heating network:
    - Piping works need a special trench wide and expansion joints that needed to be planned in detail because its important impact on the streets, that additionally tend to be narrow and full of other underground suppliers services (gas, electricity, internet, water, etc.).
    - District heating boiler room facilities needed to be designed in a way that they could storage enough fuel (wood chips) to avoid excessive truck transit within the district, located in the city centre.
- Coordination between all the stakeholders in such a complex project.

Financing issues:

The project was partly financed (up to a 54%) by different public institutions:

- 23% by European Commission
- 25% by Regional Government
- 6% by City Council

Additionally, this financing could eventually rise up to the 80% of the costs due to regular local and regional funds for energy retrofitting interventions not linked to the European Project.

Apart from this, it was constituted, in agreement with the regional government, a guarantee fund in the form of soft loans for those persons that could eventually need an additional amount to afford the cost of the project. It could cover up to the 100% of the cost, taxes included.

In some cases, the combination of the abovementioned strategies could eventually lead to a 100% financing of the cost of the project to certain people, depending their situation.

Management issues:

The main challenges and constrains regarding project management have been:

- Local consortium was a multidisciplinary team with stakeholders with very different points of view. This always entails managing challenges.
- VISESA (local leader) acted as “delegated developer” on behalf of the Communities of homeowners. Through agreements signed between both parties, VIS manages, contracts, supervises and finances the correct design and execution of the rehabilitation works, delivering the final product “turnkey” to its owners and charging them the cost difference less subsidies. VIS also manages the different subsidies administrative tasks (application, justification, etc.) as "one stop shop agency“, discharging the neighbours of these cumbersome tasks. This novel role increases management complexity.

Policy framework conditions:

The police instruments that moved the district into action were a combination of the following ones:

- Carrot-policies:
    - Real Estate Tax: City Council reduces this tax to 50% to those dwellings with an A grade on the energy performance certificate. Dwellings that are retrofitted and connected to the district heating automatically reach an A so they directly get this benefit.
    - Provincial Government, in charge of revenue, approved a new regulation on taxes that made SmartEnCity’s funds exempt from paying taxes.
    - City council changed the urban planning directives to allow the deployment of a district heating network within the boundaries of the demo district Coronación. Later on, this directive was extended to the whole city, making easier and more attractive this kind of technical solutions for both users and suppliers.
- Herd management policies:
    - The aforementioned “delegated developer” role of VISESA.
- Preaching policy:
    - One-stop shop agency
    - Local consultancy pop-ups
    - Information events and meetings

Lessons learned/interesting findings

The major success factor has been changing the idea from a product to a holistic retrofitting service, developed by a Housing Public Society, which was not specialized in urban-building retrofitting.

The major bottlenecks are related to the:

- Lack of previous information.
- Regulation that is not currently adapted.
- Compulsory majority agreement in each community (per building), minimum 60%.
- Project was specifically designed for buildings with exclusively residential apartments not including the reality of the building with commercial premises and residential apartments.
- Lack of a district heating systems culture. Citizens are used to individual heating systems.

These bottlenecks can be grouped in:

- Social aspects: the greater bottleneck was that the project had a top-to-bottom approach so it was necessary to involve and convince the target audience to join the project. This was an enormous work carried out by building technicians with not enough preparation to treat with the public. The effort needed to carry out this task was unexpectedly high and became one of the main time consuming tasks of the project in its initial phases.
    - Solution: Professionals from the social sector where hired and a door-to-door campaign started, getting in touch with more than 650 persons in face-to-face conversations.
- Technical issues: it was difficult to convince the target audience about the advantages (less consumption, money saving, higher efficiency, lower carbon print, etc.) of the district heating network to be deployed. Almost all the buildings had individual heating systems in each flat consisting on gas boilers and reluctance to change was very high. Some of the owners' communities, which initially agreed with the retrofitting, did not finally join the project because of this issue.
    - Solution: additional effort was put on information tasks to transmit the benefits of the technical solution for heating.
- Management issues: quite a high number of owners' communities (buildings) did not finally join the project because of the reluctance of the business/commercial premises located in the ground floor of the buildings. Many of these premises are empty, with no commercial use, so they do not have interest in retrofitting or connecting to a district heating network. They don`t see the benefit of the actuation and, as a consequence, they vote against joining the project in the owners' community assembly. As they usually have bigger surface (in square meters) than the dwellings, they proportionally have as well a higher weight on the decision, tipping the scale to a negative decision despite the decision of the dwelling owners may have been affirmative.
    - Solution: not easy to tackle…

The major lessons learned have been the following:

- Communication with the citizens is crucial: opening an information site at the heart of the Coronación district made the difference. The main objective was to increase the proximity to the neighbours, putting at their disposal clear first-hand information on the SmartEnCity activities and solving any eventual doubt about the project to assist the decision making process. It is essential to communicate directly with your audience. A sharp message, very clear, specific and with no changes along the project (except for

improvement) is needed. Face-to-face talks with the neighbours and listening to their feedback are essential.

- Starting with a bottom-to-top project could be more efficient. It is easier to implement this kind of interventions in district that have already asked for it or have shown their approval.
- Results have to be shown from the very beginning of the project to engage your target audience. The retrofit of at least one building in the first months of the project (even if this means assuming some risk) allows the audience to “see and touch” a real example of what you expect to achieve with the project.
- The engagement of the district associations is very beneficial. Citizen engagement will be easier if the neighbour’s associations or other social stakeholders from the demo district are supporting the project.
- To be successful on medium-large scale projects a demo inside the demo is needed, so the project has to be defined in several phases or stages:
    - Lead users
    - Early adopters
    - Main Adopters
    - Rest
- It is important to consider the right timing. The larger the intervention scale, the longer it will take to implement.