Viviendas de Corazón de María, Bilbao, Spain

Project summary

Energy concept

This is a social building with 111 dwellings, built in 1956 in Bilbao. The building renovation was projected under a global approach, taking advantage of economic incentives from Basque Government existing to promote building renovations. Improving the building energy performance is just one of the main targets of this project, which plans a global intervention taking into account not only energy aspects (improvement of the building envelope, updating the heating and DHW systems and evaluating the possibility of using RES) but also other issues such as accesibility or improving the urban area.

Background of renovation

The project aims to:

-Improve the energy performance of the building

-Improve the comfort conditions of dwellings (the building was never upgraded)

-The building accessibility will be significantly enhanced (lifts are installed)

-Recovering the neighborhood image maintaining architectural and urban original characteristics

General view of the building

Site:	**Bilbao**
Altitude:	19 m
Heating degree days:	1135
Cooling degree days:	0
Owner:	Bilbao Social Housing
Architect:	Pascual Perea

Contact Person:	**Bilbao Social Housing**
Important dates:	Originally built in 1956 Renovation started in 2014 Renovation completed in 2015
Date completed:	February 2015

Building description / typology

•A complete renovation of the building has been projected, which includes improvements on building thermal performance and accessibility.

•It is a building with concrete structure, brick walls and light weight slabs. Average area of each dwelling is 75 m²

Building envelope, heating, ventilation, cooling and lighting systems before the energy renovation

Description of building and its situation before renovation (building situation, building system, renovation needs, renovation options)

The building is located in a neighborhood that have reached certain level of degradation, and several of its buildings (many of them, inhabited by low-income-families) are needed for a deep renovation.

It is a L-shaped multistory block of flats. It has 5 levels and 111 flats, with an average area of 75 m^2. Some small neighborhood stores can be found in the ground floor of the building.

The main renovation needs are to **improve the thermal performance**, some **structural repairs** and mainly, to **improve the building accessibility** (In fact, this last one was the main motivation for the residents to carry out the renovation works)

Building envelope

The building has a concrete structure with single brick walls. It has no thermal insulation in exterior wall or roof.

The roof is made of ceramic tiles with a wooden structure.

The windows frames are varied, and some owners have carried out windows replacements in the last years. However, the majority of the windows are single-glazing windows with wood frames.

Heating, ventilation, cooling and lighting systems before retrofit

There is no central heating/cooling system. Currently, 23 residents have installed Natural Gas Boilers (only one of them is a condensing boiler) for DHW and heating system. Occasionally, some occupants can use electric heaters and it doesn't have any cooling system (It must be highlighted that the climate in the city in summer is not too hot, and cooling is not usual for domestic uses)

In many cases, the domestic hot water is supplied by individual electric heaters with storage tank and the ventilation is made by natural means.

Building before renovation

Element	Area m^2	U-Value before renovation W/m^2K	U-Value after renovation W/m^2K
Exterior walls	7284	1,7	0,27
Windows	1279	4,8	1,4
Roof	1720	1,5	0,33

Energy renovation features

Energy saving concept

The main purpose of the intervention is to improve the comfort of the dwellings, and simultaneously, to improve the energy performance of the building, by means of a global energy renovation, The projected actions related to the thermal performance of the building are:

- Improve the building envelope, maintaining its aesthetic features
- Upgrade the energy systems
- Improve the building accessibility
- Improve the comfort inside the dwellings
- Repair the roof and the wooden structure

Moreover, residents participation has been taking into account during the project definition, by means of several information campaigns and a questionnaires collection.

Technologies:

- Building insulation and thermal bridges treatment
- Windows replacement
- Natural Gas Boilers (instead the currently installed electric heaters)
- The introduction of Solar Thermal panels and a Biomass heating system is projected

Building

• Wall: Cavity wall of the façade (12 cm) will be filled with thermal insulation (EPS). The thermal bridges will be treated

• Roof: Insulation of the roof with 10 cm of rock-wool, wooden structure will be repaired.

• Windows: PVC frames + double glazing windows

	Element	Strategy - Impact/Purpose
Envelope	Exterior walls	-Exterior walls:10 cm de EPS (Filling the air gap) - Thermal Bridge treatment
	Windows	Introducing a Doble glazing windows (PVC frames)
	Roof	10 cm rockwool insulation
Energy Systems		Introducing condensing boilers
RES		Solar Thermal. Biomass.

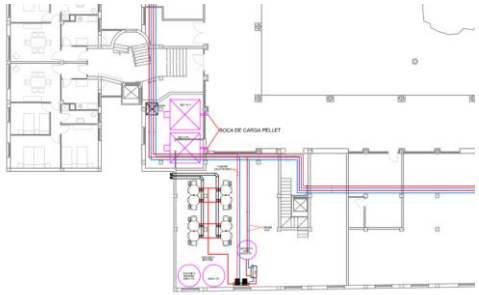
Systems

Heating: condensation	Electric boilers will be replaced by individual, boilers
Ventilation:	Natural ventilation using crossed ventilation
Lighting:	No changes are projected

Renewable energy systems

Thermal solar panels for meting the 50% of DHW are projected

Central heating system based on biomass is proposed and planed to install in the future.



Centralized heating system based on biomass is planed to install in the future

Achieved Energy Savings, CO_2 reductions and Life Cycle Costs

Energy needs	Before renovation	After renovation
Heating needs [1]	679.350 kWh/y (81,6 kWh/m^2.y)	482.020 kWh/y (57,9 kWh/m^2.y)
Cooling needs	-	-
DHW needs [2]	207.000 kWh/y (24,9 kWh/m^2.y)	207.000 kWh/y (24,9 kWh/m^2.y) 103.500 kWh/y (12,5 kWh/m^2.y)
Electricity needs (Appliances) [3]	374.070 kWh/y (44,9kWh/m^2.y)	374.070 kWh/y (44,9kWh/m^2.y)
Energy label [4]	G	C

[1] Heating demand has been calculated using Energy Plus

[2] DHW needs has been calculated based on the requirements presented in Spanish regulation (28 l/person.day; 350 residents)

[3] Electricity needs has been defined based on statistical data published by Basque Energy Agency (3370 kWh/year per dwelling)

[4] Buildings energy certification scheme in Spain ranks the energy performance of each building from level G to level A, being the first the less efficient

Calculated energy needs reductions:

Heating energy needs reduction: 29 %
Cooling energy needs reduction: N/A
DHW energy needs reduction: 0-50 %

RES contribution

Solar thermal contribution: 0-103.500 kWh/y.

Overview economic efficiency and costs per dwelling

Total retrofit cost: 38.150 €
Total energy operation cost before reno:1655 €
Total energy operation cost after reno: 995 €

Scenario 2 (Including solar thermal panels)

Total energy operation cost before reno: 1655 €
Total energy operation cost after reno: 945 €

Building façade before renovation

Costs	EUR	EUR/m^2
Craftsment	4.035.145 €	475 €
Consultants	200.000 €	23,5 €
Total	4.235.145 €	498,5 €

Building context

Overall improvements, experiences and lessons learned

Energy

Energy needs reduction for heating, cooling and DHW, compared to current state over 22 % are obtained, and a reductions over 34% can be reached if the projected installation of Solar Thermal panels for DHW are finally installed.

Indoor climate

- Reduction of draughts
- Absence of condensation phenomena
- Better comfort all year round

Economics

This renovation improves the urban context of that area, doing it more attractive for the inhabitants, and that point is good mainly to the neighborhood stores located in the area.

Economic consequences for tenants

The most direct effect consequence of renovation works is the fact that the property rise in value, due to the improvement in accessibility and thermal performance.

The enhancement on the building thermal performance also involve a theoretical energy savings around 660€. However, this value must be taken with care. Currently, many residents use no heating system, and then, renovation consequences will affect mainly on the indoor comfort in these cases.

Decision process – barriers that were overcome

Funding sources were obtained from a public administration. This involved an increase of bureaucracy. However, the funding was a key factor to carry out the renovation works, taking into account the low income profile of the building residents.

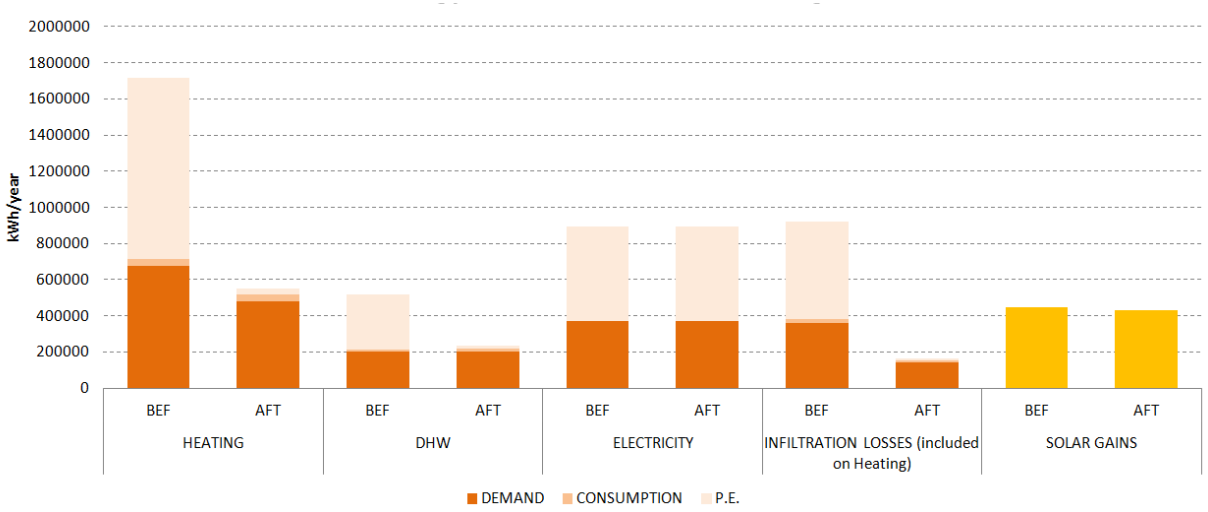
Residents participation has been promoted over the project. Residents were initially reluctant to carry out the renovation works, and, in many cases, the main motivation to carried out the renovation was not the improvement of building thermal performance, but the building accessibility.

Non-energy benefits

- Development in an depressed area of the city.
- Renovation makes easier delivering affordable warmth to the fuel poor households, and then, it involves reduction the risk of energy poverty and cold homes.
- Building accessibility is significantly improved.

Overview economic efficiency and costs

Even in the theoretical case presented in the study (operation costs) the payback of this renovation is not very attractive when only energy savings is considering. However, a global approach must be carried out, and taking into account the aforementioned non-energy benefits must be taken into account when the feasibility of this kind of renovation is assessed.



Building energy performance (Conversion Factors: Electricity 2,4; Natural Gas: 1,07; Source: IDAE // Infiltration before renovation: 0,6 ACH; Infiltration after renovation: 0,24 ACH)

General data

Sumary of the project

This is a social building with 111 dwellings, built in 1956 in Bilbao. The building is located in the core of the neighborhood, shaping the main square in this area. The case study building, like many others in this neighborhood, was built without taking into account thermal requirements. That point involves that many of the buildings located in this neighborhood present a great potential of energy performance improvement.

In this case, the building renovation was projected under a global approach, taking advantage of an economic incentives from Basque Government existing to promote building renovations. Three main objectives can be identified in this project: (1) improving the energy performance of the building, (2) improving comfort conditions of dwellings (the building was never upgraded), (3) the building accessibility will be significantly enhanced (lifts are installed).

Experiences and lesson learned

it is important that the tenants get what they expected, so from the beginning it is necessary to spend a great deal of effort on making sure that the expectation are adjusted to what can be met in practice. The residents also have to be part of the decision process. These points can make easier solving the possible problems that can arise over the works.

Closely linked to that point, it is important to take into account that the resident motivations are not always related to energy issues. In fact, in social dwelling at least, energy consumptions are usually lower than those theoretically expected, by lowering the indoor comfort level. For that reason, it is usually difficult to carried out a renovation when only “energy-motivation” is presented. Effects on indoor comfort and accessibility improvements were highlighted when renovation-benefits were presented to residents.

Although the consumption profiles and climatic conditions are technically quite good to propose an small PV auto-consumption, currently existing Spanish regulation makes difficult the feasibility of this kind of installations.

Roof and general architecture plans of the retrofitted building.

Acknowledgements

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