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Maturity Matrix Assessment: evaluation of energy efficiency strategies in Brussels historic residential stock

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Abstract

Energy retrofitting of historic or existing buildings is a challenge that it has not yet been properly fully addressed. Multiple projects and methodologies are published every day but neither of them with the holistic approach that will assure complete success since the design phase. This stock is never considered as a whole. Its components are installed, serviced and maintained by different companies and in different stages without a holistic approach to the overall building operation. The result is a lack of energy efficiency and feedback of the solutions implemented once the buildings are refurbished. Nevertheless, existing buildings play a key role in the achievement of the ambitious energy saving and greenhouse gas reduction targets that Europe has fixed for 2020 and 2050. Research has demonstrated that the impact in terms of decrease of energy use and CO_2 will be strong, considering that, in Europe, 80% of the 2030 building stock already exists and 30% are historical buildings. To achieve these goals, reliable data about energy consumption, building components and systems performance of the existing building stock is needed.

This paper presents a pre-assessment methodology to tackle the energy retrofitting of historic and existing residential buildings based on the Maturity Matrix Assessment. The maturity of the implementation of energy efficiency measures in Brussels historic residential stock is evaluated to determine future appropriate implementations. The matrix synthetizes appropriate strategies for this specific stock and provides a global map of the problematic, requirements and solutions.

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Keywords: Maturity Matrix Assessment; Historic Building; Brussels Residential Stock; Energy Efficiency; Built Environment.

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Nomenclature

BCR	Brussels Capital Region
EC	European Commission
EPB	Energy Performance of Buildings
EPBD	Directive on Energy Performance of Buildings
EU	European Union
GHG	Greenhouse Gas
H2020	Horizon 2020, Framework Programme for Research and Innovation
MMA	Maturity Matrix Assessment
PEB	Performance Énergétique des Bâtiments

1. Introduction

Buildings are at the centre of our social and economic activity. The built environment is not only the largest industrial sector in economic terms, it is also the largest in terms of resource flow [1]. Buildings are intrinsically linked to European societies, economies, and their future evolution. Energy security and climate change are driving a future that must show a dramatic improvement in the energy performance in Europe buildings [2].

The 28 European Member States have set an energy savings target of 20% by 2020 and 80-95% greenhouse gas (hereafter GHG) emissions reduction by 2050 as part of the roadmap for moving to a competitive low-carbon economy in 2050 [3]. The building sector is the highest energy consumer in the European Union (hereafter EU), with about a 40% of the total final energy consumption [4], and main contributor to GHG emissions with about a 36% [5] of the EU total CO_2 emissions what identifies it as a major contributor to the achievement of those goals.

In the Energy Efficiency Plan 2011 [6], the European Commission (here after EC) states that the greatest energy saving potential lies in buildings. The minimum energy savings in buildings can generate a reduction of 60-80Mtoe/a[4] [7] in final energy consumption by 2020, and make a considerable contribution to the reduction of GHG emissions.

Moreover, the annual growth rate of new buildings is currently estimated at around 1-1.5% [8] while the number of buildings removed from the stock is about 0.2 – 0.5% a year [9]. This means that the 80% of the 2030 building stock already exists [10]. Hence, it is the older buildings, representing the vast majority of the building stock, which are predominantly low energy performance and subsequently in need of renovation work.

This study addresses the historic buildings – those built prior to 1945 -- and, in particular, those devoted to housing. In fact, the residential stock is the biggest segment with an EU floor space of 75% of the building stock. However, the energy performance of dwellings is generally so poor that the levels of energy consumed place the sector among the most significant CO_2 emission sources in Europe. It is clear that these buildings are in general not energy efficient and are substantial contributors to GHG emissions and rising energy bills. At a time when climate change poses a real and urgent threat to humanity and its infrastructure, it is vital to initiate an improved approach to the refurbishment of historic housing, which in many cases are in danger themselves [11]. Currently, the number of refurbishments accounts for roughly 2% of the housing stock and only a 5% of heating systems replaces a year [9]. This rhythm is not sufficient to reach the energy saving deadline.

On the other hand, one of the main problems encounter while studying the approach to the retrofitting of historic buildings is the lack of understanding of the current building stock. Fragmental approaches are promoted over global vision what produces strong discrepancies between the calculated and the expected outcomes by not taking into consideration interactions between the different strategies. Retrofitting buildings one by one will never solve climate change problems. Moreover, residential buildings are never considered as a whole. The result is a lack of energy efficiency, and in some cases functionality, once the buildings are refurbished.

Finally, there is a lack of data on the building sector what supposes a major obstacle to take the right decisions over a specific building stock and, even, to develop policies. In the case of the European building stock, "*for strong policy making at EU and member State level, it is key to establish an efficient monitoring system assuring good data availability and data quality*" [2].