Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 111 (2017) 426 – 434

Energy Procedia

8th International Conference on Sustainability in Energy and Buildings, SEB-16, 11-13 September 2016, Turin, ITALY

Energy resilience of historical urban districts: a state of art review towards a new approach

Cantatore Elena[a]*, De Fino Mariella[a], Fatiguso Fabio[a]

[a]*Polytechnic of Bari, Via Orabona 4, Bari 70126, Italy*

Abstract

The paper points out the opportunity to address the current need for energy retrofitting of the historical built heritage according to a long-term perspective. For this purpose, it focuses on the concept of resilience, through a state-of-the-art review of ongoing studies and researches. Particularly, it pays attention toward the historical urban districts as integrated systems, where economic, social and cultural values should be protected in order to persist during the time. Thus, it recommends "sustainable" strategies that, beyond the thermal improvement, should achieve a resilient vision linked with the dynamic capability to adapt to climate changes by energy self-sufficiency.

Peer-review under responsibility of KES International.

Keywords: energy resilience; adaptability to the climate changes; historical urban districts; energy improvement

1. Introduction

Following the oil crisis and the high level of environmental pollution, all the countries are undertaking different levels of actions aiming to re-create a new balance between humankind and nature (Kyoto Protocol). Starting from the nearest goals of the 2020 European program, all the European production sectors (construction, environment, transport, energy and so on) have reacted to decrease the CO_2 emissions and to exploit all kinds of energy useful to ensure the human well-being. Within this context, the building sector represents a crucial case as responsible of about 40% of non-renewable energy use [1]. Moreover, some on-going studies have demonstrated that more than 55% of CO_2 emissions could be decreased by retrofitting the building envelope [2]. Even if all the targets are required for new and existing buildings, the historical heritage has an uncertain destiny. In fact, two different points

* Corresponding author. Tel.: + 39 3401492930.
E-mail address: elena.cantatore@poliba.it

Peer-review under responsibility of KES International.
doi:10.1016/j.egypro.2017.03.204

of view have to be analysed. In one hand, historical buildings represent the culture and practice of the "*genius loci*". Consequently, the preserving attitude is widespread. On the second hand, in some European countries (such as Italy and Spain), they represent a relevant share of the total building stock (residential especially). Furthermore, comparing their energy use and their extent, the real incidence on the total consumption and the emerging necessity to reduce it can be understood.

Analysing the European legislative framework, such as the Energy Performance Building Directive (EPBD) 2002/91/EU, the energy improvement of buildings is the overriding strategy. However, a particular treatment has been committed to the historical buildings. In fact, according to the energy directive, after the transformation of such buildings, "*their cultural and social values could be jeopardized*". Therefore, the EPBD waived all the mandatory transformations to improve the thermal transmittance of the envelope for them. Looking at this double perspective, several European research groups have encouraged different strategies of action aiming to decrease the energy consumptions and to preserve cultural and social values of historical architectures. However, all the experiences were applied to singular case studies, often on public structures, which do not represent the previously described majority. Other initiatives have been promoted by National Institutions, such as the Italian guidelines on "Energy improvement action for historical buildings". Nevertheless, they still follow a case-by-case strategy.

Such relevant experiences, along with the necessity to improve at the smaller urban scale the thermal behaviour of the buildings and with the absence of a specific legislative framework merged into some new singular cases. These ones, even if technically correct, have been alienated from the "*unicum*" of the context. In fact, although all the buildings in the historical centres could appear unique, they are actually the result of a particular combination of morphology, typology, construction techniques and materials, namely the result of a relation with the particular context where they are. For these reasons, an integrated and coordinated approach is required to improve their energy performances, by safeguarding the harmonious identity of the whole historical districts. Furthermore, a focus on the time limit is paramount. According to the law, all the targets previously described have a due time. In fact, the EPBD forced all the state-members to revise the targets every 5 years, so that all the previous case studies have been transformed working toward these temporary targets. Thus, the interventions represented surely a new positive starting and undoubtedly. However, the real problem of thermal equilibrium to increase energy consumptions is the evaluation of the evolving boundary conditions such as the changing local climate. Due to the increasing temperature, especially in the Mediterranean Area [3], the great challenge relates to the future energy point of balance, which ensures firstly the actual energy target and the future capability to adapt to new energy necessities and climate. Therefore, the proposal aims to understand how historical buildings could react after such particular stress. In fact, considering the historical residential buildings and their aggregates as a particular macro-system, the "*energy resilience to the climate change*" could be explicated as "*the capability of the macro-system to adapt to the future energy requirements caused by the climate changes*", starting from the analysis of the state-of-the-art of the resilience meaning and its features in literature. The present study represents the first step of a wider research work for the definition of a framework of integrated actions for energy improvement of buildings in historical districts in a long-term perspective.

Nomenclature

EPBD	Energy Performance Building Directive
UNISDR	United Nations International Strategy for Disaster Reduction
CRPP	Cities Resilience Profiling Programme
ACCCRN	Asian Cities Climate Change Resilience Network
MCEER	Multidisciplinary Centre of Earthquakes Engineering Research

2. Resilience meaning and the climate change challenges

Holling firstly introduced the concept of resilience [4], according to the ecological perspective, as the feature of a system "*to absorb changes of state variable, driving variables, and parameters, and still persist*". Thus, he underlined the capacity of the system to undergo disturbances and maintain its functions and controls [5]. Some