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DEEP RENOVATIONS WITHIN SMART ASSET MANAGEMENT

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Abstract
To cut emissions of building stock, the European Union had set minimum requirements to the energy efficiency of buildings in Energy Performance of Buildings Directive. Member States are encouraged to promote energy upgrading for the higher level by Energy Efficiency Directive, EED Article 4. In this, instead of setting new requirements, focus is on the operating environment. How it could better promote the voluntary deep renovations. The Paris Agreement on climate change imposes increasingly ambitious targets and speeds up progress towards carbon-neutral societies.
Finding energy-saving measures that do not increase the cost of living is nevertheless important for all households. Everyone agrees that incorporating measures that improve energy performance into normal structural repairs is the most sensible approach. This makes the measures the most economical to implement. From the perspective of all levels of education and businesses' product development, it is important to agree on what "normal structural repairs" encompass, in order to be able to target investments correctly.
To fulfil this kind of information need, the ASPE 15 (Need for the renovation of the housing stock) model has been developed. The main input data is the building typology and number of buildings in each category. In co-operation with stakeholders and by means of case studies, both the usual and the deep renovation measures have been identified. The first results show significant changes in the content of future renovation activities. There are changes both in renovation activities and where they are located.

Keywords:
Asset management; housing stock; energy efficiency; deep renovation; upgrading

1 INTRODUCTION

At the beginning of 2014, the European Commission published climate and energy policy targets for 2030. These include a reduction in greenhouse gas emissions to 40 per cent below the 1990 level, and an EU-wide binding target for renewable energy of at least 27 per cent [1].

The action plan for the implementation of the Europe 2020 strategy, published in 2011 [2], focuses on improving the energy performance of buildings in connection with renovation projects. The Article 4 of the European Energy Efficiency Directive adopted in 2012 [3] urges Member States to mobilise investment in the deep renovation of the national residential and commercial building stock.

According to the Paris Agreement [4], all countries will, in the future, have a responsibility to plan and implement cuts to their emissions, and to report these cuts openly and transparently. Each country can choose its own approach to implementation according to its level of development, but more and more ambitious targets need to be adopted over time.

Buildings currently account for approximately 40 per cent of total energy consumption in Europe. Over half the building stock that will be in existence in 2050 has already been built. Energy performance of existing buildings will need to be

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improved, and fossil fuel emissions will have to be cut for Europe in order to meet the targets set in the EU's climate and energy policy. The means to achieve these goals include minimising heat loss, recovering heat from extracted air, increasing the efficiency of electricity use and promoting renewable sources of energy, such as geothermal heat.

Only a minority of the housing stock is owned by central government. This means that the majority of renovation decisions are made by private individuals, real estate companies or local governments. The rights of property owners are protected by law. In other words, the central government cannot obligate property owners to improve the energy performance of their properties. Instead, they must be enticed into renovating their properties voluntarily.

When the European Energy Performance of Buildings Directive (EPBD) [5] was transposed into national legislations, there was speculation that excessively strict requirements would lead property owners to neglect the maintenance of their properties: property owners would be discouraged from undertaking renovation projects at all if these led automatically to considerable extra cost.

2 GOALS

The main goal is to establish, on a macro level, how the current building stock can be made more energy efficient. The first task is to identify the normal structural repairs that will need to be carried out between 2015 and 2035 due to migration, population ageing, and increasing health and safety requirements in buildings. The second task is to determine how measures aimed at improving energy performance can be incorporated into these repairs.

3 SCOPE

There are two ways to renovate residential buildings. The majority of renovations, both quantitatively and qualitatively, are driven by residents' wishes, and they focus on improving buildings' appearance and upgrading systems. These kinds of improvements are not a part of this project.

This project focuses exclusively on technological improvements stemming from the wearing, ageing and breakdown of structures and systems. Such needs for improvement can be predicted by means of the service life of various structures and systems. [6]

4 METHODOLOGY

The two methods adapted in the project are interactive process with stakeholders and statistical analysis.

4.1 Interactive Process

In order to ensure that property owners chose to introduce energy-efficient solutions into their existing properties, the requirements needed to be acceptable to those who ultimately made the decisions. Without interaction, unrealistic goals will be easily set, as has been the case in the Netherlands [7].

In this project, the provisions were, therefore, formulated in cooperation with property owners. They were asked to share information on issues such as the cost-effectiveness of different measures. Many solutions that are relatively inexpensive and easy to incorporate into new developments can be difficult and costly to introduce into existing building stock. One example would be installing air-conditioning in a building that lacks the necessary air ducts. On the other hand, energy efficiency can be improved considerably by simple, inexpensive measures, such as balancing and adjusting central heating systems.[8]

4.2 Statistical Analyses

The renovation needs of residential buildings can be identified with the help of the so-called ASPE model [9] [10]. This model has been developed specifically for examining the need for technological improvements and operational upgrades in buildings. In this research project, an evolution version ASPE 15 model was developed for reviewing energy efficiency improvements.

The variables used in the model are the type, age and location of buildings. The type and age of a building determine what renovations need to be carried out and how much is likely the cost. Evaluations need to take into account the fact that different construction technologies have been used in different eras, and, on the other hand, the fact that even buildings of similar age can incorporate structures that have widely divergent useful lives. This Finnish model has a lot of similarities with Norwegian housing stock model as it regards renovation [11]. The difference is to bring coming new construction as input data from an other model.

Location determines whether renovations are worthwhile, i.e. whether the building will also have a use in the future. Sometimes it makes sense to modernise buildings to meet new needs. One example is incorporating a lift to make a building better suited to older people. The development of building service systems has added new features to old buildings over time. The current drive to improve the energy performance of buildings will create a whole new wave of modernisation across old properties' building service systems.

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5 RESULTS

5.1 Empty units

There are a significant number of buildings that could potentially be made more energy efficient in connection with normal structural repairs. The question raised in discussions with interest groups, however, is whether all buildings are worth renovating. According to the banking sector, there are areas where buildings cannot be accepted as collateral for mortgages in areas where population is decreasing.

Population forecasts for these areas were consequently examined more closely. It was found that these areas have what is known as a "greying population".

5.2 Pre-fabricated apartment buildings

The industrialisation of construction (pre-fabrication over on-site construction) has changed building technology significantly. Energy upgrades are needed both in old buildings constructed on site and in slightly newer, industrially constructed buildings. Different approaches are needed to renovate the two types of buildings.

Due to their thick, solid walls, older buildings actually consume less energy, but renovating them is more expensive due to the high proportion of manual labour involved. Renovating older buildings also costs more due to the fact that there are more areas that require attention than in newer buildings.

Buildings constructed during the early years of industrialisation have the worst energy performance of all buildings. Energy efficiency could therefore be increased the most by focusing on buildings that were constructed during the early years of industrialisation. Developing industrial renovation models, products and services specifically for these kinds of properties is a worthwhile investment.

6 DISCUSSION

6.1 Empty units

Urbanisation is a growing trend all around the world. Both natural population growth and migration contribute to urbanisation. Migration means that an increasing number of residential buildings in the countryside are left empty. From the perspective of material efficiency, this is an unfortunate but inevitable scenario. The question of whether there will be demand for homes in an area in the future can be answered by comparing population forecasts to the existing building stock.

If no demand can be seen for a property in the future either, the most energy-efficient solution is to abandon the building. Eliminating excess empty space would increase the energy performance of the national economy. Demolition may be an option if a property has stood empty for a long time and the owner is unable to find an alternative use for the building. Buildings on inefficiently developed plots in growing urban areas have occasionally been demolished to free the land for new housing with more floor space. New buildings are more energy-efficient than the ones demolished so as to make way for them.

If there does appear to be demand but only for a relatively short period of time, it is prudent to avoid deep renovations. However, no opportunity to improve energy performance should be ignored altogether.

6.2 nZEB and deep renovation

Article 4 of the EED requires member states to establish a long-term strategy for mobilizing investment in the renovation of the national stock of residential and commercial buildings, both public and private. This strategy must encompass 'policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations'.

Nearly Zero Energy Building, nZEB target will add a so-called nearly Zero Energy Building Renovation, nZEBR complimentary element to deep renovation strategy. Hitherto, deep renovations have been voluntary. In future, they will gradually become mandatory. nZEBR has different definitions. One definition is to reduce the primary energy consumption by 75 per cent compared to the pre-renovation status. An alternative definition for nZEBR is to satisfy at least 50 per cent of energy consumption by renewable forms of energy. There are also other options. So far, there is no clear definition of nZEB renovation [12].

Based on the results of this study, the 75 per cent target is only justifiable for buildings of extremely low energy performance at the moment. A European study [13] arrived at the same conclusion. The promotion of smart and integrated nZEB renovation measures in the European renovation market, NEZER project concluded that the target is only feasible for buildings constructed before the year 1980. For newer buildings, the target is too ambitious. According to our study, no line can be drawn on the basis of the year of construction, as some older buildings were actually renovated with energy efficiency in mind during the 1970s energy crisis.

Increasing the percentage of renewable energy to meet the target is relatively easy in respect of single family houses. The target is also technologically feasible in multifamily houses, but more difficult to implement in practice. What makes renovating multifamily houses especially challenging is the fact that decisions need to be made collectively and the fact that some of the necessary measures may be dependent on a centralised energy supplier. The majority of

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multifamily houses are located in densely populated areas, where there is little room for harvesting renewable energy. It is nevertheless important to remember that renovating buildings up to the nZEB target is only ever justifiable if there is long-term demand for them.

6.3 Self-paying renovations

Housing costs need to be kept in check even in the face of demands to improve the energy performance of buildings. One way to curb housing costs is to lower energy consumption (heating, cooling, ventilation, hot water, and lighting). The Promotion of smart and integrated nZEB renovation measures in the European renovation market (NEZER study) demonstrated that energy consumption can be lowered by between 30 per cent and 80 per cent. There is more potential in old buildings than in newer ones. Lower energy consumption can help to finance building renovations and keep housing costs under control. From this perspective, renovation technologies need to be as affordable as possible.

Energy efficiency can only be improved if the renovation project is carried out professionally and with up-to-date technology from start to finish. Clients need to specify what they wish to achieve with the renovation in terms of energy efficiency; the engineers need to find the means to meet these objectives, and the builders need to carry out the repairs and ensure that the energy performance targets set are reached in practice. Regulations and recommendations need to be supported by high-quality engineering and building know-how. Emphasis must be placed on the importance of careful planning and skilled builders in achieving a high-quality end result.

The energy performance of buildings is a goal and research topic shared by many countries. New technologies and solutions come from investing in a common objective. New solutions need to be tested in real environments, and this requires that regulations are waived so as to enable the testing of breakthrough technologies.

The concept of energy efficiency as an integral part of all renovations should be emphasised by incorporating it into the curriculum at all levels of construction education. Energy efficiency and renovations are essential elements of life cycle management, a discipline that has so far largely been neglected in education in favour of courses focusing on new construction. Courses are needed for both young students and workers, and for both new recruits and professionals who have already established themselves in the industry.

Material efficiency as part of life cycle management should be factored into teaching. Courses focusing on renovation projects should include lessons on ways to improve energy efficiency as well as new technologies. Virtual learning resources would also be a way of making the information accessible to individuals already in the labour force.

Cost of the renovation work will get higher even there are new technologies in use. Just now the price of the energy is decreasing. The combination of these things will decrease cost-effectiveness of the renovation work. For ordinary people the payback time is more important than carbon dioxide decreasing. During times where there are low energy cost and high renovation cost there are difficulties to activate deep renovation which reduce energy use of buildings.

7 SUMMARY

In order to reach climate and energy targets set to building sector, measures need to encompass the majority of building stock. There is a lot of potential to lower energy consumption in theory, but in practice, there are a number of obstacles. The problem lies in the fact that most of these kinds of decisions rest with private individuals and many buildings are not worth energy conservation.

Property owners cannot be obligated to improve energy performance by renovating structures and systems that are otherwise serviceable. This is why the way forward is to encourage property owners to introduce these kinds of improvements in connection with normal structural repairs and system upgrades. This is also the most cost-effective way to improve the energy performance of existing buildings.

Decisions on renovations need to take into consideration whether buildings will have a use in the future. Population ageing and urbanisation will see more and more buildings left empty in the near future. Deep renovations in these kinds of buildings are probably not worth the investment.

The concept of energy efficiency as an integral part of all renovations should be emphasised by incorporating it into the curriculum at all levels of construction education. Energy efficiency and renovations are essential elements of life cycle management, a discipline that has so far largely been neglected in education in favour of courses focusing on new development. Courses are needed for both young people and more mature students, and for both new recruits and professionals who have already established themselves in the industry.

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