Upgrade or Replace?
The effect of the EPBD on the choice between improvement or replacement

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Abstract (Revised)

What is better: improvement or replacement by new construction?
The choice between life cycle extension and replacement of existing buildings is at itself a vital but very difficult decision, involving a wide range of different aspects and affecting several contrary and often conflicting interests.
The emerging ecological awareness of the building and real estate trade tends up to now mainly towards improving the energy efficiency of buildings. The introduction of the European Energy Performance of Buildings Directive (EPBD) is intended to seduce proprietors of existing buildings to upgrade their stock to the green top of the label range. Especially in the case of older building, the question will raise to what extent the investments needed to achieve that level countervail replacement by new construction.
In the past decade we studied the decision making on demolition in the Netherlands. Based on the available literature and statistical data we analysed the actual practice in the Netherlands and built a conceptual framework for further comparative and case study research. In addition to this research we placed the choice between improvement and replacement in a sustainable context, made an inventory of existing literature about comparative findings, analysed the outcomes and compared them with our own findings. Overlooking the results so far we concluded that life cycle extension by renovation and reuse of existing stock is generally more sustainable, more effective and more efficient as replacement by new construction. But how valid is this conclusion under different circumstances, in particular substantially aggravated energy performance requirements?
To answer this question, our paper distinguishes the most determining variables for the decision-making, discusses the possible outcomes and concludes with recommendations for the decision-making process.

Keywords:
decision-making, demolition, energy efficiency, energy performance, housing market, life cycle extension, renovation, tenure
1. Introduction

The choice between replacement and life cycle extension of existing buildings implies a vital but difficult decision. It involves a range of aspects and affects contrary and often conflicting interests. In the past years we studied decision making about this subject in the Netherlands. We analysed actual practice and built a conceptual framework for comparative and case study research. In addition to this research we placed the choice between improvement and replacement in a sustainable context. Overlooking the results we concluded that life cycle extension by renovation and reuse of existing stock is generally more sustainable, more effective and more efficient as replacement by new construction. But how valid is this conclusion under different circumstances? Will the outcome of the decision making about the choice between reuse and replacement be different as a result of the changing context we are confronted with?

A recent example of the changing context is the European Energy Performance of Buildings Directive (EPBD), introduced in 2002 (EU 2002). An important objective of the EPBD is to stimulate proprietors of existing buildings to increase the energy efficiency of their buildings. The underlying assumption is that clearness about the energy performance will make owners and users aware of the energy efficiency and will thus influence their behaviour as well as the property value of the buildings. Combined with other incentives like tax discounts and publicity campaigns the expected result is a boost in investments in the energy efficiency of the built environment. Recent Dutch publications support this expectation, as e.g. the housing associations have promised a 20% reduction of energy consumption in the next 10 years by combining renovation and refurbishment with energy efficiency improvement (Min.VROM 2008). On the other hand the involved extra investments will influence the decision between life cycle extension and replacement. Especially in the case of older building, the question will raise to what extent the investments needed to achieve the required level of energy performance countervail replacement by new construction.

In this paper we will discuss the possible impact of a 20% reduction of energy consumption on the decision-making about replacement and reuse. We will answer three questions:

1. what does a model of the decision-making about improvement and replacement look like; what are the main variables and how are they related?
2. what is the possible impact of the required improvement of the energy efficiency and related influential variables on the decision-making about improvement or replacement?
3. what conclusions can be drawn and what recommendations can be made?

Background and origin of the main evidence is the Netherlands resp. the Dutch housing stock.

Since the changes in the context are of recent date, the answering of the last two question will take the form of an ex ante evaluation and will be partly speculative. This is acceptable as the goal of this exercise is not to attain hard outcomes but to gain further insight in the decision making process, to improve and further develop our conceptual model and to underpin further case studies.

The first question will be answered in section 2, question 2 and 3 in successively sections 3 and 4. Section 5 contains the conclusions.
2. Decision making, model and variables

To answer research question 1 we use the findings in previous research. In Thomsen A. & van der Flier K. 2009a we distinguished a number of determining variables influencing the choice about re- or disinvestment in the life span of dwellings:

- Object related factors:
  - Physical quality: building type, building age, building quality;
  - Economical quality related factors: housing market, value, assets.

- Owner related factors:
  - Tenure: ownership, scope, goals and targets;
  - Capacity: resources, means, organisation.

Fig. 1. gives an overview of the main factors in a conceptual scheme:

*Fig. 1. Decision making about demolition, conceptual scheme*

![Decision Making Conceptual Scheme](image)

Most of these factors and variables are interrelated and the impact of changes are interdependent. This is in particular true for tenure.

Regarding proprietors motives we found decisive relations between ownership (rented vs. owner-occupied) and motives (quality vs. profit driven) as shown in Table 1 (Thomsen & Van der Flier 2009b).

*Table 1. Ownership and demolition motives*

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Motives to demolish</th>
<th>Profit driven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rented</td>
<td>building condition</td>
<td>land value</td>
</tr>
<tr>
<td></td>
<td>dwelling quality /suitability</td>
<td>property yield/value</td>
</tr>
<tr>
<td>Owner-occupied</td>
<td>building condition</td>
<td>land value</td>
</tr>
<tr>
<td></td>
<td>dwelling quality /suitability</td>
<td>property value</td>
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</tbody>
</table>

Overlooking factual demolition in the Netherlands, tenure can be more specifically narrowed: Rented is in practice social rented, as both demolition as well as intensive renovation by commercial landlords is almost non existent; smaller private landlords have no recourses for re- or disinvestments and larger institutional landlords have no motives as they have sold their older stock long before the question
arises. Owner-occupied is in practice owners of detached houses, as demolition of semi-detached or row houses requires simultaneous accordance between multiple owners. Important exception is demolition after purchase by developers or municipalities to realise urban plans; though not necessarily profit driven, the result is similar.

We will use Table 1 in the next chapters to identify decisive changes in energy performance requirements and relevant influential variables - question 2 - and the effects on the decision making - question 3.

3. Changes in energy performance and relevant influential variables

Changes in the context are by definition almost countless. This paper focuses on the possible effects of a 20% reduction of the energy use of dwellings. But changes seldom come alone and the effects are largely influenced by other variables as economy, market situation, tenancy and owners motives.

In this section we discuss energy performance as main variable on the decision making and - as far as relevant - to what extend influential variables have interfering impacts on the outcomes.

3.1. Energy performance (EP) of dwellings

Up to now, energy efficiency is the most developed component of physical sustainability.

With respect to sustainability, a distinction should be made between the use of harmful CO2 producing finite fossil energy sources, or emissionless renewable energy sources. The energy efficiency of dwellings looks at reduction of the first and replacement by the latter (EU 2002).

The energy efficiency in the residential sector is determined by two different factors (Koene et.al. 2010):

- the energy performance - or building related energy efficiency - of dwellings - further indicated as EP -, and
- the behaviour of the residents - or user related energy efficiency, which is in the scope of this paper less relevant.

The energy performance of dwellings is determined by two different features:

- the energy efficiency of the construction (reduction of consumption and loss by e.g. design, installations and insulation), in Western Europe mainly concerning spatial heating (natural gas/oil), and to a lesser part cooling (mainly electricity).
- the production and/or use of renewable energy (e.g. solar boilers, PV, heat pumps, residual heat etc.).

Improvement of the EP has - apart from the need for a more sustainable environment - positive effects for residents: lower energy costs and improved comfort and - if properly constructed - a better interior climate and health. But nothing venture, nothing gain, improvement of the EP goes with substantial additional investment costs, causing property owners to hesitate to invest in it.
3.1.1. Regulatory framework

To encourage and stimulate property owners and residents to invest in EP, national governments have developed a range of policies and instruments, most recently followed by the European Energy Performance Building Directive (EPBD, EU 2002).

Sunikka (2006) found a wide variety of European energy reduction policies and underlying approaches and ambitions.

Noailly (2009) states that energy regulation for buildings in Europe shows two main characteristics. The number of regulations are very large as a result of the absence of a strong lobby in the building sector against (or in favour) of regulation. The lobby of the building sector is weak and fragmented compared with other sectors like the automobile industry. The second characteristic is that energy regulations are predominantly set at the national level rather than at the international level. Both characteristics may be reasons for the slow implementation of European regulation in the member countries.

The European Building Energy Performance Directive was decided on in 2002 but implemented in most countries only after 2006. The Dutch government introduced the energy label system in 2008. Energy labels show in classes (A till G) and colours (Green till Red) the EP of a building and gives possible ways to increase the energy efficiency. Because of implementation problems the label system was revised in 2009. By January 1st 2010 owners are obliged to hand over the (revised) energy label when they rent out or sell dwellings and other buildings (MIN.VROM 2010).

The introduction of the energy label is one of the means to reach the objectives set by the Balkenende IV administration in 2007 in its working program ‘Meer met Minder’ (More with Less, or Clean and Economical). The program endorses the EU objective to reduce the CO2 emissions of the building environment. It sets the objective of 30% reduction in 2020 compared with 1990. Other objectives are an increase of the energy efficiency by 2% each year, or 20% in 2020, and an increase of the use of sustainable energy up to 20% in 2020.

In 2008 the objectives were elaborated with the building sector in the ‘Meer met Minder’ covenant (Min.VROM 2008). The parties (housing associations, building trade, owner-occupier and tenant unions) agreed to increase the energy performance of 0.5 million existing dwellings up to energy label B or at least with two ‘label steps’ in 2011. Objective for 2020 is a 30% energy-reduction in 2.4 million existing dwellings.

Also in 2008 additional energy-saving and supporting measures were agreed upon with housing associations and tenant organization in the social rented sector, implying a 20% energy reduction of the existing social rented stock in 2020 and the insertion of the EPBD energy label in the Dutch rent control system (Min.VROM 2008a).

Summarized: a number of measures have been, implicating a 20% energy reduction, or 20% improvement of the EP, in the existing housing stock. Although up to now taken on a voluntary base en by means of (non binding) covenants, the tendency is clear: the pressure on owners of dwellings and other buildings to improve the EP of their property is increasing and will increase in the future. This 20% aggravated EP target is the focal point of the next sections.

3.1.2. Implementation, implications and possible effects

Criterion to the question to what extend a 20% EP improvement will influence the decision making about reinvestment in dwellings, more in particular between life span extension and demolition, is the
balance between the extra costs and benefits. The costs are the additional investments necessary to realize a higher energy efficiency c.q. label, the benefits are - apart from ecological gains - reduction of energy costs, improvement of comfort and addition of user and property value. In practice, residents consider these benefits as decisive for their support (Bogerd cs. 2009), being for owners-occupiers their willingness to invest, for tenants to accept the raise of the rent.

As shown in a range of surveys (e.g., Van Hal 2008, Itard cs. 2006, Klunder 2004, Koene 2010, Meijer 2010, Palmer 2003), improvement of the building related energy efficiency will generally be done in combination with other construction works like major repairs and renovation of in particular the envelope. In this way the result is not only cheaper and more efficient, but the combined benefits of energy efficiency with dwelling quality, comfort and users value is also more in line with resident preferences (Bogerd cs. 2009). This combined effect increases with the volume of necessary repairs and renovation, making the condition of the envelope in this respect - the decision making about re- or disinvestment always refers to older dwellings - a relevant variable: the worse the better.

Concluding: the building condition of in particular the envelope is a relevant variable for the decision making, as is the costs/benefits ratio of the improvement works. As table 1 shows, this conclusion should be further elaborated with regard to tenure, proprietors motives and other influential variables.

3.2. Other influential variables

To answer the question about the effect of a 20% aggravated EP on the decision making, figure 1 indicates that the following influential variables should be distinguished and examined on relevancy.

3.2.1. Dwelling quality: building type, age, condition and suitability

Though there is a strong relation between age and quality, this relation is not linear due to significant qualitative differences between building periods and afterwards improvement and demolition (Thomsen & Van der Flier 2009a).

Building type, condition and suitability are determining for the kind and urgency of required structural improvements, the feasibility of technical solutions and design options, the costs and the potential success of a renovation. In particular for owner-occupiers, suitability is a decisive motive for improvement and/or enlargement of dwellings. This in the same way applies for improvement of the EP, in particular the energy efficiency of the building construction i.e. the envelope. Apart from the technical aspects, the additional investment costs and the resulting increase of the market value are crucial input for the economic part of the decision making, see 3.2.2 below.

Regarding the building type, single family dwellings are generally larger but the improvement opportunities usually better than apartments. This certainly also influences the decision to invest in EP, but it is doubtful to what extend this results in other outcomes of the decision making about re- or disinvestment.

In line with table 1, the conclusion is that the building condition and suitability are relevant and decisive aspects for an additional investment in EP. A bad physical condition of in particular the envelope can in principle offer an extra opportunity to be replaced by a highly energy efficient alternative with additional positive effects on comfort, interior climate and noise reduction as well as drastic improvement of the architectural appearance (Riccardo 2008). This could in principle have a positive
effect on the choice for life span extension in case a poor building quality would otherwise lead to demolition.

3.2.2. Economical quality: housing market, market value, yield

The situation on the regional housing market and the market position of the property are decisive factors for the willingness or reluctance of owners to invest in their property. There are hardly reasons why this applies differently or lead to different outcomes for reinvestment in renovation/transformation and/or in EP improvement.

Variables are the demand on the market, the sought-afterness of the property and the type of ownership. The mutual effects of these variables are hard to predict. The 2008-2009 credit crunch and following stagnation show a dramatic drop of the construction industry - mainly due to retracting developers - but a much lesser effect on the maintenance, repair and renovation sector, as the need for maintenance and repair goes on and more owner-occupiers decided to skip their plans to move and instead invest in upgrading their actual homes (REF).

The market value - or more specific: the resulting value increase after improvement - determines to what extent a reinvestment will be economically accountable. Improvement of the EP may be considered economically feasible if the investment costs will be covered by the net present value of the energy cost reduction, and - in the case of rental property - by the yield c.q. rent increase, and/or - in case the investment has to be financed c.q. mortgaged - by the increase of the market value. The latter was up to present questionable, as the EP was insufficiently mirrored in the market value of dwellings (EU 2002). Though the intended market effects of the EPBD labels still have to be proofed, the transparency of the labelling system enables a better insight in the EP. This applies to recent EP improvements since they can be measured and proofed with the amount of label steps and is in particular relevant with regard to the expected yield. Unlike general improvement, investment in EP improvement should in principle result in a profitable reduction of the energy costs.

Transparent evidence based prediction of the cost/benefits ratio - if possible guaranteed - can take away the hesitations of property owners to invest in it, and tenants to pay a higher rent.

As mentioned above, the building type is also relevant. Single family dwellings have a generally higher market value and residents appreciation than comparable apartments, and as a consequence the profitability of investments in improvement - be it generally or of EP - is more feasible as compared to apartments (Wielenga, 2009).

This all together leads to the conclusion that the market situation is not a relevant nor decisive aspect as there are no evident arguments for different outcomes of re- or disinvestment decisions with or without EP improvement. Market value and yield may be relevant in case the combination of renovation and EP improvement results in a better costs/benefits ratio or contrarily in case EP improvement requires excessive investments.

3.2.3. Tenure: ownership, scope and goals

As already stated, tenure has a crucial influence on the decision making about reinvestment or disinvestment. Recent Dutch data (Min.VROM 2009, Metjer et.al. 2010) show interesting differences between the present EP in relation to tenure: In absolute numbers the lowest EP labels are found in the owner-occupied stock, in relative share in the commercial rented stock. This has mainly to do with building age i.e. the share of older pre-war dwellings, which is - due to renovation and demolition -
lowest in the social rented stock. The differences in the more recently built stock are limited, due to strict and increasing EP requirements in the building regulations, in particular after the mid 80'ies. These differences are aggravated by the discrepancies in number and volume of investments in EP improvement which show the opposite figure: the most in the social rented, the least in the commercial rented with the owner-occupied stock in the middle. As the same applies to investments in renovation reinvestment in general, tenure does not seem a decisive variable.

Tenure has a significant impact on the choice between re- or disinvestments, as demolition is almost non existent in the commercial rented sector and owner-occupied row houses; though less than one third of the demolition in the social rented sector, the only other sizeable flattening occurs in the detached owner-occupied stock.

As table 1 shows, proprietors motives and the underlying scope, goals and targets are highly decisive for demolition. In case of high potential land value and relative low building value, profit driven owners are hardly interested in other solutions but redevelop and/or sell, or in the case of owner occupiers looking for a building lot, buy and replace. For quality driven owners, the considerations above apply in the same way, with one evident exception: (Thomsen & Van der Flier 2009b).

The resulting conclusion is that, though generally of vital importance, tenure in general is not a decisive variable for the impact of aggravated EP requirements on the choice between re- and disinvestment, but sustainable owner’s goals and motives obviously do make a difference.

3.2.4. Capacity: resources, means, organisation.

Apart but not independent from the ownership, the capacity of the proprietor - the ability by means of resources and organisation to realise life span interventions - is also of importance. The large-scale portfolio activities of Dutch housing associations (upgrading and predominantly demolition) are largely attributable to the combined availability of resources and organisation, and of motives to deploy these. In the same way, the lack of activities of Dutch commercial landlords shows the opposite: smaller private landlords have no recourses and larger institutional landlords no motives as they have sold their older stock long before.

Similar effects occur in the owner-occupied stock, as most owners have no professional knowledge, skills and organisation and - depending on their capital resources - means to hire support, let alone invest in improvement. This regards in particular an intangible and knowledge intensive subject as EP. This may be to some extend relevant for the decision of owner-occupiers for EP improvement, but applies in principle also to major improvement and demolition in general.

This leads to the conclusion that for the decision between re- or disinvestment, capacity is conditional but not decisive.

4. Conclusions

Summarizing the above results, relevant and decisive aspect for the impact of aggravated EP requirements on the choice between re- and disinvestment are:

- Building condition/suitability: as replacement of poor elements by EP improving alternatives can have a positive effect on the choice for life span extension in case a poor building condition and/or suitability would otherwise lead to demolition.
Market value and yield: as addition of EP improving can have a improved costs/benefits ratio of renovation in case this otherwise would lead to demolition.

Owner’s scope: as sustainable goals obviously will be decisive.

Applied to Table 1 this does not imply major changes, as Table 2 shows.

Table 2. Aggravated EP requirements, decisive aspects for re- or disinvestments

<table>
<thead>
<tr>
<th>Tenure</th>
<th>Proprietors Motives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quality driven</td>
</tr>
<tr>
<td>Rented</td>
<td>building condition/suitability</td>
</tr>
<tr>
<td></td>
<td>building type</td>
</tr>
<tr>
<td></td>
<td>property value/yield</td>
</tr>
<tr>
<td></td>
<td>sustainability</td>
</tr>
<tr>
<td>Owner-occupied</td>
<td>building condition/suitability</td>
</tr>
<tr>
<td></td>
<td>building type</td>
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<td></td>
<td>property value</td>
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<tr>
<td></td>
<td>sustainability</td>
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This means in short that aggravated EP requirements will in general and under unchanged conditions not shift the balance towards more demolition but instead offer more opportunities for improvement. To what extend this actually will result in reinvestments is largely depending on the capital resources of the owners.

As stated above, the goal of this paper is not to attain hard outcomes but to gain further insight in the decision making process, to improve and further develop our conceptual model and to underpin further case studies. In this respect, the conceptual model is at least useful for analyses like done in this paper. And the outcomes are at least convincing as an indication for the effects analysed.

If and to what extend aggravated EP requirements will factually shift the balance towards more sustainable life span extension instead of demolition has to be proofed in practice.

Decision making is not only a rational process, as emotions, attitudes, courage, willingness to stake at long term are also decisive factors (Thomsen & Van der Flier 2008). As Van Hal states, adequate and accessible information is essential for the dissemination of innovative examples and approaches (Van Hal 2008). Knowledge resources as the Dutch Nationale Renovatie Prijs (National Renovation Award) can be very useful for that purpose.

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