



Remarks on the green retrofitting of historic buildings in Italy



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ABSTRACT

Latest European Union programs related to energy efficiency underline the need for retrofitting existing buildings, which are responsible for 40% of EU final energy consumption. Although new buildings can be constructed with high performance levels, the majority of the building stock, characterized by a low energy performance, still needs renovation. Thanks to its potential to deliver high energy and CO₂ savings, green retrofitting of existing buildings can thus play a pivotal role in creating a sustainable future. In this context, interventions on buildings constructed before 1945 (commonly defined as “historic buildings”) mean a higher benefit/cost ratio, because, in many cases, green retrofitting can be linked to unavoidable refurbishment works and renovated buildings can take on an interesting market value. However, an important part of these historic buildings in Italy is composed of cultural heritage buildings; these buildings require a specific design approach, and green retrofitting is often not attractive from an economic point of view. The remarks reported in this work aim to stimulate a discussion on operational procedures, barriers and challenges that investors, professional figures and supervisory authorities can encounter when they are engaged in the green retrofitting of historic buildings belonging to Italian cultural heritage.

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1. What does the green retrofitting of an existing building involve?

The building sector is one of the key consumers of energy in Europe, where energy use in buildings has seen an overall rising trend over the past 20 years [1]. In 2011, buildings in Italy affected the total final use of energy (138.4 Mtep) by 35% (47 Mtep), showing a progressive increase each year, till reaching 1 + 18.3% compared to 2000 and 1 + 46.9% compared to 1981. About 60% of such consumption (28.2 Mtep) is due to indoor climate control and production of sanitary hot water, and of this about 66% (18.6 Mtep) can be attributed to residential buildings, while the remaining part (9.6 Mtep) is attributed to service sector buildings, such as offices, schools, commercial structures, hotels and restaurants, hospitals, sports centers, etc. [2].

The existing building patrimony is extremely energy consuming because of the age of the buildings, of the type of materials used for their construction, of the absence of planned maintenance and because of the poor efficiency of the energy systems that supply the buildings. Moreover, more than 50% of the Italian building patrimony dates back to before the application of Law 373/76, the first

national law which, imposing the maximum installable thermal power for the heating of buildings in relation to the climatic zone and to the relationship between dispersive envelope surfaces and heated volume, obliges builders to introduce an adequate thermal isolation of the building envelopes.

The “green retrofitting” consists, on one hand, of the carrying out of suitable interventions to ensure a significant reduction in the energy demand and a rational distribution of the energy flows that affect the building system, from the perspective of maximizing the energy efficiency of the system itself and of exploiting renewable energy sources, and on the other, and more in general, of conducting interventions that would make buildings more “sustainable” and more “smart”, in terms of indoor environment quality, use of water, maintenance operations, energy uses control. The following interventions can therefore be considered part of the sphere of a green retrofitting:

- the improvement of energy performances of the building envelope;
- the substitution of obsolete components of the air conditioning system and of the lighting system;
- the management of natural ventilation;
- the passive cooling (in order to limit the spread of summer air conditioning, with consequent increases in electric energy consumption);

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- the monitoring of the indoor environmental quality and of the energy efficiency by advanced building automation systems;
- the replacement of the existing energy systems with others characterized by elevated efficiency, less impact on the environment and exploitation of renewable energy sources;
- the reduction of water consumption and the recovery and reuse of rainwater;
- the use of eco-compatible, recycled or recyclable materials.

Such interventions should be assessed, case by case, in relation to their technical feasibility.

2. Which cautions in cultural heritage buildings?

About 30% of the Italian building stock (12.5 million buildings) was constructed before 1945, the year that saw the beginning of building reconstruction and industrialization in Europe. If the definition is assumed according to which buildings that belong to a different period from the present are considered historical, and are therefore material testimony of civilization, this part of the stock can be considered “historical buildings”.

From this set of historical buildings, a part, equal to about 1.8%, can be considered to belong to the cultural heritage, according to Legislative Decree no. 42 of 22 January 2004 pertaining to the Cultural Heritage and Landscape Code [3], in that they are buildings which, showing elements of artistic, historical, archeological or ethno-anthropological interest, are subject to protection by the competent Ministerial Authorities.

These protected buildings cannot be destroyed, allowed to deteriorate, damaged or used for purposes that are not compatible with their historical or artistic nature, or for such use that would jeopardize their conservation, and the authorizations relative to the conduction of the interventions, including those pertaining to energy efficiency, are released by the department responsible for the cultural heritage of the territory. Buildings of this type, whether of public or private property, are found extensively in urban centers in Italy and are frequently used for service activities of various kinds, such as local government headquarters, public organization administrative offices and credit and insurance institutes, but also for activities involved in promoting the development of culture, such as museums, libraries and archives, where mobile cultural goods of historical, artistic and ethno-anthropological interest are kept and displayed.

It is not known what amount of the final use of energy can be attributed to these buildings, but it is certain that those that are inhabited require a remarkable quantity of energy compared to the amount requested for new buildings used for the same purposes.

On the other hand, uninhabited buildings, when subjected to building interventions that allow them to be recuperated and used for residential or service purposes, can become consumers of a remarkable quantity of energy, considering that building recovery interventions of cultural heritage buildings can be conducted, notwithstanding the current regulations. It is therefore not rare that an investor, after a recovery intervention, complains about “excessive” energy consumption.

However, on the basis of the above mentioned Cultural Heritage and Landscape Code, any intervention on such buildings must be preceded by a “coherent, coordinated and programmed study, prevention, maintenance and restoration activity”, where “prevention” means the set of activities that are suitable for the limitation of situations of risk connected to the cultural goods in their context, “maintenance” means the set of activities and interventions that are used for the control of the conditions of the cultural goods and the maintenance of their integrity, of their functional efficiency and of the identity of the goods and of their parts, while

“restoration” means the direct intervention on the goods through a set of operations aimed at the integrity of the material and recovery of the goods themselves, as well as at the protection and at the transmission of their cultural values.

Particular attention should therefore be paid to the designing of the green retrofitting of the historical buildings that make up the Italian cultural heritage; it is from this that the interest of the Italian Cultural Heritage Ministry (MiBAC) has arisen, which started up a dialogue with both ENEA, in order to arrange an action program for “the improvement of energetic efficiency and the reduction in consumption and in the dependence on traditional energy sources in the state’s cultural sites”, and AiCARR, in order to draw up guidelines of a technical nature to direct and check green retrofitting interventions, all within a context of irrevocable protection of the real estate on which the interventions are made [4].

3. The needs: A key factor of a green retrofitting project

The functional reorganization and/or the refurbishment of a building of historical or artistic value, whether constructed in the first half of the twentieth century or in the previous centuries, involves a change in the internal environmental conditions (temperature, relative humidity, quality of the air, lighting) in relation to the foreseen final use: in the case of a building which, even after interventions, remains museums of itself, the environmental conditions are determined by the conservation needs of the furnishings, the frescos or the works of art; in the case of a building that undergoes a change in use or which takes on a new use for the first time, the environmental conditions are determined by the needs of environmental comfort.

In the case of buildings constructed before the XIX century, that is mostly aristocratic buildings and mansions conceived to be used as habitual residences or representation buildings, because of the absence of HVAC systems, environmental comfort conditions were in fact allowed that today would be considered completely unacceptable, or conditions which have objectively determined the progressive degradation of the building and of its contents. In buildings constructed in the twentieth century, the installed mechanical and electric systems are now obsolete and unsafe, and the building envelopes are not thermally insulated and, as a result, the use of the building requires heavy interventions.

Particularly the changes in the indoor environmental conditions lead to the installation of new HVAC systems or the renewal of existing ones, with consequent energy consumptions. Furthermore the HVAC systems exert an unavoidable duress on the pre-existing construction as they come from a different dwelling culture and from a different technological culture; so the HVAC systems should only be installed when absolutely necessary.

The transformation of an eighteenth century ballroom into a modern conference hall, or a contemporary art gallery exhibition hall, could be compatible, in both architectonic and structural terms, and could be authorized by the cultural heritage protection authorities, but all of the actors involved in the project should be made aware of the fact that such a transformation involves the installation of a power plant, air handling units, as well as air ducts and piping, all of which are technological objects that have to be added to the original building structure, after having found suitable technical spaces. Whoever has professional experience in this field knows that it is in fact the occurrence of changes in the environmental conditions, following a modification of the changes in use of a building, rather than the architectonic and artistic restraints, which animates the dialogue between designers, owners and cultural heritage protection authorities: HVAC systems, with their invasiveness

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