Sangallo, ALER-Varese (Italy)

Country: **Italy**

Name of city/municipality: **Varese**

Title of case study: Sangallo, ALER-Varese

Year and duration of the renovation: 2015, 1 year

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Link(s) to further project related information / publications, etc.:
https://www.alervarese.com/home/patrimonio-interventi/nuove-costruzioni-recuperi-demolizioni.html

Schematic figure or aerial overview

The area of intervention is shown in Figures 1 and 2.

Figure 1. Map of Quartiere Sangallo district with the renovated buildings highlighted

Figure 2. Satellite view of Quartiere Sangallo district with highlights on the renovated buildings

Table 1. Main features of the study area.

	Quartiere Sangallo	**Renovated buildings**
Buildings heated area [m²]	23,257.96	3,661.32
Number of building units	235	48
Buildings use category	Residential	
Buildings' owner	ALER Varese – Como – Monza Brianza – Busto Arsizio	

Introduction and description of the situation before the renovation

Quartiere Sangallo is a social housing district in the city of Varese (north Italy) owned by ALER (i.e. Lombardy Company for Residential Buildings) - Varese (i.e. for the territorial sectors of Varese, Como, Monza-Brianza and Busto Arsizio). It consists of 24 residential buildings, including detached houses, multi-family homes, apartment blocks and towers while a building has a commercial ground floor.

Buildings have been built between the end of 1960s and early 1970s and, as usual in that period, have a reinforced concrete bearing structure. All of them are over a basement (garage), except for building Bb which is over pilotis.

Buildings envelope
Buildings have poor quality envelopes, featured by high thermal transmittance values. Also, several thermal bridges are revealed, mainly in the structure nodes and windows. Buildings are characterized by: uninsulated external walls made of hollow bricks and air cavity, floors made of concrete slabs with clay bricks, single glazed windows with wooden frame and uninsulated wooden shutter boxes.

Systems
Regarding the space heating energy supply, 23 buildings are connected to a district heating (DH) network, which is fed by 3 recently installed heat generators (total capacity 3.9 MW), each one made of 2 condensing gas-boilers, while one building (i.e. Dg) has an individual heat generator on the roof. Due to the local orography, the DH network is split in 2 branches having 2 plate heat exchangers (1.8 and 1.5 MW, respectively) linking the primary with the secondary distribution networks. Regulation of the system is accomplished through climatic compensation sensor within the thermal power plant. Within buildings, the distribution system is made of uninsulated vertical raiser pipes while the emission system is made of cast iron radiators.
Regarding the Domestic Hot Water (DHW) energy supply, in all buildings individual electric boilers are installed.

Figure 3. Left: Satellite view of the thermal power plant. Right: Thermal power plant

Description of the renovation goal

The project aims are the reduction of energy consumptions and, subsequently, of the related CO_2 emissions, through measures for increasing the regulation and distribution efficiencies of the heating system and, in particular, focussing on major energy renovation of 3 buildings (i.e. Ba, Bb and Bc) concerning the opaque and glazed envelope, the DHW system and the integration of renewables.

Description of the renovation concept

Major renovation of buildings Ba, Bb, Bc

Buildings envelope thermal insulation

- of external walls through both cavity insufflation with glasswool flocks and external insulation with high density glasswool panels, also useful to correct the thermal bridges;
- of walls against unheated staircases with glasswool panels;
- of floors against outside (i.e. pilotis - only in Building Bb) with high density glasswool panels;
- of floors against unheated underground spaces (i.e. garages) with high density glasswool panels;
- of walkable floors below the pitched roofs with polystyrene panels;
- of not walkable floors below the pitched roofs with glasswool panels;
- of floors of the terraces with polystyrene panels;
- replacement of windows with double glazed ones with PVC frame;
- of shutter boxes (finally not done);
- correction of thermal bridges of windowsills with insulating covering.

Table 2. Thermal transmittance values of envelope elements before and after the energy renovation.

BEFORE RENOVATION		**AFTER RENOVATION**	
Opaque vertical envelope			
Element	**U [W/m^{2}K]**	**Element**	**U [W/m^{2}K]**
External wall 39 cm	1.273	External wall 39 + 6.6 cm	0.121
External wall 29 cm	1.261	External wall 29 + 6.6 cm	0.188
External wall below windows 23 cm	1.400	External wall below windows 23 + 6.6 cm	0.401
Wall against staircase 25 cm	2.548	Wall against staircase 25 + 4 cm	0.772
Floors			
Element	**U [W/m^{2}K]**	**Element**	**U [W/m^{2}K]**
External floor 30 cm	1.354	External floor 30 + 14 cm	0.199
Floor over garage 30 cm	1.152	Floor over garage 30 + 11 cm	0.262
Walkable floor below roof 35 cm	1.097	Walkable floor below roof 35 + 15 cm	0.279
Floor below roof 35 cm	1.097	Floor below roof 35 + 10 cm	0.279
Floor of the terrace 26 cm	1.146	Floor of the terrace 26 + 15 cm	0.281
Windows			
Element	**U [W/m^{2}K]**	**Element**	**U [W/m^{2}K]**
Single glazed – wooden frame (windows 130x140 cm)	4.693	Double glazed – PVC frame (windows 130x140 cm)	1.654
Single glazed – wooden frame (windows 140x140 cm)	4.728	Double glazed – PVC frame (windows 140x140 cm)	1.651
Single glazed – wooden frame (windows 70x250 cm)	4.440	Double glazed – PVC frame (windows 70x250 cm)	1.665
Single glazed – wooden frame (windows 140x250 cm)	4.928	Double glazed – PVC frame (windows 140x250 cm)	1.611

Buildings systems

- replacement of the individual electric boilers with the installation of two DHW tanks (2000 litres) per building having double coil (DH connected during winter, HP connected during summer)
- installation of one air-to-water heat pump per building ($P_{Heating}$ = 31.8 kW - P_{Input} = 9.1 kW - COP = 3.51) for producing DHW in summer period
- installation of PV systems grid-connected (polycrystalline panels) on each building roof (per each building P = 16.2 kWp and estimated production = 16,800 kWh/year)

Renovation measures on all buildings

- installation of thermostatic valves on radiators;
- installation of hydraulic separator with mixing valves controlled by a climatic sensor within each building substation.

Renovation measures on the centralized thermal plant

- replacement of the climatic control unit with a highly efficient one and removal of mixing valves on primary distribution networks (now present in each building substation therefore redundant).

Description of the non-technical aspects, e.g. stakeholder involvement, communication, etc.

The project has been funded through a call by the local public body Regione Lombardia on energy efficiency in buildings, foreseeing that the interested buildings would have to be upgraded at least to the energy class B according to the local energy labelling. The overall budget has been covered by one-third from the public body, while the buildings' owner "ALER- Varese" assigned the remaining two-thirds to an ESCO (i.e. CNP, 20 years Project Financing).
The association of tenants (i.e. Sunia) has been involved to discuss the project. The early stage design of the project was attributed to the Politecnico di Milano, while final stages and realisation to the CNP.

Apart from being mentioned into the ALER-Varese webpage, the project has not been disseminated, yet.

Project Fact Box (I.a)

Quartiere Sangallo

Parameter	unit	before renovation	after renovation
Covered area:	m²	7,542	7,542
Population in the area:	Apt	235	235
Number of buildings in the area	-	24	24
Heated floor area of all buildings	m²	23,258	23,258
Building mix in the area:			
Single family homes (SFH)	% of heated floor area of all buildings	-	-
Multi-family homes (MFH) - up to three storey and / or 8 flats		29	29
Apartment blocks (AB) - more than 8 flats		71	71
Schools		-	-
Office buildings		-	-
Production hall, industrial building		-	-
other (please specify)		-	-
Consumer mix in the area:			
Small consumers: SFH + MFH – < 80 MWh/a	in % of annual heat demand	29	29
Medium consumers: AB, schools, etc. – 80-800 MWh/a		71	71
Large consumers: industrial consumers, hospitals, etc. > 800 MWh/a		-	-
Property situation of buildings:			
Private	% of heated floor area	-	-
Public		100	100
Property situation of energy supply system (district heating):			
Private	% of heated floor area	-	-
Public		100	100

Project Fact Box (I.b)

Renovated Buildings (Ba, Bb, Bc)

Parameter	unit	before renovation	after renovation
Covered area:	m²	1,066	1,066
Population in the area:	apt	48	48
Number of buildings in the area	-	3	3
Heated floor area of all buildings	m²	3,661	3,661
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		-	-
Apartment blocks (AB) - more than 8 flats		100	100
Schools		-	-
Office buildings		-	-
Production hall, industrial building		-	-
other (please specify)		-	-
Consumer mix in the area:			
Small consumers: SFH + MFH – < 80 MWh/a	in % of annual heat demand	-	-
Medium consumers: AB, schools, etc. – 80-800 MWh/a		100	100
Large consumers: industrial consumers, hospitals, etc. > 800 MWh/a		-	-
Property situation of buildings:			
private	% of heated floor area	-	-
public		100	100
Property situation of energy supply system (district heating):			
private	% of heated floor area	-	-
public		100	100

Project Fact Box (II)

Renovated Buildings (Ba, Bb, Bc)

Specific information on energy demand and supply:

Parameter	unit	before renovation	after renovation
Primary energy for space heating (calculated)	kWh/m^{2}a	219	50
DHW primary energy (calculated)	kWh/m^{2}a	54	22
cooling demand (calculated)	kWh/m^{2}a	-	-
electricity demand (calculated)	kWh/m^{2}a	-	-
heating consumption (measured)	kWh/m^{2}a	197	-
domestic hot water consumption (calculated)	kWh/m^{2}a	22 electricity	14 gas 3 electricity
cooling consumption (measured)	kWh/m^{2}a	-	-
electricity consumption (measured)	kWh/m^{2}a	-	-
(Thermal) energy supply technologies:			
decentralized oil or gas boilers	% of heated floor area	-	-
decentralized biomass boilers		-	-
decentralized heat pumps		-	-
centralized (district heating)		100	100
decentralized electric boilers for DHW		100	0
Centralized at building level heat pumps *+ centralized (district heating)* for DHW		0	100
renewable energy generation on-site:			
photovoltaics area	m²	0	303
photovoltaics	kWp	0	49
other (please specify)	kW	0	0

Financial issues:

Parameter	**unit**	**before renovation**	**after renovation** (including 10% VAT)
total investment costs of the renovation	Euro/m^2	-	334
- building envelope renovation costs	Euro/m^2	-	250
- heating/cooling supply costs	Euro/m^2	-	60
- renewable energy production costs	Euro/m^2	-	25
LCC available	yes / no	no	no

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

DHW system

- replacement of the individual electric boilers with the installation of two DHW tanks (2000 litres) per building having double coil (DH connected during winter, HP connected during summer)
- installation of one air-to-water heat pump per building ($P_{Heating}$ = 31.8 kW - P_{Input} = 9.1 kW - COP = 3.51) for producing DHW in summer period

The DHW system includes these components, installed in the buildings' basement:

- circulating pump;
- water softener system and Legionella bacteria control system;
- energy meters for both the heat pumps and the DH side.

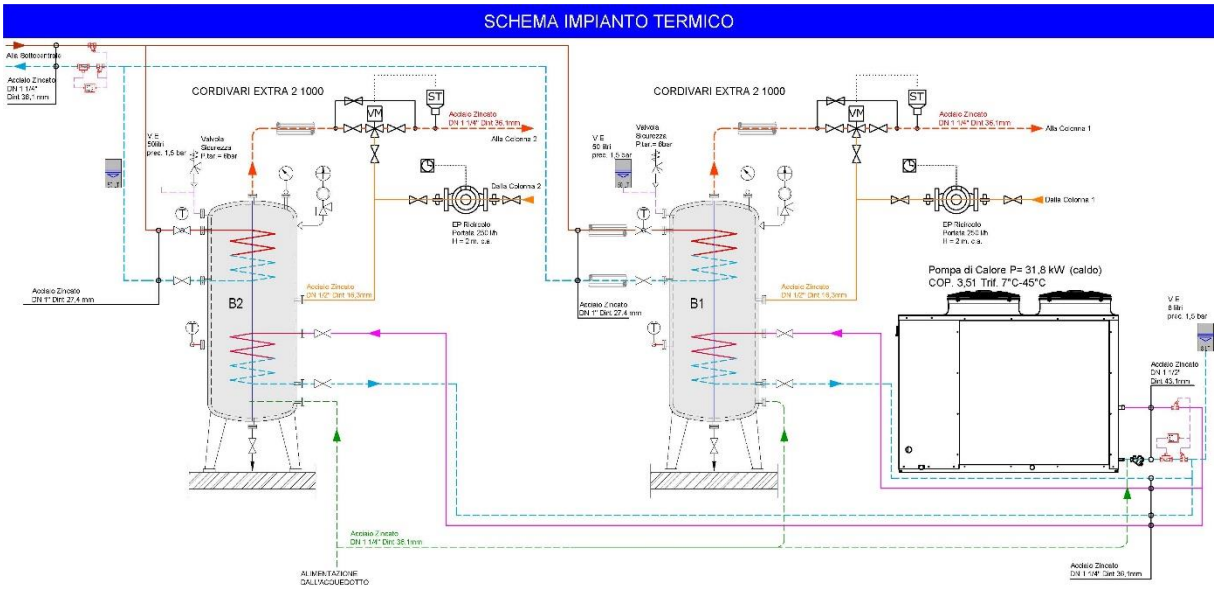

Figure 4. DHW system scheme

Decision and design process

General/organizational issues:

The project was initiated taking advantage from a public call on energy efficiency, in order to reduce the energy consumptions and related emissions of existing social housing buildings, typically featured by poor energy quality.

Stakeholders involved

- Policy actors: Regione Lombardia (as public financier);
- Users/investors: ALER-Varese (as owner of the built area), CNP (ESCO co-financing the project);
- District-related actors (Community/occupants organizations, etc.): Sunia (association of tenants)
- Energy Network Solution Suppliers: CNP
- Renovation Solution Suppliers: Politecnico di Milano (in charge of early stage design), CNP (in charge of final stages design and realization)

Main steps

The main step for the successful implementation of the district heating was to involve the CNP-ESCO.

Resources available before the project

There were no resources available before the project.

Drivers and barriers (opponents)

The main drivers have been ALER-Varese, aiming at renovating its low performing building stock, and Regione Lombardia, awarding the call and financing the project for 1/3 of the total costs.
The main barrier was the unavailability of funds from the owner.

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.)	Regione Lombardia	Public Financier	Call for boosting for energy efficiency in public buildings
Users/investors (individual owner, housing association, building managers, asset manager, project developer)	ALER	Decision maker	Energy renovation of the owned building stock
	CNP	ESCO Co-Financier	Business
District-related actors (Community/occupants organizations, etc.)	Sunia (association of tenants)	Influencer	Protect tenants' needs
Energy network solution suppliers (Distributor system operator, energy supply company, energy agency, ESCO, renewable energy companies)	CNP	ESCO	
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.)	Politecnico di Milano	Technical advisors	Early stage design
	CNP	Technical advisors	Final stages design + realization
Other intermediaries (public bodies, trade organizations, NGO's, consultancies, research institutes)			

Design approach:

The aim of the project has been to reduce the buildings energy demand, achieving the class B of the local energy labelling, and subsequently reduce the related CO_2 emissions.

Decision steps

- Public call from Regione Lombardia
- Early stage design from Politecnico di Milano
- Presented projects' evaluation
- Presented projects' ranking and announcement of the assignee
- Assignation of funds
- Involvement of an ESCO and evaluation of its proposal for final stages design

- Assignment of work to CNP-ESCO
- Renovation of buildings

Main challenge
The main challenge has been the achievement of the energy class B starting from the initial G one, as required by the call.

Technical issues:

Major technical challenges/constraints regarding system design/implementation
During the renovation a higher wall cavity thickness than expected has been founded. Because of the additional costs related to the larger cavity insulation, it has been decided not to insulate the shutter boxes as initially foreseen. The PV system grid-connected is not working yet because of bureaucracy related problems.

Financing issues:

The whole renovation project has been financed for 1/3 by a public body (i.e. Regione Lombardia) and 2/3 in Project Financing by a private ESCO (i.e. CNP).

Subsidies or other financial incentives
Apart from the 1/3 of the public funding there were no other subsidies or financial incentives.

Main challenges/constraints regarding financing
The main challenge has been retrieving the financier for the 2/3 of costs, solved with the involvement of CNP.

Business models
Project Financing.

Management issues:

The main project management challenges have regarded dealing with the complex Italian bureaucracy and regulations in terms of public buildings renovation.

Policy framework conditions:

Regulations which stimulated / hindered the process
The project has been carried out respecting current EPBD national (and regional) implementation requirements.

Police instruments that moved the district into action
The policy instrument that moved the district into action can be considered as a “carrot-policy”.

Lessons learned/interesting findings

Major success factors

The 1/3 public body (i.e. Regione Lombardia) funding call and the private ESCO (i.e. CNP) investing for the remaining 2/3 in Project Financing.

Major bottlenecks

The barrier was the unavailability of funds from the owner, solved with the involvement of an ESCO. As it has been explained, during the renovation a higher wall cavity thickness than expected was founded. Because of the additional costs related to the larger cavity insulation, it was decided not to insulate the shutter boxes as initially foreseen. The PV system grid-connected is not working yet because of bureaucracy related problems (still unsolved).

Aspects to be transferred from this intervention

The ALER – Varese intends to achieve continuous improvement of its owned buildings' energy performance according to the specification ISO 50001 "Energy management systems – Requirements with guidance for use". Besides, considering the issue of low income of the building tenants, the project has had the additional goal to reduce the related fuel poverty condition.