Valdastico (Italy)

This success story is only focused on the energy system, no measure related building renovation has been performed, but it may be relevant to other similar interventions.

Country: **Italy**

Name of city/municipality: **Valdastico**

Title of case study: **Valdastico district**

Year and duration of the renovation: **2014**

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Link(s) to further project related information / publications, etc.:

Schematic figure or aerial overview

The Municipality of Valdastico is located in the Province of Vicenza, in the north east of Italy, and it represents a typical small community of mountain area (1,300 inhabitants at 405 m above sea level).

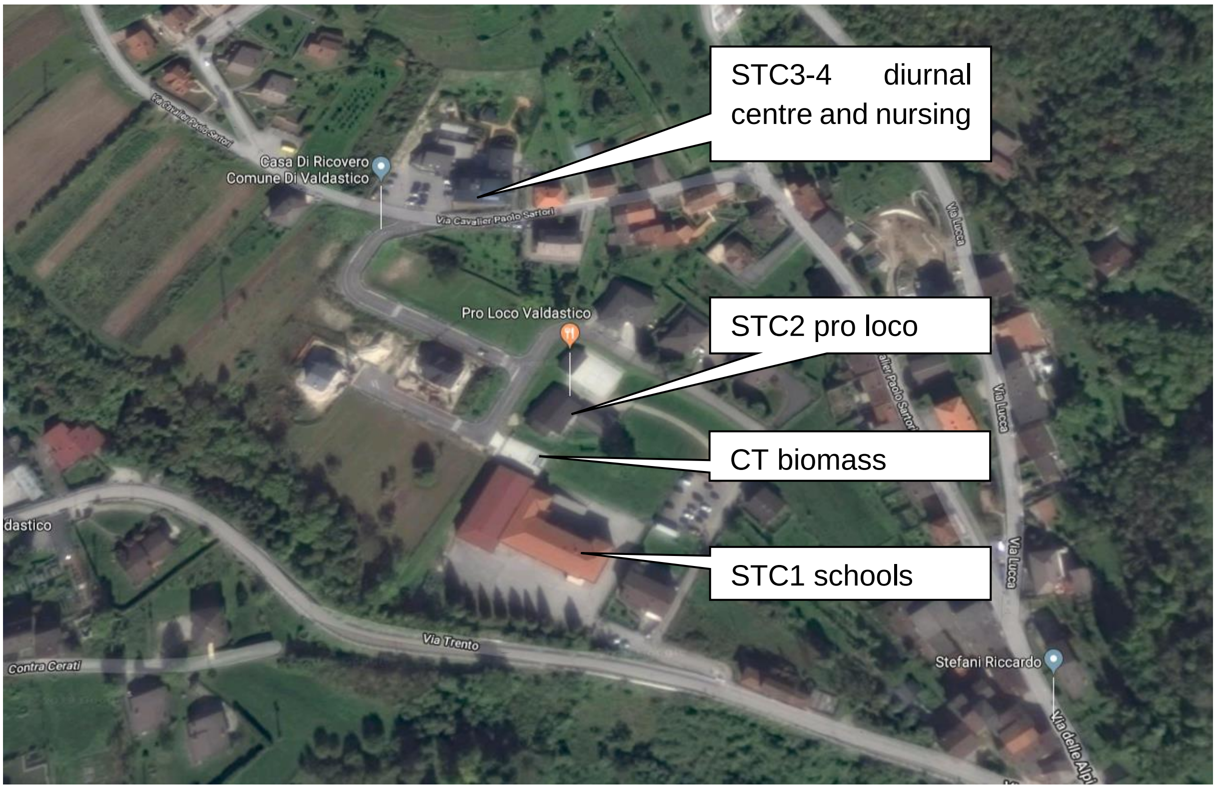

Figure 1. Satellite view of Valdastico district with highlights on the interested buildings

The district heating net consists on a thermal power system, powered by **biomass** of agro-forestry origin (wood chips), to **produce thermal energy for the heating and domestic hot water** production of 4 public buildings by the Municipality of Valdastico:

- Middle and elementary schools,
- Head office of the Valdastico Pro Loco;
- Nursing home “Casa Nostra”;
- Nursing home “Casa Nostra” (diurnal centre).

Table 1. Main features of the researched area.

	Valdastico Renovated buildings
Buildings heated area [m²]	4,000
Number of building units	4
Buildings use category	School - Nursing home
Buildings’ owner	Valdastico Municipality

Introduction and description of the situation before the renovation

Before the renovation the buildings were heated by gas boilers.

Table *2* shows how energy use was focused on winter months, while in summer was very limited and practically attributed only to the nursing houses, that are responsible of the great part of energy use (almost 60%).

Table 2. Main data about the situation before the intervention, focusing on heated volume and yearly energy use by the interested buildings, with reference to consumption data for 2012/2013.

	Users	heated volume	useful power exchanger	2012/13 annual gas consumption (before renovation)		
				Yearly consumption	Winter (H+DHW)	Summer (DHW)
		[m^3]	[kW]	[smc]	[smc]	[smc]
1	Middle and elementary schools	8,080	300	20,156	18,396	3,010
2	Head office of the Valdastico Pro Loco	660	35	1,750	1,000	500
3	Nursing home “Casa Nostra”	3,300	170	27,179	19,184	3,655
4	Nursing home “Casa Nostra” (diurnal centre)	830	35	7,022	5,383	1,639
	Total	12,870	540	56,107	43,963	7,804

Description of the renovation goal

The general goal was to create a sustainable complex for public users. The new biomass district heating plant has the goal of covering 100% of the thermal demand through renewable sources.

Utilities are connected to the biomass power plant using a specific district heating network, seized to provide energy to other public buildings in the future.

Specifically, renovation goals were to:

- Reduce energy costs and CO_2 emissions;
- Use renewable sources for energy use;
- Increase the living quality and adapt the buildings to a contemporary standard of living;
- Improve the image in order that there is a good effect and it works as identification for the inhabitants and for the district.

Description of the renovation concept

Buildings systems

The renovation project concerns only the system. The technical choice fell on the following aspects:

- Central biomass heating plant (wood chips) centralized in order to fully meet the thermal needs of users;
- Solar heating system to supplement the summer domestic hot water needs of the nursing home users;
- Maintenance of existing boilers, after appropriate requalification and regulatory adaptation, as emergency system in case they are needed.

The management of the system can be carried out remotely, in order to minimize the operating costs of the entire system and to guarantee a higher quality of service and a real-time response in case of breakdown.

The substations were made in order to not substantially modify the heat distribution circuits to the users, thus maintaining the current distribution and adapting it to the operation envisaged with district heating.

Middle and Elementary School

By maintaining the existing boiler as a back-up, the following improvements were carried out, together with the installation work of the DHN substation:

- Switching from an open vessel to a closed vessel system, with a consequent reduction in the dirt and corrosion of the plants;
- Integration and replacement of the safety devices currently present on the gas boiler to allow operation, in case of emergency, as an alternative to the district heating exchanger, by a simple manual interception of the exchanger circuit;
- Installation of a new primary circulation pump to allow operation of the system with the district heating exchanger.

Pro-Loco head office

For the Pro-Loco, due to the recent construction of the boiler and the systems, only a minimum intervention for interfacing has been provided. The connection between the exchanger and the existing gas boiler is achieved by means of manual ball shut-off valves.

Nursing home

The gas boiler for heating was kept, while, for the production of domestic hot water, the boiler with gas burner was replaced due to the not regulatory compliance.

In this substation the following improvement measures were carried out:

- Integration and replacement of the safety devices currently present on the gas boiler to allow operation as an alternative to the district heating exchanger;
- Installation of a solar thermal system on the roof and a boiler for the production of domestic hot water supplied by solar heating or, in case of necessity, by district heating. The boiler will be equipped with a thermostatic mixer;
- Dismantling of the gas cylinder that does not comply with current regulations.

Nursing home – diurnal centre

Also, in this case, given the recent construction of the boiler and the systems, only the minimum interventions required for interfacing have been foreseen.

The connection between the exchanger and the existing gas boiler is achieved by means of manual ball shut-off valves.

Project Fact Box (I)

General information

Parameter	unit	before renovation	after renovation
Urban scale of area:	m²	8,000	8,000
Population in the area	-	300	300
Number of buildings in the area	-	4	4
Heated floor area of all buildings	m²	4,000	4,000
Building mix in the area:			
Single family homes (SFH)	% of heated floor area of all buildings	0	0%
Multi-family homes (MFH) - up to three stories and / or 8 flats		0	0%
Schools		63	63%
Office buildings		5	5%
Nursing home		25.5	25.5%
Nursing home (diurnal center)		6.5	6.5
Consumer mix in the area:			
Small consumers: SFH + MFH – < 80 MWh/a	in % of annual heat demand	0	0
Medium consumers: AB, schools, etc. – 80-800 MWh/a office + school		39	42
Large consumers: industrial consumers, hospitals, etc. > 800 MWh/a 2 nursing home		61	58
Property situation of buildings:			
private	% of heated floor area	0	0
public		100	100
Property situation of energy supply system (district heating):			
private	% of heated floor area	-	0
public		-	100

Project Fact Box (II)

Specific information on energy demand and supply:

Parameter	**unit**	**before renovation**	**after renovation**
heating demand (calculated)	kWh/a	-	-
domestic hot water demand (calculated)	kWh/m²a	included in the heating demand	included in the heating consumption
cooling demand (calculated)	kWh/a	-	-
electricity demand (calculated)	kWh/a	-	-
Heating + electricity demand (calculated)	kWh/m²a	124	148
heating consumption (measured)	kWh/a	-	-
domestic hot water consumption (calculated)	kWh/m²a	included in the heating consumption	included in the heating consumption
cooling consumption (measured)	kWh/a	-	-
electricity consumption (measured)	kWh/a	-	-
Heating + electricity consumption (measured)	kWh/m²a	140	200
Energy vector used		52,000 m^3 gas	174,000 kg of Biomass (wood-chips)
(Thermal) energy supply technologies:			
decentralized oil or gas boilers	% of heated floor area	100	In emergency case
decentralized biomass boilers		-	-
decentralized heat pumps		-	-
centralized (district heating)		0	100
other *(please specify)*		-	-
renewable energy generation on-site:			
solar thermal collector area	m²	0	13.8 m²
photovoltaics	kWp	0	0
other (please specify)	kW	0	0

Financial issues:

Parameter	**unit**	**before renovation**	**after renovation**
total investment costs of the renovation	Euro	-	670,000 (€ 332,828 by Regione Veneto fund)
- building renovation costs	Euro	-	-
- heating/cooling supply costs	Euro	38,000	20,000
- renewable energy production costs	Euro	-	-
LCC available	yes / no	no	no

Description of the technical highlights and innovative approaches

Biomass plant - characteristics of the system

The installed biomass boiler has a rated power of 550 kW, with mobile grate technology with screw feed, is able to burn chips with water content up to 40%.

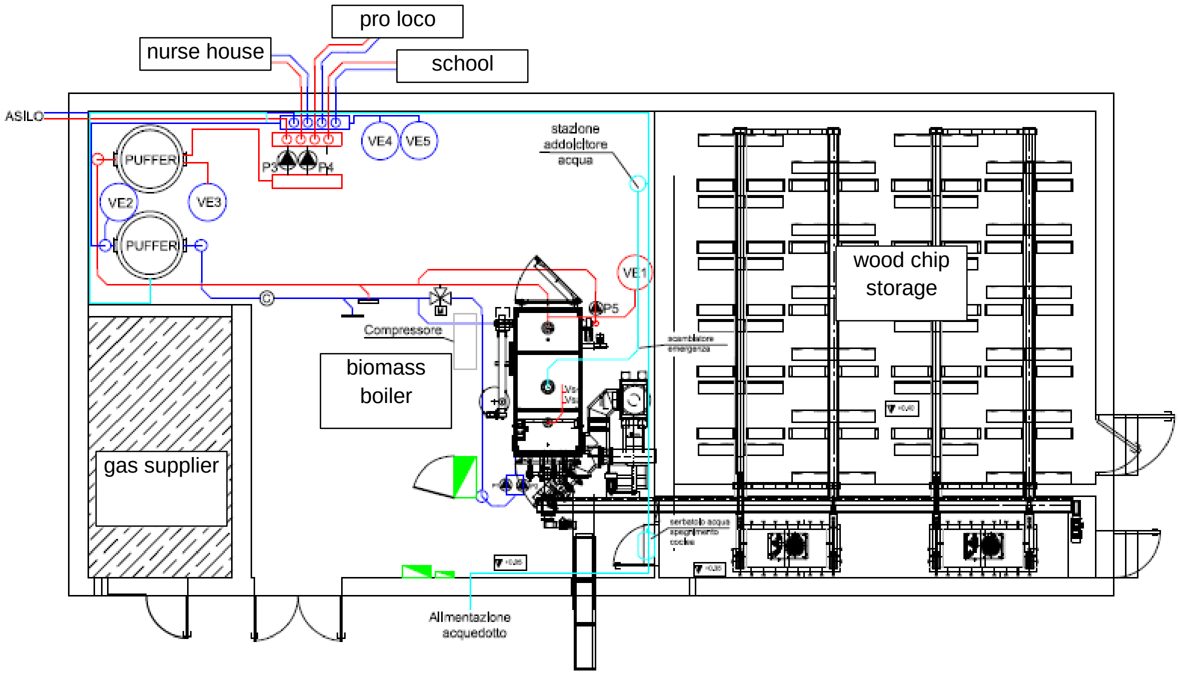

Figure 2. Layout of the thermal plant

It is equipped with inverter control of the fans for air combustion and smoke exhaust. The local deposit has a useful volume of 290 m^3 and is equipped with 4 rakes with 2 pistons for handling the wood chips. The boiler is equipped with a management programmable logic controller (PLC) that automatically regulates its operation, as is the discharge of the ash into special containers.

The thermal energy produced is accumulated in two "puffers" of 3,000 litres each and from these taken and distributed to the users through 2 inverter pumps.

Table 3. Technical data biomass plant

Brand and model	UNICONFORT – BIOTEC G50
Nominal useful power	550 kW
Nominal hearth power	640 kW
Nominal yield at 100% power	86%
Water content	2,040 litres
Operating pressure	4 bar
Operating temperature	85 °C
Wood-chips characteristics	Max 40% water content, P45
Local wood-chip storage	290 m^3
Thermal storage tanks	2 x 3,000 liters

Biomass plant - wood chips fuel

The biomass boiler uses wood chips as fuel. The quality of the combustible material is of strategic importance both for the purpose of controlling the polluting emissions and for the purpose of the effective performance of the boiler and its duration in time.

Table 4. Characteristics of the wood-chips

Type	100% fir
Origin	Veneto and Trentino Alto Adige Region
Size	< P 45
Water content	< 30%
Calorific value	> 3.4 kWh/kg
Ash content	< 1%
Certifications	certified supplier PEFC

This choice allows to optimize the combustion characteristics of the boiler, the number of fuel recharges and the need for maintenance of the system.

The selection of wood chips is essential to achieve the objectives of effective emission reduction without increasing the local pollution, by guaranteeing the quality and the traceability of the supplied fuel.

The analysis of the local wood chip market makes it possible to state that, given the high availability of high quality chip chippings in the immediate vicinity, it is believed that the supply of wood chips is sustainable from an environmental, technical and economic point of view in the medium to long term.

As for the treatment of fumes, in addition to the normal emissions regulations, a multi cyclone dust collector (a kind of pulveriser) is planned to further reduce dust emissions, especially during boiler start-up and shut-down phases.

Thermal solar system - characteristics of the system

As a supplement to the biomass plant, a solar thermal system was installed at the nursing home, to increase the use of local renewable sources. Six solar panels and a thermal storage tank with a capacity of 1,000 litres have been installed.

Since the user is a nursing home, the use of domestic hot water is well distributed throughout the day and there are no significant monthly or weekly changes, also based on consumption trends.

Table 5. Technical data of the solar thermal system

Net capturing surface	13.8 m^2
Tilt angle	25°
Orientation	25° West
Annual irradiation in the panels plane	1,286 kWh/m^2 year
Average annual return	60%
Average annual thermal energy production	10,650 kWh/m^2 year
Primary energy savings	14,200 kWh/m^2 year
Useful life solar system	20 years
Coverage of DHW requirements in summer	56% of requirements

In an emergency it is possible to use the pre-existing gas boilers, thus ensuring continuity of service to all users.

The heat exchangers are equipped with a control unit, with two-way power modulation valve, which allows to regulate the temperature and power supplied to the user in order to use the actual needs.

Table 6. Technical data district heating network.

Overall length of the network	600 m
Brand and model	BRUGG – Calpex
Material	Polyethylene PE-Xa pre-insulated
Main line diameter	110 mm ø int. - 162 mm ø est.
Transportable thermal power	1,000 kW
Average temperature difference expected	< 20 W/m
Number of users that can be intercepted in the thermal power plant	3 (active) + 1 (prepared)

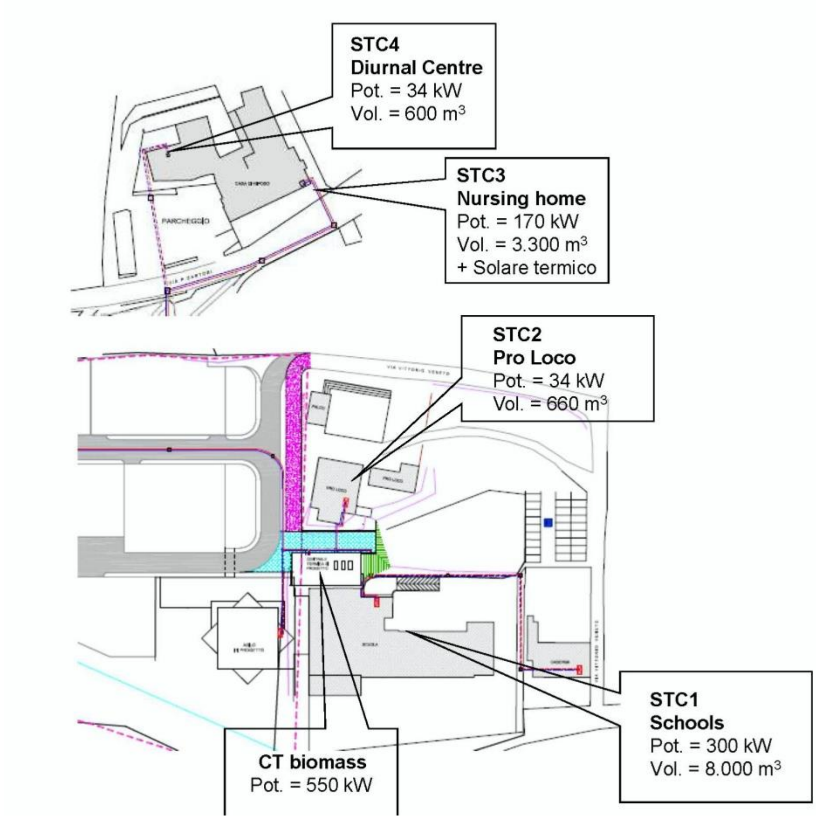

Figure 3. The District heating net includes 5 buildings: a CT thermal central station and 4 STC substations. For each buildings a label describes the name of the station, the use, the installed power Pot and the volume Vol

Decision and design process

General / organizational issues:

Valdastico municipal administration planned the intervention according sustainability goals with the aim to reduce the energy use and cost by fossil fuels and the relative GHG emissions.

Stakeholders involved

The stakeholders involved were the following:

- Policy actors: municipality;
- Users: housing association and school administration;
- Design and consultant company: Studio Centro Sicurezza Ambiente, in charge of design and realization stages;

Main steps

The main steps were: the availability of public funds to apply the intervention; the total adhesion to this project by the three municipal administrations during the whole process; and the installation works. Moreover, the installation woks have been possible without resettling the hosts in the nurse houses and without interfere in the school activities.

Resources available before the project

Before the renovation the buildings were heated by gas boilers. There were no esources available before the project.

Drivers and barriers (opponents)

The main driver is the municipality and the large availability of wood-chips in the neighboring environmental context, that allows an eco-compatible use of the district heating system with a drastic reduction of the pollutants emitted.

The main barrier regards the unavailability of funds of the administration to face the project and an unexpected consequence after the intervention, because the strong noise coming from the central disturbs the neighboring inhabitants.

Stakeholders' role and motivation:

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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.)	Municipality	Decision maker	Savings, CO_2 reduction, quality of living improvement
Users/investors (individual owner, housing association, building managers, asset manager, project developer)	Regione Veneto	Financier	Call for boosting for energy efficiency in public buildings
District-related actors (Community/occupants organizations, etc.)	Occupants organization of schools and nursing home	Influencer	Savings, standards improvement
Energy network solution suppliers (Distributor system operator, energy supply company, energy agency, ESCO, renewable energy companies)	unkonwn	Decision maker/delivery	Profit, experience, fame
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.)	Studio Centro Sicurezza Ambiente	Consultant and design company, Technical advisor	Profit, experience, management of design + realization stages;
Other intermediaries (public bodies, trade organizations, NGO's, consultancies, research institutes)			

Design approach:

The new biomass district heating plant has the objective of covering 100% of the thermal demand through renewable sources.

Decision steps

The steps implemented were as follows:

- Public call from Regione Veneto
- Early stage design by Studio Centro Sicurezza Ambiente
- Presented projects' evaluation
- Presented projects' ranking and announcement of the assignee
- Assignation of funds by Regione Veneto
- Evaluation of proposals for final stages design
- Assignment of works and project management
- Intervention

Main challenges in the design phase

The main challenge was the evaluation of the most effective technical solution in terms of plants in order to reduce the energy costs; in addition, the administration was obliged to seek external technical support in order to present a valid project for the call of Region Veneto in terms of requirements and timing.

Technical issues:

The challenges in this phase concern the choice of positioning the biomass plant and the solar heating system and the net design for connecting the more distant public buildings. During this phase the problem was keeping and adapting the existing boilers as emergency system. One more challenge concern on organize the schedule of intervention during the summertime, in order to not interfere with school activities.

Financing issues:

The renovation was financed by public money. The project was funded by the region through the funds by the ministerial plan for energy production from renewable sources and energy efficiency.

There was availability of Conto Termico, a particular incentive plan for the production of thermal energy from renewable sources for small plants, achievable after the intervention.

The main challenge for municipal administration has been to find and to financing the cost non covered by funds, a very difficult step for a small city of 1,300 inhabitants.

There was no business model applied.

Management issues:

No relevant management aspects are known.

Policy framework conditions:

There were no special policy frameworks. The project has been carried out respecting current EPBD national implementation requirements, in particular for energy efficiency measures and of thermal energy production from renewable sources for small plants.

Policy instruments

“Carrots-policy” was the policy instrument that moved the district into action.

Lessons learned

Major success factors

First of all, the achievement of public funds, without which the project would not have been funded for a small city as Valdastico.

From the technical point of view, the new biomass district heating plant has the objective of covering 100% of the thermal demand through renewable sources; most of the summer energy demand (limited to the use of domestic hot water in the nursing home) is covered by solar thermal panels. This also improves the efficiency of the use of biomass, since in summer the biomass boiler has lower yields (due to the greater ignition and shutdowns) and the dispersions along the network become significant; the use of fossil source (natural gas) is limited to the case where both systems are not able to meet the energy needs.

The analysis of the local wood-chip market makes it possible to state that, given the high availability of high-quality chip chippings in the immediate neighborhood, the supply of wood chips is sustainable from an environmental, technical and economic point of view in the medium to long term.

Major bottlenecks

Some difficulties during the process were:

- the choice of an effective technical solution in terms of plant in order to reduce the energy use and costs, by connecting distant public buildings, with different use;
- the cost of changing the existing plants implied an expense for the disposal of the old plants, so the decision was to keep and adapt the existing boilers as emergency system;
- the municipal technical offices were not equipped with technical personnel competent in plant engineering topics, so the administration was obliged to seek external technical support in order to present a valid project for the call of Region Veneto in terms of requirements and timing.

Major lessons learned

The availability of public funds; national incentive plan is crucial to help and involve small communities to reduce the energy consumptions and related CO_2 emissions of public buildings.

Aspects to be transferred from this project

The reduction of fossil use is possible by the realization of small net connecting public buildings; moreover the availability of national funds and incentives cover a great part of the investment, given the possibility also to a small community to improve the living quality in terms of energy use and environmental impact reduction and also to reduce the public costs for energy bills.

From the technical point of view, the transition to biomass as energy source is an efficient and sustainable solution for mountain communities, especially nearby woodland areas.