

Energetic behaviour and Renewable Energy in traditional rural architecture

Daniela Bosia
II Faculty of Architecture
Politecnico di Torino
e-mail: daniela.bosia@polito.it

ABSTRACT

The paper aims to present recent guidelines to improve energetic behaviour and Renewable Energy in rehabilitation works of traditional rural architecture. The guidelines are referred in particular to the G.A.L (Local Actions Groups) of Mongioie and Langhe & Roero sites in North Italy. Those rural areas are involved in the Italian Tentative Lists, submitted for inscription on the Unesco's World Heritage List. Both "Guides" can be configured as recommended standard instruments and were drawn up on the basis of study of the construction traditions and characteristics of the landscape in the reference area, which is largely mountainous and hilly. In both cases, the projects were carried out within the Plans for Local Development founded by Regional Rural Development Plan.

KEYWORDS

Guidelines, Rural architecture, Renewable Energy, Retrofit.

INTRODUCTION

The energy refurbishment of rural architectural heritage that is, to all effects, part of the built heritage of acknowledged historical-cultural value, is a highly topical and delicate issue. Complex interventions on the built environment (whether restoration, conservation, recovery, refurbishment, restructuring, maintenance) that include forms of energy rehabilitation must always measure up, on the one hand, to the need to respect the existing, its morphological and structural system, material content and, on the other, to compliance with energy performance improvement demands with a view to ensuring eco-sustainability.

It is, therefore, a question of reconciling conservation/transformation of the building, an expression of acknowledged cultural values, with the necessary energy rehabilitation measures, assessing possible solutions able to guarantee environment-energy integration at building or micro-urban scale.

This is certainly not a new issue, but identification of a solution has become ever more urgent. The most recent regulatory norms in the construction sector as regards energy consumption and energy production from renewable sources, also applicable to interventions on existing architecture, impose various reflections in order to identify, if possible, guidance criteria and guidelines for an aware, attentive approach to the low energy and sustainable refurbishment of existing buildings, in particular where these express now remote ways of living and are characterizing elements of

the landscape and of local identity. Energy requalification in unique landscapes such as that of the hilly territory of the Langhe, which has submitted candidacy for inclusion in Unesco's World Heritage List, is an even more delicate issue.

At the initiative of the G.A.L. Mongioie, particularly attentive to sustainability issues, and of the G.A.L. Langhe Roero Leader, guidelines have been developed for the energy refurbishment of rural building and architectural integration of systems for the production of renewable energy for these territories.

FROM RECOVERY TO ENERGY REQUALIFICATION.

In the past, the problems of maintenance and renovation of rural architecture were addressed and solved with attention and care by the owners or users of the buildings. In recent years, in the wake of economic processes that have, to a varying extent, impacted the entire rural territory, most rural production and residential buildings, especially in mountain areas, have been abandoned and have lost their original function [1].

In the meantime, the material and construction culture that had generated and maintained the constructed rural landscape as transmitted to us has been gradually lost. Today, with newer economic and production prospects, forged by renewed vocations, including tourism of the territory, there is a tendency to restore rural areas and buildings to new functions without, however, the attention due to such delicate cultural landscapes [2].

All too often, recovery and refurbishment works fail to consider the origins, the past, the culture of the "peasant-builder" who, exploiting the limited means available, did everything possible to cater to living and production requirements using local resources (materials, climate, orography of the land, vegetation, etc.), thereby undermining centuries of rural construction culture.

The "Guides", produced all over Northern Italy [3,4,5], represent a first practical and applicable response to combating this tendency. However, in addition to those outlined above, a further, particularly pressing requirement has not emerged: that of approaching building recovery according to the general principles of respect for the environment for the sustainable development of rural areas. This need can be interpreted from various viewpoints with regard, for example, to selection of technological materials and solutions, the use of renewable energy sources, etc.

Catering to these aspects when recovering traditional buildings – "strong" in some respects and extremely "fragile" in others – inserted in delicate, often unique landscapes, may become extremely complex.

In requalification projects, the introduction of systems that use renewable energy sources is not sufficient to solve the problem. If, on some occasions, such as in the case of high altitude mountain villages, technology represents a solution to many energy problems, it may also thwart any effort to dedicate attention to the built environment and the landscape in which it is inserted. The problem of integration between architecture and technology for the production of energy from renewable sources must never be underestimated. The installation of energy production systems in rural buildings without due attention may, on the one hand, offer a

technical solution to the problem of energy procurement while, on the other, undermining the success of recovery operations in the rural context.

THE TERRITORY

The energy requalification guidelines refer to the rural architecture of territory of the G.A.L. Mongioie and G.A.L. Langhe Roero Leader and complete the guidelines for architectural recovery formulated in previous years and already tested [6,7]. The area concerned comprises part of Piedmont, a region of Northern Italy located in the more disadvantaged climate zones (E-F) according to the classification of the most recent regulations on reduction of building energy consumption. The reference territory comprises the G.A.L. Mongioie, with around fifty partly mountainous and partly hilly Municipalities, and the G.A.L. Langhe Roero Leader with around seventy hilly Municipalities.

The territory comprises the production zones of internationally-renowned wines such as the area of Barolo, Barbaresco, Nebbiolo, Dolcetto. The hills are mainly under vines with extraordinary landscape values which represent the “core zone” of the UNESCO candidacy. The not only production but also tourist vocation of the area, tied to the landscape and food&wine culture – this is also the production zone of the famous Alba truffle – has also spread to neighbouring territories, extending therefore beyond the limits of the “buffer zones”.



Figure 1. Langhe's landscape

Built heritage

The built heritage of the territory is both vast and extremely interesting, ranging from small dry stone buildings, found mainly in the mountain areas and hills of the Alta Langa, to large farmsteads and historic rural settlements perched mainly on hilltops.

In the zones of the territory dominated by specialised agriculture, rural buildings are almost always completely used although there have been cases of abandon also in the more productive zones, possibly due to gradual modifications to the management of agricultural work.

The territory where specialized agriculture has not developed is characterized by frequent abandon of rural buildings with the risk of serious losses also of a cultural nature. In these zones, located mainly in the Alta Langa and in the mountain areas of the territory (Alta Valle Tanaro and Valli Monregalesi), where entire rural settlements have been abandoned in the last 20-30 years, repopulation policies are now being adopted; therefore, it is important to guide recovery and refurbishment projects in order to conserve the identity of the territory.



Figure 2. Abandoned rural settlement

THE GUIDELINES

For energy rehabilitation of existing buildings, it is necessary to identify solutions able to combine compliance with the need to conserve what exists with improved energy performance, aiming to integrate the technologies adopted. From certain aspects, when intervening on buildings constructed with traditional techniques, usually characterized by masonry structures with high thermal inertia and reduced size openings, energy retrofitting operations may also be very limited.

Certainly, it is not possible to generalize: in all projects addressing existing buildings and even more so in the case of high prestige historic buildings, it is essential to adopt a “case by case” approach as each building, each urban or landscape ambit is unique with problems and characteristics that may require specific purpose-designed

solutions; this means not stopping at the first solution identified but going further, examining and seeking solutions that respond more effectively to the aims of the project.

Aware energy requalification of existing buildings must first of all consider passive technological solutions to reduce energy demand (for lighting, heating and cooling), followed by the use of active technologies in order to respond to energy demand, maximising use of the energy produced. The reduction of energy demand and integration of innovative technologies based on renewable energy sources in the existing built environment are the design challenges to be met.

The agricultural and tourist vocation of the territory imposes attention not only to recovery but also to energy requalification, which should never be considered a minor intervention but always as an action intended to improve the building in accordance with its identity and the culture that has generated it.

In view of the characteristics of the landscape and of traditional rural constructions, an appropriate approach must be adopted in energy requalification projects and, even more so, when inserting devices for the production of energy from renewable sources is involved.

The energy requalification guidelines developed are based on the following principles:

- energy requalification in a traditional rural building must comply with the characteristics of the building and its context;
- requalification must first of all aim to reduce energy consumption and only subsequently to introduce devices for energy production from renewable sources;
- each project must give priority to using natural, eco-compatible materials;
- each project must be assessed case by case;
- generally, the aim is to identify solutions that represent an acceptable compromise between energy requirements and the environment, rather than solutions that comply fully with energy aspects to the detriment of conservation of the building.

Structure of the guidelines

The Guides¹, which represent an integration of the Guides for recovery of rural architecture of the territory of the G.A.L. Mongioie [6] and of the G.A.L. Langhe Roero Leader [7], comprise two parts.

The first part outlines the main energy requalification and retrofit strategies. First of all, building energy consumption (and therefore energy demand) must be reduced with interventions on the opaque and transparent enclosure and to combat waste of precious resources such as water today.

The second strategy addresses integration of components that use renewable energy such as the sun, wind, the ground, water and biomass, and which should be to be adopted only after the first.

¹ The Authors of Guides to improve energetic behaviour and Renewable Energy in rehabilitation works of traditional rural architecture are Daniela Bosia, Roberto Marchiano and Fabrizio Perrone for G.A.L. Mongioie guidelines and Daniela Bosia and Roberto Marchiano for G.A.L. Langhe Roero Leader guidelines.

The second part provides indications and general criteria for selecting the most appropriate solutions taking into account availability of renewable energy sources and constraints imposed by the context. More specific guidelines, also inserted in a summary sheet, are provided for each type of building identified in the Guide for building rehabilitation works.

Main contents

The general guidelines address and guide selection of the most appropriate type of energy retrofitting and of any integration with devices for the production of clean energy according to the type of building and context, providing indications for verifying existence of the necessary conditions to assure sustainability and efficiency of devices used to produce energy from the sun, wind, water, the ground and biomass.

With regard, for example, to energy retrofit operations on the transparent building envelope, the guidelines recommend a conservative approach, ranging from improvement of the thermal performance of existing window, replacing panes with insulating glass, to installation of new window with suitable performance on the inside while maintaining the existing window on the outside, considering complete replacement of window as a last resort, to be assessed and addressed with attention only in the case in which the previous operations are impossible.

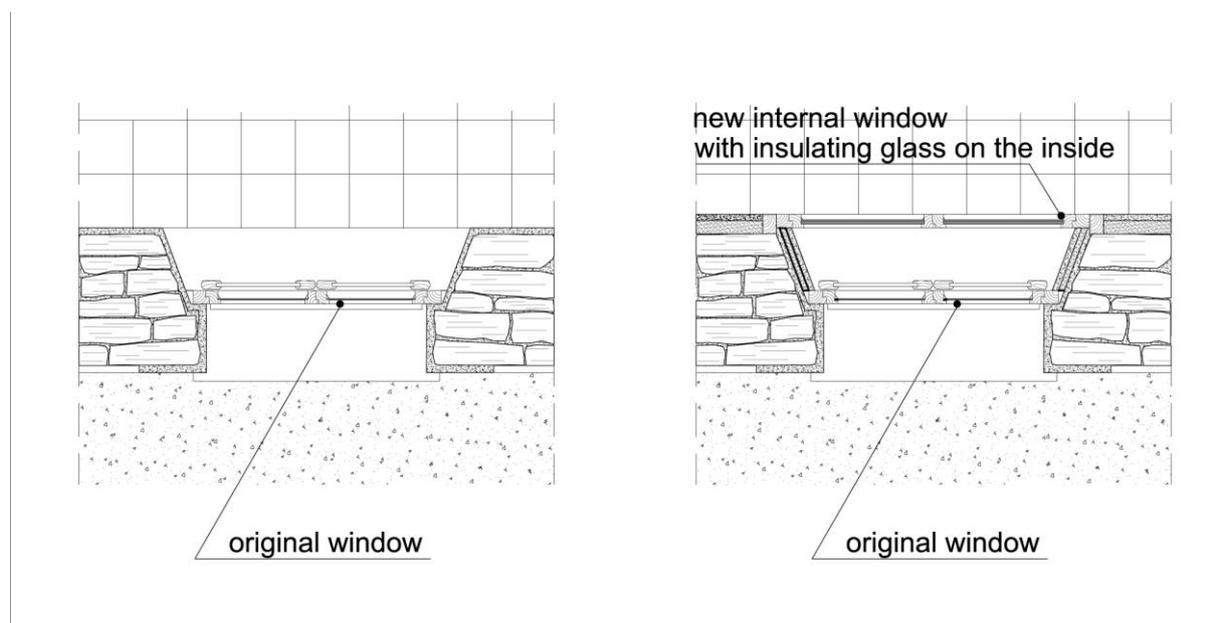


Figure 3. Energy retrofit operations on the window: plan-view drawings (G.A.L. Mongioie Guidelines)

For example, biomass systems are recommended in the case of locally available biomass, to avoid problems of transport, and are highly recommended in the case of buildings located in woody areas, in order to exploit the timber deriving from forest management, or for buildings forming part of agricultural holdings or farm holiday complexes that produce residual biofuels. However, indications regarding aspects requiring special attention and recommendations for installation of the necessary

devices (chimney stacks, chimney pots, hot water distribution systems, etc.) are also provided.

For photovoltaic and solar-thermal systems, which represent a high critical element of the architectural integration of existing buildings, installation on the roof or façade or to replace roofing elements is generally not recommended. Small ground-mounted systems and installation of semi-transparent photovoltaic modules or thin films on limited sections of the portico are permitted but must be attentively assessed case by case.

The guide also provides general and specific criteria for energy requalification of traditional rural buildings, organised according to type of building based on the constructions types identified by guides to the architectural recovery of buildings[6,7], drawn up previously as part of Leader+ program, one of four initiatives financed by EU structural funds and is designed to help rural actors consider the long-term potential of their local region².

In addition to a set of sheets outlining general principles and illustrating typical energy retrofit operations referring to the main elements of the opaque and transparent enclosure, the guidelines also include a series of indications and guidance design schemes referring to each building type.

The following are indicated for each type of building:

- a description of the type of building;
- general operating criteria, valid for the building type examined, in order to carry out the energy requalification project in compliance with the characteristics of the building and of the environment;
- design indications, specifying permissible interventions, those considered not permissible and interventions characterised by critical elements which are, therefore, not always to be excluded but which must be attentively assessed case by case.

Compatibility of consumption reduction and energy saving interventions and compatibility with regard to the installation of systems for the production of energy from renewable resources is then assessed for each type of building.

For example purposes, brief indications are provided of one of the most frequent types of intervention in rural areas: the re-use haylofts and utility buildings for residential or tourist-accommodation purposes.

In this specific case, in view of their original use, the buildings are completely devoid of any type of installations and require thermal insulation systems of the enclosure and closing of the large apertures of barns and haylofts. In this case, the installation of photovoltaic or solar-thermal systems on top of or to replace building elements and the use of exterior Insulation and finishing Systems (EIFS) are not considered permissible. The construction of solar greenhouses exploiting the openings of the haylofts, if facing South, and the installation of small ground-mounted solar systems, positioned so that they are not visible from roads, paths, footways or panoramic

² From http://ec.europa.eu/agriculture/rur/leaderplus/index_en.htm

viewpoints, are considered critical interventions to be assessed case by case and permissible only in certain situations.

EXPECTED RESULTS

The indications provided in the guidelines must be acknowledged by local authorities as an integral part of municipal regulations and therefore, become compulsory. The guidelines will be tested on a number of pilot interventions co-financed by the G.A.L. which may contribute to highlighting any application problems and also provide useful feedback for further actions.

It will be possible to acquire data useful in assessing the effectiveness of the guidelines only through checking and monitoring of the interventions. Certainly, previous experience relating to the architectural recovery of rural buildings in the same territory has been encouraging and it is hoped that significant results will also be achieved in the field of energy requalification.

It is also to be hoped that local authorities will promote the organization of territorial “recovery and energy” consultation points in order to promote an aware approach to recovery in rural ambits and to optimise eco-sustainability.

CONCLUSIONS

Projects for the recovery, energy requalification and insertion of devices for the production of energy from renewable sources referring to traditional rural buildings, carried out without due attention or according to the principles of new constructions may prove to be extremely destructive or negative.

The guidelines that have been drawn up cannot solve all the problems but can certainly steer the projects towards solutions more suitable for heritage buildings of historic interest and the context in which these are inserted, contributing to configuring an approach attentive to building energy performance but also to conservation of the cultural assets involved.

REFERENCES

1. Agostini, S., *Recupero e riuso degli edifici rurali*, Maggioli editore, Santarcangelo di Romagna, 2008.
2. AA.VV., *Rural Architecture in Europe between Tradition and Innovation*, Alinea, Firenze, 2005.
3. Musso, S.F. and Franco, G., *Guida agli interventi di recupero dell'edilizia diffusa nel Parco Nazionale delle Cinque Terre*, Marsilio, Venezia, 2006.
4. AA.VV., *Guida alla manutenzione e al recupero dell'architettura rurale intelvese*, Cesarenani ed., Como, 2006.
5. Ferrario, V., *Tabià. Recupero dell'edilizia rurale alpina nel Veneto*, Regione Veneto, 2006.
6. Bosia, D., Franco, G., Marchiano, R., Musso, S.F., *Guida al recupero degli elementi caratterizzanti l'architettura del territorio del G.A.L. Mongioie*, Tipoarte, Bologna, 2004.
7. Bosia, D., *Guida al recupero dell'architettura rurale del G.A.L. langhe Roero Leader*, Blu Edizioni, Torino, 2006.