REVALUE

D 1.3
The REVALUE valuation framework

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Deliverable description

The Deliverable D1.3 The REVALUE valuation framework provides a framework, which takes energy efficiency, sustainability and related aspects into consideration when valuing a residential building held for investment purposes, with a special emphasis on those held for social housing.

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Executive Summary

Valuation professionals lack both the information and guidance to consider issues of energy efficiency (EE) and sustainable building strategies consistently and confidently when conducting an appraisal. Investors, alike, require more transparency and evidence that EE and sustainability are sound investment options.

This document proposes a framework for more detailed and consistent consideration of energy efficiency, sustainability and related characteristics when valuing a residential property, both within the private and social/ public sectors.

The intent of the REVALUE framework is to provide more transparency and denote the benefits of EE and sustainability for both of these stakeholders. The framework includes three major themes: the income approach, the market approach and the reduction of information asymmetry. Within these themes, topics of how to gather, analyse and then use relevant and current data is introduced. This data links to key performance indicators (KPIs) within the renovation packages to establish benchmarks. Country specific regulations, differing values for energy performance certificates (EPC) and the plethora of building characteristics all play a role in the challenges that face valuers. These obstacles are what REVALUE attempts to clarify and quantify within the framework.

In the income approach, (discussed in detail in REVALUE Deliverable 1.1), the framework establishes the relationship between a building's gross income in connection to EE improvements and the achievable market rent. EE improvements are typically linked with maintenance and standard building improvements. The development of renovation packages within the framework begins to distinguish the standard building improvements from the EE focused improvements. The packages and related methodologies can be used to compare specific characteristics and provide more transparency to the valuer and investment options for the investor.

On a large scale, within each country, there exist regulations and standards for rent levels as well as energy costs. REVALUE considers these variables in order for the framework to be applicable across the five countries in the research.

As we move into the market approach and apply this method to the framework, it is the transaction prices and typology of surrounding properties, which guide the valuation process. Building typologies with additional EE related benchmarks are used for the classification and segmentation of building stocks and are the anchor point from which valuers can begin to appraise a building. The challenges of finding the appropriate comparable properties are then the issue. Within the REVALUE framework, a data structure is described and fine-turned by the energy consultants and statistics team, with input from the consortium. This group organises and analysis the data requirements of building components, energy use, financial data, tenant turnover and vacancy data, supplied from the housing companies and pilot projects (Work Package 2).

In cases of older buildings with delayed maintenance, the overall marketability can be in question. An insufficient Energy Performance Certificate (EPC), hazardous material and banned technical systems are just a few examples where appraisers will need to adjust the appraised value.

In the cases where alternate sources of energy, (i.e., wind, solar) are in use, there is the possibility for additional revenue streams. In these cases adjustment values must be determined in relationship to the local market and if available, comparable properties.

Tangible building characteristics (but difficult to quantify) are that of tenant comfort and satisfaction as part of the building standard. A hedonic price model defined in the framework assesses the weight of the different characteristics and is relevant to investigate the impact of the EPC rating on property values and to separate the impact on value from the rest of the property characteristics.

Due to the increased complexity of integrating EE components into the valuation process, the framework describes an expanded and broader database in order to reduce the asymmetry of the information. This broad and diverse database will support a summary of the impact of EE upgrades specific to typology and country. This database is also to provide evidence to the RICS committee whose task it is to provide and review the current EE and sustainable guidelines. This committee can then provide updated guidelines, instructing valuers as they modify and adjust values according to their judgment, experience and choice of valuation method regarding energy efficiency and sustainability in buildings.

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Chapter 1 Introduction and scope

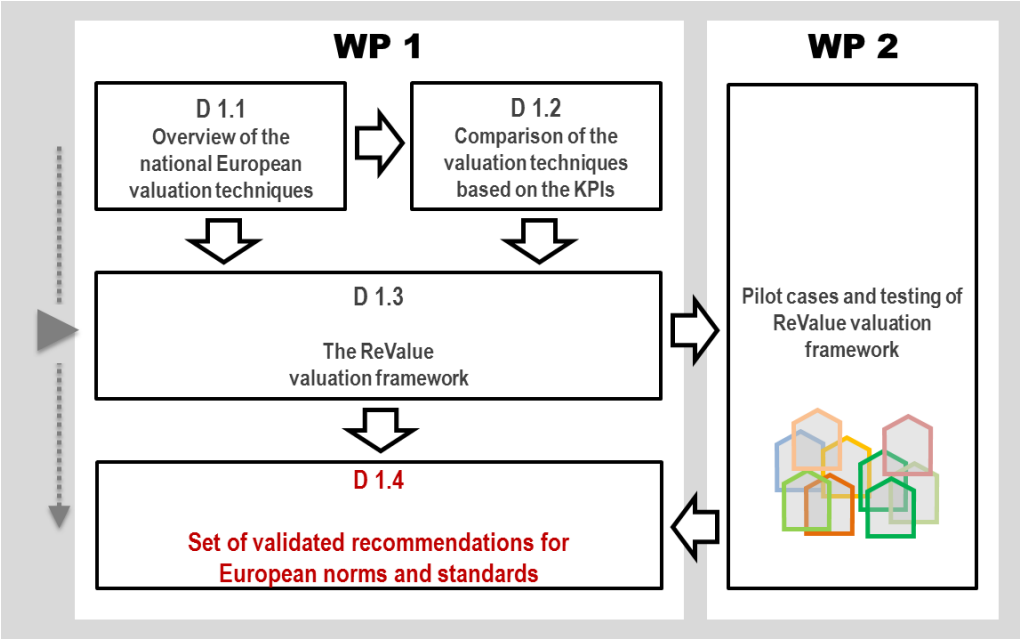
1.1 Purpose of Document

This document proposes a framework for more detailed and consistent consideration of energy efficiency, sustainability and related characteristics when valuing a residential property, both within the private and social/ public sectors.

The framework is developed to address recommendations for new European valuation norms and standards. These progressive norms and standards will assist appraisers in the valuation of energy efficient strategies during a buildings appraisal. There are many occasions for valuation of a property (discussed in detail in REVALUE work package 1, Deliverable 1.1). A main use of appraised values is by investors to help determine the value of the properties they buy, sell or own. The framework provides validated guidance of EE interventions and strategies that may be most appropriate for a given property.

Professional valuers are reviewing the framework, accounts are validating it and academic peer-reviews will confirm usability in the industry. The framework will be tested in WP 2 in pilot projects conducted in United Kingdom, Germany, The Netherlands and Sweden. These pilot cases will test the validated recommendations for new European norms and standards by establishing valuation benchmarks and identifying barriers.

Figure 1: Towards a set of validated recommendations for European norms and standards



1.2 Value and Valuation Approaches

A commodity possesses economic value when there is trade between those who supply the product and those who demand it. Basic market economic theory proposes that price is fixed at the interaction between supply and demand. When supply is scarce in relation to demand, prices will rise and vice versa. Property values are underpinned by this relationship. However, this relationship is complex and for many products and services, including residential property, the market is inefficient (i.e. the pricing mechanism is disrupted by lack of transparency and imperfect knowledge) or/and fails. The latter occurs when demand may be weak in economic terms but there is a need on social grounds for the supply to be maintained above the level of economic demand. This may occur with social housing where an element of subsidy is introduced, normally by government, to ensure that those who cannot afford market rents are able to access good quality housing.

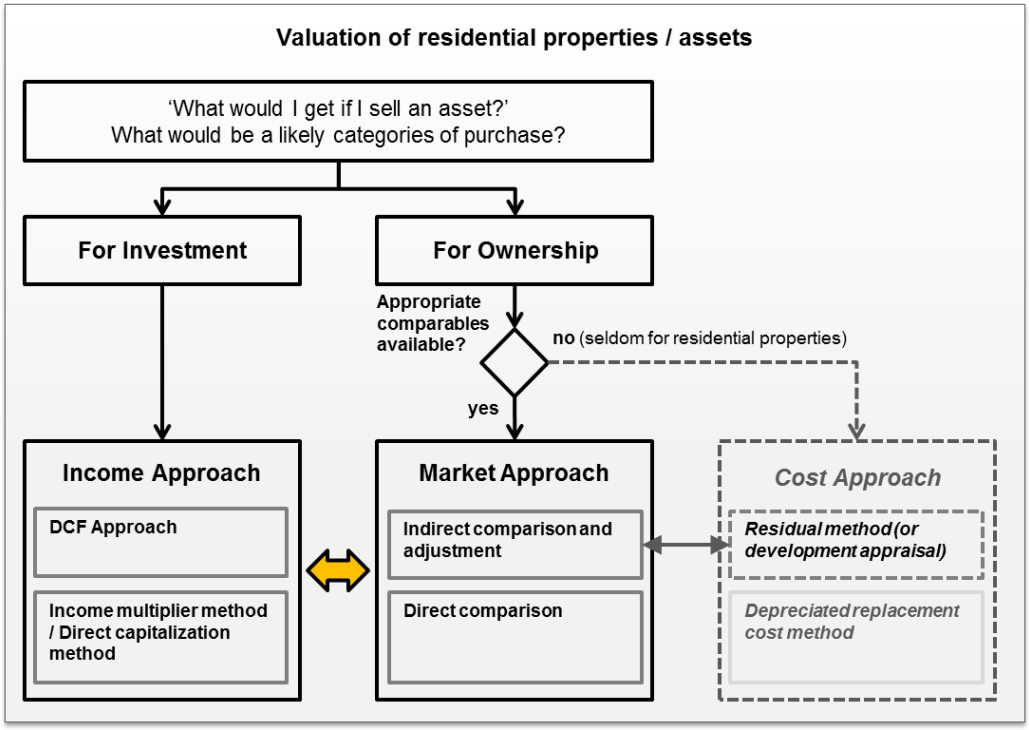
A market valuation is prepared for many purposes, such as sale or secured lending or accounting and taxation. The purpose will determine the basic method adopted by the professional valuer. Over time, and to recognise the purpose and type of market (i.e. needs or demand driven) a number of different methods or approaches are in use.

- The Market Approach (or comparative method, market sales comparison approach)
- The Income Approach:
  - Investment Method
  - Profits Method
- The Cost Approach
  - Depreciated replacement cost method
  - Residual method (or development appraisal)

The most relevant approaches for valuing residential properties are the market and the income approach. In the scope of the REVALUE project, the cost approach is typically not applicable.

The following graphic illustrates the choice of method / approach for valuation of residential properties.

Figure 2: Valuation approaches relevant for types of properties researched in the REVALUE project[1]



[1] cf. (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, pp. 9-12)

Chapter 2 The Income Approach

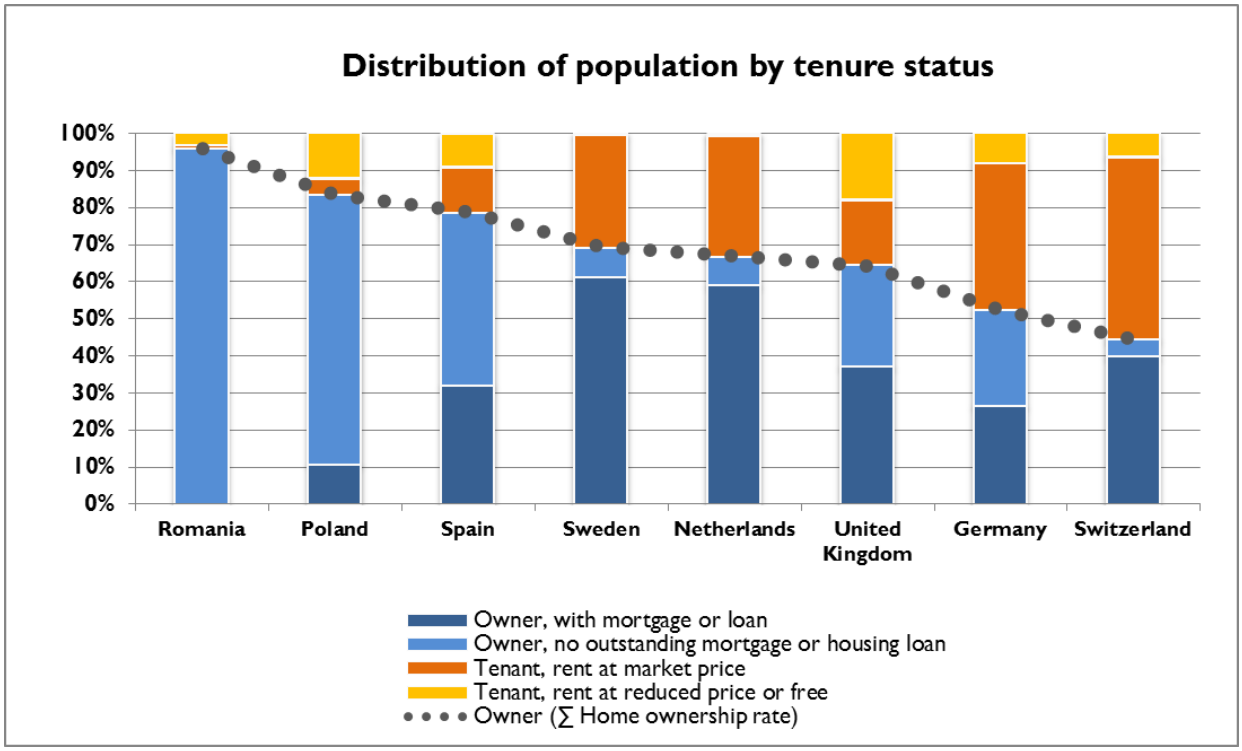
Where a property is held for investment purposes, as in a part of the cases in the REVALUE project, the normal approach adopted is the income approach (or investment method). This "has *a number of variants, but essentially this approach is based on the income that an asset is likely to generate over its remaining useful life or a specified period*."[2] It is an approach "*that provides an indication of value by converting future cash flows to a single current capital value*"[3].

The use of the income approach in determining property market values depends mainly on the availability of information on comparable assets in a similar location, and this can be difficult to source. The valuer relies on evidence of both rents paid, which for social housing may be subject to government controls, and a capitalisation factor. This is conventionally also drawn from comparable evidence and depends on the investment markets view of the future.

Alternatively, investors, when making purchase decisions, look not just at other market transactions, but also at the projected cash flows that will be achieved by holding the property over a specified period. The cash flows are discounted at the investors required rate of return, which may or may not be related to the cost of borrowing. Where a discounted cash flow approach (DCF) is used, it is referred to as an estimate of investment value or 'worth' (see glossary); where the value is based on analysis of the market transactions or the market value.

It follows that for a market valuation by the investment method to be reliable there needs to be a transparent market with a good number of both rental and capital transactions. Within all European countries, the share of rented properties range between 45 to 96 percent[4]. The country with the highest rate of ownership is Romania; the countries with the lowest rate of ownership are Germany and Switzerland.

Figure 3: Market complexity - Splits between market and subsidised[5]



[2] (RICS Red Book global Guidance, 2014, p. 80)
[3] (RICS Red Book global Guidance, 2014, p. 7)
[4] (Statista, Wohneigentumsquoten in ausgewählten europäischen Ländern im Jahr 2014, 2014)
[5] cf. (Eurostat, 2015)

Value determinants related to energy efficiency and other aspects of sustainability are easier to assess when the value is determined by cash-flow; where it relates only to analysis of rent and yield it is very difficult to 'unpick' the specific impact on any one characteristic. The income of rental property depends on the achievable market rent that is based on supply and demand equilibrium of the local market and a market segment. For properties let at a 'market rent;' the energy efficiency will only impact values if it is clear to the valuer that it influences the amount that the tenant is willing to pay – or the anticipation by the landlord that there is a potential for higher rents. In addition, social housing rents for residential properties are typically regulated and guidance of rent levels is monitored. In such cases even where tenants may place high value on energy efficiency this may not be reflected with higher rents.

The value integration of energy efficiency is further complicated by the way energy costs for heating and domestic hot water production (DHW) are handled within tenancies. In general, two different cases can occur:

Case 1: Energy costs for heating and DHW have to be paid by the tenants and are therefore direct running costs for the tenant.

Case 2: Energy costs for heating and DHW have to be paid by the property owner (landlord) and are accrue directly as operation costs by the owner.

These two cases have differing impacts on the motivation of the landlord to invest in EE measures. In the first case, the landlord does not directly benefit from the energy savings; therefore the case for investment has to be based on other motivations. A possibility of increased rent arising from the tenant's willingness to pay for a more energy efficient home, or as a strategy for competing with surrounding, comparable properties are both possible. Another strong is to 'future proof' your building and portfolio, a defence against future value depreciation due to a change in what is regarded as 'normal' levels of efficiency.

In Case 2, the landlord has a direct benefit through the reduction of the energy consumption. Within the subject countries, Case 1 is the normal arrangement.

With the application of the income approach, the following methods can be applied:

- Discounted cash flow method
- Income multiplier method
- Direct capitalization method[6]

The most common techniques are the discounted cash flow (DCF) method and the income multiplier method. The DCF method is growing in use and often adopted for management and strategic investment purposes. The income multiplier is used for establishing a likely sales price (Market Value).

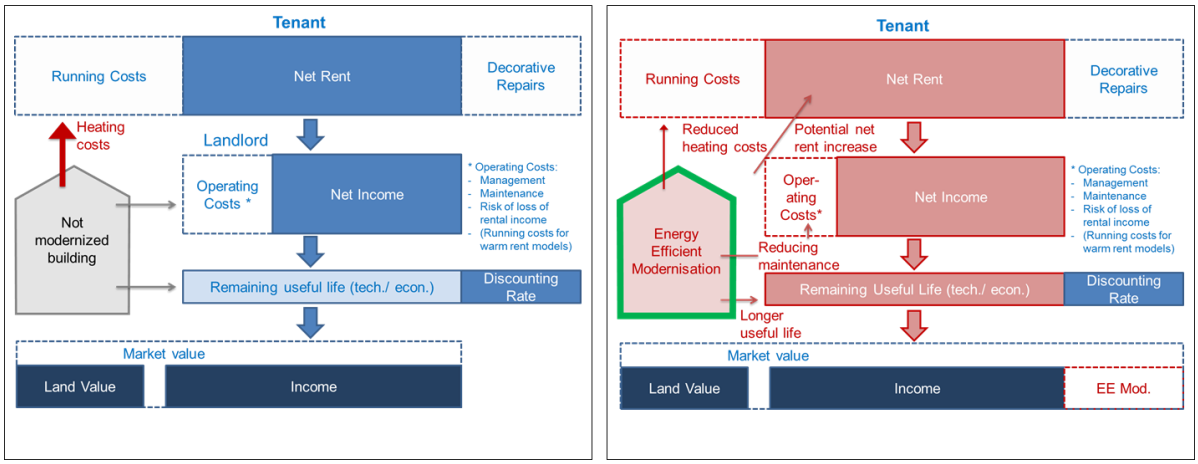
[6] No standardized method for Germany

2.1 Influencing Elements for Energy Efficiency (EE)

From a landlord's perspective, the following elements are all key considerations in terms of the building:

1. Gross income/ net rent
2. Economic and technical lifetime
3. Operating costs
4. Discount rate/ yield
5. Additional income from energy production

Figure 4: Influencing Elements and EE



1. The gross income:

The gross income is determined by the net rent of the property and any other sources of income, such as service charges that may be paid over and above rent.

In cases where energy costs for heating and DHW production are paid by the tenant, the future income may be influenced by the amount of energy costs. Increasing costs for energy reduces the tenant's available amount to be spent for the rent of the unheated apartment. It was found that the price elasticity of demand for having a comfortable room is higher compared to the demand for an unheated room[7]. Therefore, it is assumed that the priority for tenants is to have an apartment, heated or unheated regardless of energy costs.

There is now a significant body of academic literature relating to the relationship between domestic rents/sales values and energy efficiency assessed through labels which points to growing price recognition of energy efficiency as a value driver.[8] However, the entirety of these works relate exclusively to private sector situations, only one[9] considers rents specifically and there is no work examining social housing. Further, very little work examines motivations for investment: it has tended to be statistical analysis of public data using hedonic modelling and it is recognised that most research to date does not deal with the age and structural type of the building. As such the research, whilst providing a foundation to demonstrate the emergence of energy efficiency as a market driver is not focused on information which can necessarily asset valuers or help owners with strategic or operational decision making.

EE-refurbished buildings often have an improved standard compared to un-refurbished buildings. These improvements can result in an increased usability, improved aesthetical appearance and an increased functionality and sustainability such as higher comfort, better sound protection, etc. There is also a reduced risk of tenant vacancy and a likely increase in the duration of the tenancy. This stabilises the income generated by the building.

[7] For instance it was found during expert interviews that tenants are willing to sacrifice comfort in order to remain or getting apartment in their preferred location

[8] See for example Brounen and Kok (2011); Fuerst *et al.*(2015); Hyland *et al.* (2013*);* Stanley *et al.*(2015).

[9] Hyland *et al.* (2013)

One other factor that is critical in establishing the rent level that the valuer will use is the impact of any statutory controls over rent levels. Within the study countries, differing controls exist for social housing rents.

2. Economic and technical lifetime

The period over which the gross income can be generated depends mainly on the market performance and "currentness" of the property's specification within that particular local market and market segment. EE-refurbishment may influence the market attractiveness and hence value of the property through higher efficiency and reduced consumption with lower expenses for energy. The majority of EE interventions imply a general improvement of a property and may reduce the need for repair and raise the condition, services, layout and fittings of the building thus increase tenant comfort. These factors should be reflected when determining the duration of the gross income. The evaluation and consideration of the improved positioning in the respective local market is crucial. The scope of possible EE-measures is quite wide and many different building components can be improved through refurbishment. The evaluation of their impact should always be in conjunction with the current local market trends.

A 'Building Quality Scoring Model' can be a helpful instrument to assess a building's qualities, taking into consideration the standard improvements and EE-qualities. It should be recognised that some building types are easier to upgrade to modern expected standards than others are. Ideally, it covers all relevant building components and compares them with the local market standard. This can be investigated with a score model to assess the building quality compared to the local market standard for residential buildings. The weighting of the different building components used in the score model should be calibrated to the local market and reflect the importance of the different elements. The building architype is critical in order to have the scoring model reflect comparable buildings within the local market segment and thus enable the valuer to make an assessment as to the potential for and likely costs of energy and general retrofit.

Table 1: Building Quality Scoring Model[10]

Specific Improvements	Weighting factor	Evaluation	Score
Roof	XX%	XX Points	XX Points
Windows and Doors	…	…	…
Distribution Systems (pipes, ducts, etc.)	…	…	…
Heating Supply and Heat Production	…	…	…
External Walls (insulated, etc.)	…	…	…
EPC level	…	…	…
Use of renewable energy	…	…	…
Accessibility			
Other…	…	…	…

The outcome of building quality scoring model is an analysed score value which can serve as a basis for determination of an exit value for a DCF method, a remaining life span for the income multiplier method or a yield adjustment for the direct capitalization method.
For these three different value methods, an appropriate interpretation of the score is essential. In regards to the remaining life span, conducting retrofit measures will reduce the obsolescence of the building and the remaining lifespan can be increased, albeit that it has been found that value after refurbishment will not achieve the value of a new building[11]. The equation below shows an example of how the increase of a lifespan can be considered.

[10] LUWOGE consult GmbH
[11] Thomsen, A., van der Flier, K. and Nieboer, N., 2015. Analysing obsolescence, an elaborated model for residential buildings. Structural Survey, 33(3), pp.210-227.

Equation 1: Example for an increase of the remaining lifespan

$$n = b - a + x + y$$

n = remaining life span
a = building age
b = maximum life span
x = impact of upgrade through modernization and improvement of EE
y = adjustment

To determine the exit value for a DCF analysis, the exit value needs to reflect the different options of an investor and has to reflect the most likely future value with consideration of those options: sale of units within a building or the whole building or keeping the building as an investment[12]. An appropriate adjustment of the exit value to a potential future purchase price with consideration of the EE-related building qualities is very important. The challenge in applying this equation is that maximum life span if normally unknown as it is dependent primarily on economic, not physical, factors and the 'adjustment' is a qualitative figure determined by the valuer.

3. Operating costs

Operating costs stand between the gross and net income and normally comprise:

- Management costs
- Costs for maintenance
- Costs for vacancy (losses through temporary vacancy due to market fluctuation)
- Cost for long-term vacancy
- Costs for losses of rental fees
- Costs for heating of non-occupied apartments and 'common part's where these are heated
- Costs for heating of occupied apartments (In case landlords take over costs for heating and DHW production of the rented apartments, these occur also as operating costs.)

[12] cf. (Royal Institution of Chartered Surveyors - RICS, p. 12)

EE-refurbishment influences the height of operating costs mainly in two ways:

I.) Savings through reduced maintenance

The value determined based on the DCF method or the income multiplier method is a projection of future cash flows with consideration of costs and revenues.

The determination of maintenance costs within the valuation process can be based on existing benchmarks with consideration of the building type, age and condition. This maintenance cost strategy could include a building typology based benchmark system.

The historical building maintenance costs, along with building typology and a scheduled maintenance plan will help determine the impact of EE refurbishments on maintenance costs. There is a potential for EE-refurbished buildings to have a decrease of maintenance costs in the future. However, where buildings are refurbished with solutions generated with/by highly technical equipment, maintenance costs can also rise after EE-modernisations.

Within some contracts, many of these maintenance and other 'service' charges are recouped from tenants under a contractual arrangements. A reduction in the service charge makes the property more attractive to tenants and may have an impact on the level of rent chargeable.

II.) Savings through EE upgrades

In the case of 'warm rent' contracts the landlord profits directly from energy savings for heating and DHW production. In this circumstance, the market value should reflect the reduced energy consumption of the EE-refurbished building.[13]

EE-refurbishment can also influence a building's management costs. Information and support to the tenant regarding the functionality of the EE strategies within the building may be needed. The tenant behaviour can have a strong influence on the building's energy consumption.[14]

EE-efficient refurbishments typically provide a more comfortable building. This added comfort can result in a reduction of tenant turnover and vacancies[15].

4. Discount rate/yield

The determination of discount rates is a complex process and is a key competence of an appraiser.
Where a DCF approach is used the discount rate adopted reflects return requirements, often based on cost of money plus entrepreneurial reward and certain risk premia and need to be balanced against other relevant factors used in the valuation. For a direct capitalisation approach the discount rate is based on a market yield - i.e. it is a ratio figure between income and capital values observed in comparable transactions. Specific knowledge of the local market is necessary to derive an appropriate discounting factor which reflects the characteristics of the location, the building type and, where evidence exists, the EE performance and modernisation status.

The results of energy efficient refurbishments translate to a more stable financial structure. A building whose systems efficiently utilise the resources needed for heating, ventilation and DHW is at a lower risk, is less influenced by the fluctuations in the commodities market of energy, oil prices, changes in taxes and laws focused on the environment. It is also more likely to be attractive to tenants, both incoming and existing.

These parameters help to establish the discounting rates adjustment factors.

[13] This contractual arrangements can lower the motivation of tenants to save energy through environmentally beneficial behaviour and it will be crucial to install intelligent monitoring and motivation systems to avoid irresponsible and wasteful behaviours.
[14] Especially through the use of modern devices such as ventilation systems with heat recovery, shading systems
[15] Confirmed during Roundtables in London and Amsterdam.

The basis used to derive a discounting rate can be descripting as follows:

Equation 2: Principal basis determination for discounting rates

$$p = \frac{income}{value}$$

p = basis for discounting rates

For consideration of building energy efficiency it is recommended to use the net instead of the gross income.

5. Additional income from energy production

Buildings are often not only passive objects which consume energy. Some modern or retrofitted buildings using renewable energy techniques may be capable of being net producers of energy which is used to cover the building specific energy demand and the surplus of which can be sold to specific purchasers[16]. The governments of many European countries have developed 'guaranteed feed into grid compensations' for electricity which is produced with photovoltaic or micro heating plants with cogeneration. Often a specific price per unit is guaranteed over a specific period. In the future it may also be possible to sell electricity produced by the building directly to the tenants. However, this extra revenue needs to be considered in the building cash flow if the respective facility is connected with the property. But in so doing valuers will be aware of the risks that the revenues produced may be subject to variation if compensation schemes, such as the UK's Feed-in Tariff,[17] are changed which is a regular occurrence.

Furthermore, models exist to rent roof or other building areas to energy suppliers for installation of photovoltaics modules used for electricity production. The achievable rent for these lettings is generating specific additional revenue that has to be considered as extra income. However, if the income is built into the appraisal, the terms of the contract have to be understood, especially those pertaining to the end of the contract period and any works of reinstatement that will be required.

[16] Energy suppliers or other organisations
[17] http://www.fitariffs.co.uk/

2.2 What determines gross income?

A building's gross income depends mainly on the achievable rent, together with any addition incomes as set out in Chapter 3.4. The possibility to consider EE-performance is determined by the achievable market rent and the legal framework which regulates rents and rent increases after EE modernisations.

EE-refurbished buildings show a lower energy demand and additionally a changed, improved building standard. Both the reduced energy demand and increased building standard may influence the achievable rent. On one hand there exists a non-negligible lack of transparency in terms of sustainability and EE. On the other hand, regulations and tenancy law have a high impact on the chargeable rent and appropriate rent adjustments. In order to determine the allowable and achievable rent relevant to influencing factors, such as energy savings for tenants, standard rent increases, the impact of the legal framework, and lack of transparency have to be taken into account. Within the study countries, for social housing there are also controls on the maximum rents payable; this will affect the ability to charge additional rent for energy improvements, even where effective demand exists.

For buildings, wide ranges of different EE-refurbishment interventions are possible. Principally, a reasonable combination of several interventions with consideration of the building typology, local climate condition, the status of maintenance and the economically feasibility are likely. EE-interventions and refurbishment packages should be economically beneficial.[18] The interdependency between the quality of the building envelope and the technical system of the building is an important aspect to be considered.

2.3 Rent and Energy Cost

In the case of cold rent contracts, the building EPC label is an indication of the theoretical average energy demand[19] per square meter usable area of the building,[20] based on standard behaviour parameters.[21] Methods used for determination of the EPC related energy demand are mostly stationary calculations and not transient dynamic calculations. Therefore, they are not reliable guides to actual consumption.

Deviations between calculated demand and consumption always occur. The actual tenant behaviour influences the energy consumption and all the above-mentioned influencing parameters interact with each other. Furthermore, in the Netherlands the location of an apartment within a building influences the actual energy of the consumption.[22] In Germany and the UK, this distinction is not calculated.

Concerning tenant behaviour, a simple rule is observable over time in relation to the impact of improvements. The so-called Jevon's paradox, or rebound effect[23] would suggest that for relatively bad performing buildings the real consumption would be lower than the calculated demand. For buildings with an improved EPC label, the real consumption will be slightly higher than indicated through the energy label. The reason for this rebound effect is mainly due to changes in tenant behaviour. In well performing buildings tenants, assume that buildings with an improved EPC label provide more comfort due to warmer interior temperatures without significant impact on the energy demand. For poorly performing buildings with higher costs for energy the awareness regarding the impact of their behaviour is much higher which results in lower energy consumption than calculated. However, research points to this being a very complex and not fully understood phenomenon[24].
The cold rent reflects qualities of the rented area, in the specific building and the specific location. Part of this quality is the thermal performance of the building and the resulting energy consumption influenced through the behaviour of the respective tenants. EE is a specific building characteristic and influences the running costs to be paid by the tenants.

[18] Positive NPV with a reg. useful lifetime intervention considering the actual life cycle of the building
[19] Distinguishing between finale energy demand and primary energy demand needs to be acknowledged.
[20] Not the specific rented object
[21] For instance internal room temperatures, air exchange rates, internal heat gains and operating times are standardized and not specific to the individual tenant.
[22] Attic and basement floor have in principal a higher share of heat transferring envelope compared to apartments located in the middle of the building.
[23] For a discussion see Herring, H. and Roy, R., 2007. Technological innovation, energy efficient design and the rebound effect. Technovation, 27(4), pp.194-203.
[24] Galvin, R., 2014. Making the 'rebound effect' more useful for performance evaluation of thermal retrofits of existing homes: defining the 'energy savings deficit' and the 'energy performance gap'. Energy and Buildings, 69, pp.515-524.

For the determination of an appropriate rent, which reflects the thermal quality of the usable area it, is important to take the behaviour of the typical tenant in regard of energy consumption and expected comfort into account. The share of cold rent for an increased building EE should consider the potential of the reduced energy consumption and the respective saved expenditures for energy.
For determination of the cold rent premium, the standard performance of the relevant market-segment needs to be considered as a baseline and a certain percentage of the saved energy costs can be a potential premium for EE. The same logic can be used for buildings with a low EE that would lead to a discount of the rental income over the time[25]. However, it has to be recognised that where the rents are determined in the market place, it is possible that tenants will not act in such a rational way as to calculate exactly the amount of rent they will offer dependent on energy efficiency. It may be part of the 'mix' of factors, but it will seldom be the key determinant.

2.4 Standard Improvements

Buildings with an improved EPC label have an efficient building envelope and an efficient heating system, sometimes combined with the use of renewable energy. Beyond the reduced energy consumption modernized buildings show an improved general standard. Along with these direct visual improvements, other sustainable characteristics are also often improved, for example:

- Thermal comfort:
  Reduced U-Values increase the internal surface temperatures of envelope components and associated with this, the radiation temperature results in reduced temperature asymmetry[26]. There are more consistent interior temperatures during both summer and winter. Summer comfort and overheating protection can be achieved through external shading, increased thermal insulation, and in winter increased solar exposures and thermal insulation help keep interiors warm.

- Usability:
  Modern heating and DHW systems are often more flexible and can better meet the tenants demands. Response times are sometimes shortened and the interaction with the systems improved compared to older technical systems.

- Air quality:
  Ventilation systems in general ensure the necessary air exchange to avoid unhygienic internal air qualities. In combination with filters, the supply air can be cleaned from undesired substances such as allergens[27] or fine dust. Ventilation systems with heat recovery increase the supply air temperature and comfort. In the case of passive ventilation, tenant behaviour is critical for proper ventilation and typically, there is no control over allergens, which enter the residence.

- Risk of mould:
  Good quality thermal envelopes and/or a ventilation system reduce the risk of mould formation, whereas a simple concentration on improving airtightness may have the opposite effect and lead to condensation and mould growth.

- Sound protection
  EE-windows and external insulation systems influence the buildings sound protection.

These aspects may have an impact on the achievable market rent. Their relevance depends very much on the standards within the local market within the respective market segment. A direct monetisation of these characteristics is not directly measurable, but the overall performance of these parameters affects the general building standard and has been shown to also affect the achievable market rent. Furthermore, this higher performance can also positively influence the stability of the income because higher comfort and an improved wellbeing of tenants can reduce fluctuation and short-term vacancies.

[25] For instance to be used in a DCF model
[26] Temperature asymmetry stands for temperature difference between air and radiant temperature (the radiant temperature is a result of the internal surface temperature and the U-Values of the components of the building envelope
[27] Pollen

2.5 Rent Determination

Rents in the residential social housing sector in Europe are extensively regulated whereas those let within the private sector may not be. In nearly all European countries exists rules with the aim of protection of the tenant's interests. It influences the income of a rented property and it also influences an achievable price of a rented possession in case it should be sold; however it should be noted that this will not be the case where the sale is in the social rented sector to a sitting tenant, if discount pricing is in place.

In regard to building EE for rented buildings there needs to be a distinction between warm and cold rental contracts.

- Warm rental contracts (rent for heated apartments):
  In the case of warm rental contracts, the tenant does not benefit directly from EE, but they do benefit from the standard improvements as described above. In the determination of the achievable rent and a potential rent increase, consideration of the local market along with the improved standard of EE-refurbishments have to be considered. For social rented stock, statutory controls on the rent determine whether increases are allowable.

- Cold rent contracts:
  For cold rent contracts tenants of EE buildings profit from both reduced expenses for energy and standard improvements as described above.

  The achievable rent over time, in theory, should reflect the estimated reduced energy consumption. Rising energy prices would lead to a greater differentiation between EE and non-EE buildings. Higher energy costs reduce the available budget of the tenant available for the cold rent and therefore may have an effect on tenant behaviour.

Chapter 3 Market Approach

The market approach is the favoured approach for property valuation where a sale is in prospect and is based on comparing a property to be valued with similar properties and the prices achieved for them (comparison of like with like[28]).

The most important basis for the valuation is a dataset with transaction prices of appropriate comparable properties. The availability of current data depends on the rate of ownership plus the holding period and differs from country to country. Especially for properties such as 'standard' condominiums or terraced houses a significant amount of comparables are available. Transaction prices reflect the respective value determined by the characteristics of the property like the location, the qualities of the building and other aspects. The location and building characteristics along with the actual recorded transaction price is the data that is required.

Property is essentially a heterogeneous product: everyone is different. Where characteristics of comparables differ, there is the need for adjustment, which is the norm. EE upgrades, sustainable strategies and EPC labels are all characteristics that can influence the value. The local market drives the relevance of EE in relationship to the property characteristics. In cases of differences in the building EE performance, e.g. if the comparable building has a lower EPC rating then the building to be valued, then a qualitative difference needs to be quantified with an adjustment.

For the market approach, the valuer must modify and adjust values according to their judgements of the circumstances. For example, in cases of defects and underperformance, a cost-based adjustment to value is used. When standard differences in building characteristics are prevalent, a hedonic price model can aid in determining an appropriate adjustment factor. Production of renewable energy may present additional revenue streams to be valued. How to calculate for capitalisation within the residential market, for an investor-to-investor sale is based on experience within the local market. In cases of valuing renewable energy sources for investment management purposes, a full DCF approach is usually performed.

3.1 Defects Hindering Marketability

When the condition of a building to be valued is so poor that it is not usable, the value will be determined by the residual approach. This is when the building, after complete redevelopment or substantial upgrade is valued and the costs of such works are then deducted. Additional to this is an allowance for the time required, the costs of finance and an entrepreneurial profit.

National and EU legislation and building codes surrounding the standards of buildings are becoming increasingly stringent; therefore more buildings are at risk of being deemed sub-standard. Examples include:

- Not achieving minimum EPC ratings necessary for renting or selling[29]
- Problems with condensing water due to poor thermal qualities, resulting in mould growth
- Banned technical systems
- Hazardous materials

The adjustment needs to be based on calculated costs for restoration to an appropriate status of use.

3.2 Hedonic Price Model

The hedonic price model is a common technique undertaken by academic researchers to isolate the effect of EE on market prices. The inclusion of different adjustment factors allows us to derive the appropriate impact on rents, transactions or appraisal values30. Hedonic models estimate the impact on the value of EE on the corresponding real estate properties controlling for the influence of different characteristics of dwellings such as its location, size,

[28] (Shapiro, et al., 2013, p. 36)

[29] For example within the UK, the Energy Act 2011 is introducing minimum EPC requirements for buildings that are offered for rent in the market from 2018 and for all residential let buildings from 2020.

[30]Brounen, Dirk, and Nils Kok. 2011. "On the Economics of Energy Labels in the Housing Market." *Journal of Environmental Economics and Management* 62(2): 166–79.

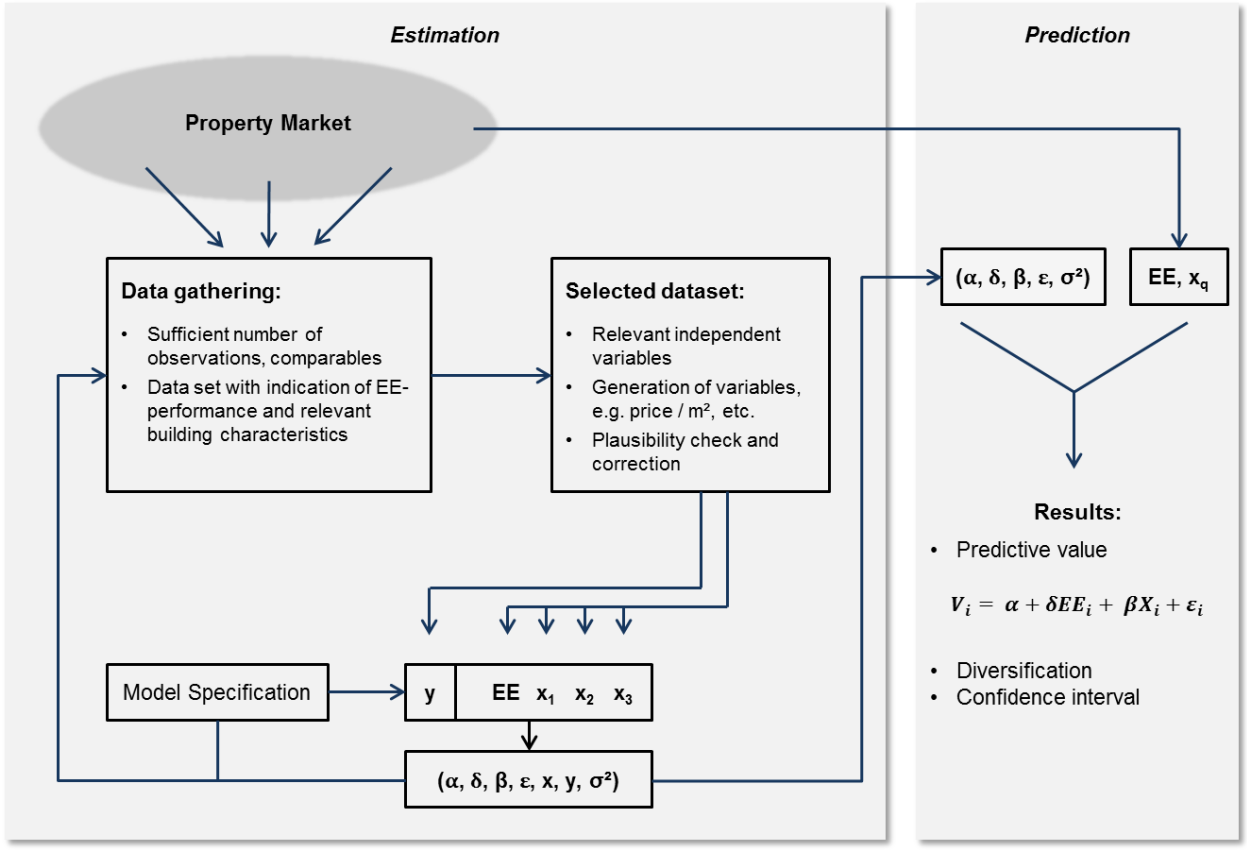
construction year or type. Failing to control for such characteristics would potentially lead to a bias estimation of the value of EE driven by the omitted factors.

If a sufficient number of dwellings are included in the sample, hedonic models are very useful to investigate the impact of the EPC rating on property values. In particular, hedonic models provide an accurate estimate of changes in property values driven by changes in EPC ratings. Currently, EPC certificate ratings are established in all EU countries.
They are an instrument to enhance the market transparency and to strengthen the market mechanism that can cause an impact on the market equilibrium price. However, their reliability and accuracy has been questioned and whilst some research undoubtedly finds a connection between EPCs and transaction prices, there is an acknowledgement that for example, poor EPCs are strongly correlated with older, poorer condition properties; [31]. Further most of this research is related to capital transactions in the private sector, not to rented stock where the evidence is far weaker.[32]

An important question is the definition of the market segment to be investigated. A market segment refers to a specific location and focuses on a specific building typology with consideration of the trends in the local market. The availability of sufficient data is the most important prerequisite for being able to derive robust and representative statistical evidence of how building characteristics related to EE influences property values in the respective market segment.

The analysis of a hedonic price model starts with the data gathering. Compared to simpler analysis based on direct correlations or cross-tabulation comparables, hedonic price modelling techniques require the inclusion of detailed information from a high number of observations[33]. As such, it is a very useful analysis tool for detection of trends; however it does not necessarily aid in the prediction of price at the individual level.

Figure 5: Property valuation with hedonic price models - general process[34]



[31] (Franz Fuerst*, 2015, pp. 145-156)
[32] (Stanley, 2015, pp. 1-11)
[33] (Maier & Herath, 2015, p. 4)
[34] (Maier & Herath, 2015, p. 5)

The core of the hedonic price model is the multi-regression analysis to investigate the relationship between the independent variables and the dependent variable, which is normally the price. The influence of building's EPC ratings can be investigated with the real estate valuation framework based on the hedonic model of Rosen (1974)[35]. In order to establish how EPC ratings can affect the transaction prices of housing a hedonic equation is estimated. In the econometric analysis, the value of a dwelling *i*, measured by the different collected measures (i.e. transaction prices, rents, appraisal), is a function of energy efficiency (EE) of the property (measured by the EPC ratings or labels) and a set of hedonic characteristics (X):

Equation 3: Regression equation

$$V_i = \alpha + \delta EE_i + \beta X_i + \varepsilon_i$$

V	*as the dependent variable is the logarithm of the transaction price per m² floor space, rents or appraisal values.*
EE	*Energy efficiency aspects of dwellings based on EPC rating or labels.*
δ	*is the average effect of EE on value of dwelling.*
X	*Hedonic characteristics such as number of rooms, size, type of dwelling, location of dwelling.*
ε_i	*Normally distributed error term, describing the unobserved/non-included characteristics of the dwelling*

All of the models estimate using ordinary least squares (OLS) using year fixed effects to capture systematic differences in the real estate market over the year. The estimated coefficient associated with the energy performance measures (EE) describes the average effect of changes in energy efficiency of dwellings on their market value reflected by changes in their transaction or rental prices, or appraisal value.

The use of hedonic analysis is widely present in the establishment of property price indices; however its usefulness in the consideration of an individual value is less certain as first hand evidence of comparable value is considered to be preferred.[36]

3.3 Impact of EE Intervention on EPC Rating and other Value Related Improvements

A distinction between the standard improvements and the EE upgrade needs to be established in order to quantify the impact of the EPC rating.

For all buildings, there exists the need for standard maintenance and modernisation improvements. When these improvements are coupled together with EE refurbishments, then the possibility to receive an improved EPC scoring is also possible. Currently, as building owners perform standard upgrades and repairs, codes and regulations require EE upgrades.

This distinction is also the opportunity for valuers to investigate the cost benefit of the standard, improved building characteristics. An example of this would be the replacement of old windows. New modern windows will not only look and operate better, but they are also connected to lower U-Values, reduced energy demand, better noise control and lower maintenance.

[35] Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." Journal of Political Economy 82(1): 34.
[36] RICS (2012) Comparable Evidence in Property Valuation.

Table 2: Examples of Impact of EE-Interventions on different Value Driver[37]

Intervention/EE-measure	Impact on EPC rating	Impact on Building Standard	Other
Installation of new EE-windows	Reduced heating demand, increased EPC scoring	Increased usability and visual impression, higher comfort and lower draft	Reduced maintenance costs
Installation of EE-pumps and insulation of distribution pipes	Reduced distribution losses and lower aux. energy demand, increased EPC scoring	Minimal impact on building standard	Slightly higher maintenance costs possible (higher effort for adjustment)
Installation of Photovoltaic system	Additional energy production and reduced final energy demand, increased EPC scoring	No direct standard improvement	Slightly higher maintenance costs possible (higher effort for adjustment) but additional income or reduced operational costs
Exchange of a decentralized heating[38] through an central heating system with an highly efficient boiler	Higher efficiency of energy production, but also slightly higher distribution losses, improved EPC scoring	Often drastically improved standard (higher qualities of rooms, ease of operation, comfort, air quality)	Increased living space, reduced operational costs, etc.

3.4 Additional Revenue Streams

In situations where renewable energy systems have been incorporated and a property is producing energy for profit, there exists additional income. This income and its respective potential have to be considered.
In these cases, an alternate method such as a DCF or a specific value adjustment can be used. Consistency between the specific comparables and the building being valued must be maintained.

[37] LUWOGE consult GmbH
[38] For instance outside air dependent coal / oil fired ovens

Chapter 4 Reduction of Information Asymmetry

4.1 Increased Complexity and Need for a Broader Data Basis

Property valuation is a complex task and the aim to widen the scope, considering a building's EE, increases this complexity. The availability of data and the expense to gather it plays a key role and is one of the main obstacles within the valuation process.

Data gathering of EE and sustainable building qualities is no exception. In addition, valuers and energy consultants have different expertise regarding buildings/real estate. Each holds their understanding and experience of how they evaluate buildings. Each group uses specific key performance indicators[39] and uses different assessment methods. The interface in terms of collaboration between these two professions needs to be improved and the data exchange and understanding of the relevance of different KPIs enhanced. A clear summary of the impact evidence of EE upgrades is required by Valuers in order to broaden their understanding and its significates for property valuation.

Furthermore, with the growing use of BIM[40] and BLM[41] the available data will improve and allow Valuers and investors access to more current and precise building information. Therefore, a definition of datasets provided to Valuers, comprising the relevant information, is a logical step. Due to the availability of more data in a higher quality, combined with clear guidance and tested methodology, Valuers may be able to widen the current scope of valuation.

4.2 Relevance of Building Typologies

In this context building typologies, or often-called archetypes, play a significant role. Building typologies are nothing new and widely used in the process of property valuation. They are used for classification and segmentation of building stocks. Typologies serve as an anchor point from which Valuers can begin to access a building. For residential buildings, the segmentation of the building stock in different building typologies is often driven by the building size and use.

In terms of residential building categories, such as detached single-family homes, terraced houses, multi residential houses and apartment blocks are common distinctions. Another aspect for segmentation can be the building age and in some cases, separate categories for specific types of constructions are used. Hitherto information like adjustment factors (used for the market approach) or input factors to derive discounting rates[42], exit values or remaining lifespans are allocated to a relatively simple and varying system of building types. In order to enhance the database to consider building EE and sustainability in building valuations, the segmentation should be enhanced. Therefore, more detailed building information could be helpful. This broader structure should cover the following dimensions; building size, and building age in conjunction with selected technical aspects.

The "Tabula Data Structure"[43] provides data and a methodology for segmentation, which can serve as a template to determine typologies, with enough flexibility for country and regional adaptions. The level of aggregation depends on the respective country, the particular property market and the data allocated to the building types.[44] Through an enhanced data basis that comprise more data provided to valuers consideration of building EE can be supported and the data can be used to derive and adjust relevant input parameters used for valuation. Even the information about potential for EE improvements or existing limitations for specific building types could have an influence on the value.

[39] Valuers use more economy based KPIs (e.g.: discount rates, rents, adjustment factors). Energy consultants and architects operate mainly with technical and investment cost related KPIs (e.g. efficiencies of building envelope and mechanical system).
[40] BIM stands for Building Information Modelling
[41] Building Lifecycle Management
[42] For Germany All-over Capitalization Rates (Liegenschaftszinssatz)
[43] http://episcope.eu/building-typology/tabula-structure/concept/
[44] Especially due to changes of the construction methods and EE qualities in response to new EE regulations differences between buildings types increases.

In this context, it might be helpful to provide regional EE related building type specific benchmarks to be used in the valuation process. These building type specific benchmarks should cover a scope of relevant refurbishment packages associated with EPC ratings used for a comparison against the building to be valued. Useful KPIs for benchmarking in relation with assessment of EE are:

- Impact on relevant operational costs (e.g. maintenance cost, other operational costs)
- Standard improvements (comfort, technical upgrade of diverse components)
- Internal rate of return (IRR) / payoff time (ROI)
- Investment cost[45]
- Carbon dioxide emissions, final energy demand for heating and DHW production[46]
- Adjustment factors for EE and other characteristics

This specific EE and sustainability related benchmarks can serve as basis to enable valuers to adjust property values in accordance with the building's EE and sustainability performance.

The proposed KPI and benchmark system will be tested through pilot case studies in Workpackage 2 of the REVALUE project. Based on evidence and situational relevance it allowed RICS to update their international guidance notes, providing valuers enhanced instruction for greater transparency in terms of a building's EE and sustainability. This will help valuers to reflect the market value of EE in their appraisals of social and private housing stock for new builds and renovations.

In combination with RICS guidance notes, the principal for consideration of a building's EE is be improved. Furthermore, investors can use this data as guidance to achieve greater building sustainability of their portfolios or to identify the worth of different investment options. A data structure to be tested is outlined in the appendix of this document.

[45] (including differentiation between EE-related and not EE related costs)
[46] With consideration of energy carrier

Chapter 5 Conclusion

Deliverable 1.3 establishes the link between building EE-performance, EE-refurbishment and property valuation of residential buildings. The income approach and market approach were analysed and a framework was developed to define how relevant aspects of building-EE in the property valuation process should be considered. It is established that often building-EE-refurbishment interventions not only influence the building energy demand and consumption, but also have an impact on the general condition of a building. Characteristics such as thermal comfort, sound protection, general building standard and the maintenance condition are also impacted. The impact on the property value is not only driven by the achievement of a specific EPC rating, but also influenced by altered building characteristics associated with the EE-refurbishment measures. The main drivers in building valuation are location, building aesthetics and the general standard of the building. EE-performance is often a subordinated building characteristic in relationship to the main drivers. The management of a single property or a property's portfolio and its maintenance and refurbishment measures are typically a 'holistic' process, with the priorities of work as follows:

1. Building maintenance,
2. Building standard/ upgrade
3. Building energy efficiency and sustainability

The majority of all interventions (linked with the building envelope and the technical system) have an impact on the three-named aspects and are planned accordingly. In many cases, it is difficult to differentiate between the impact of the performances of the three aspects on the property value. Furthermore, the impact on property value of these aspects differs from market to market and need to be addressed together with the dominating influence of the building location. In some cases the property value is 'dominated' by the qualities of the location and specific characteristics like building EE-performance, thus making improved energy performance difficult to determine.

Rent regulations exist not only in the social housing sector, but also in the private sector. Rented dwellings often have diverse regulations due to respective tenancy laws. These regulations influence the value determining cash flows and have a high impact on the motivation to invest in building EE. Local markets with shortages of supply can minimise the relevance of EE-performance drastically, due to the high demand for housing.[47]

In the majority of the European countries, a mass replication of EE-refurbishment is not yet the standard. The relatively slow market penetration of EE-refurbishment has an impact on the availability of appropriate comparables with the adequate EE-concepts and performances. The effort and complexity of collecting appropriate data in order to run the related statistical analysis for derivation of acceptable data for adjustment relating to energy efficiency and sustainability is a major difficulty for the valuers. Therefore broad statistical evidence is not yet readily available.
Technical concepts are continually changing and there exists uncertainty in relation to the acceptance of EE-concepts throughout the relevant markets. This is amplified through changes of the construction EE regulations and standards, and volatile and unpredictable energy prices. These elements make it more difficult to assess the impact of EE-performance on the property value and contribute to the challenges that valuers face in how building-EE is to be considered in an appraisal.

For the market approach, the establishment of appropriate data for value adjustment in order to quantify the building's EE-performance is the preferred method to determine the effect of EE on the value of a dwelling. In cases with buildings that have poor EE, their marketability (now or in future) could be hindered. In these cases, the potential costs for upgrades should be considered as a value discriminating aspect between well performing and low- or underperforming properties. For the income approach, the prediction of future rent with the consideration of reduced energy costs due to EE upgrades would appear obvious. Nevertheless, due to legal restrictions this is not always an applicable method. Additional benefits of EE can be lower operational costs and an increased building standard both of which can be reflected in a higher net income, a longer remaining lifespan, higher exit values or lower discounting rates.

The availability of tested and proven data, statistical proof and benchmarks for relevant local market segments is critical. This, in combination with more guidance and training for valuers, will enable valuers to investigate and consider the impact of the respective EE-performance of the buildings to be valued. In the 'digital age' the availability of data should be more readily available.

[47] http://isites.harvard.edu/fs/docs/icb.topic1143374.files/Rena__Chap%202.pdf

The availability of benchmarks and indicators for investigation of building EE-performance enables valuers to investigate the often-subordinated impact of building-EE on the appraisal. Therefore, a distinction between a well performing and an underperforming property can take a more significant role in a building's value. Furthermore, this may support investors in anticipation of the implication of changes of regulations or policies, energy prices or customer awareness of their portfolios.

Chapter 6 Appendix

The proposed valuation framework defined in D 1.3 will be tested in WP 2.

Building owners and housing associations provide data and descriptions of pilot cases, which will be analysed by experts on how the proposed valuation framework might influence the building value or decisions of the building owners on current and future investment programmes. The focus is on a definition of investor's worth and the market value of properties. Analysis of portfolio data from public and private sector housing associations, the interdependencies between building's EE / sustainability performance and building value will be analysed.

As preparation of the necessary data gathering process a common template including a common structure was developed. Data in the following categories is being gathered:

- Basic building information
- Financial data
- Building envelope
- Building services

The general aim is only to gather data, which is necessary in terms of worth, and value determination. A specific difficulty is the often-inconsistent data structure and the problems with the availability of data for different property portfolios. Therefore, it is distinguished between information, which is necessary, and data, which is more or less "nice to have". The tables below show the information to be gathered.

Basic building information

Item	Unite	Importance
Location	[Region, Street, Complex]	must have
Usable area	[m²]	must have
Num. of res. units	[qty.]	must have
Basic building type	Pulldown	must have
Level individual apartment	[-]	nice to have
Site occupancy index	[-]	nice to have
Type of individual apartment	Pulldown	nice to have
Construction year	[date, yyyy]	must have
EPC rating	[A, B, C, ...]	must have
Energy demand. (SAP, other)	[kWh/m²a]	nice to have

Financial data

Valuation date	[date, yyyy]	nice to have
Value	[£/€]	nice to have
Tenant turnover	[%]	must have
Vacancy (long term)	[%]	must have
Voids / defaults	[£/€/m²]	must have
Long term inflation	[%]	must have
Nominal Discount Rate	[%]	must have
Rent	[£/€/m²]	must have
Share Rent	[%]	must have
Growth rent 1	[%/a]	must have
Market rent	[£/€/m²]	must have
Growth market rent	[%/a]	must have
Comparable yield	[%]	nice to have
Maintenance costs	[£/€/m²]	must have
Management costs	[£/€/m²]	must have
Other operational costs	[£/€/m²]	must have
Comparable yield	[%]	nice to have
Building standard	Pulldown	must have
Maintenance condition	Pulldown	must have
Purchase price	[£/€]	nice to have
Purchase date	[date, yyyy]	nice to have
Encumbrances and restrictions	[Text]	nice to have

Building envelope

Roof	Pulldown	must have
External Wall 1	Pulldown	must have
Wall1: No ex. insulation possible	[x]	must have
Is wall insulated	[x]	nice to have
External Wall 2 (if existent)	Pulldown	must have
Wall2: No ex. insulation possible.	[x]	must have
Is wall insulated	[x]	nice to have
Lower boundary	Pulldown	must have
Window-quality	Pulldown	must have
Win. Modernized	[date, yyyy]	nice to have

Building services

Future need of repair	Pulldown	nice to have
Ventilation type	Pulldown	must have
Heat generator 1	Pulldown	must have
Energy carrier H1	Pulldown	must have
Efficiency system H1	Pulldown	must have
Heat generator 2	Pulldown	must have
Energy carrier H2	Pulldown	must have
Efficiency system H2	Pulldown	must have
Solar thermal system	[m²]	must have
Electricity from PV	[m²]	must have

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Glossary

(Achievable) Market rent	The estimated amount for which an interest in real property should be leased on the valuation date between a willing lessor and willing lessee on appropriate lease terms in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion.[48]
Asymmetry of information, information asymmetry	Asymmetric information, sometimes referred to as information failure, is present whenever one party to an economic transaction possesses greater material knowledge than the other party.[49]
Building characteristics	Elements about a building for example; function, size, age and construction characteristics. Quality of the building, building standard, building EE, efficiency of building equipment and systems, etc.
Building Information Modelling (BIM) and Building Lifecycle Management (BLM)	The process involving the creation, collation and exchange of shared 3D models and intelligent, structured data attached to them; BIM is the generation and management of digital representations of physical and functional characteristics of an asset's entire life-cycle.[50]
Building standard	Another way in which to describe the quality of a building, within its relevant local market and by its use. Aspects that influence the building standard are the quality of building materials, type of construction, quality of windows, doors. Type of heating system (simple coal or oil fired stoves or automatically operating systems), other technical equipment, etc.
Building sustainability	Covers a range of social, environmental and economic matters, the three-pronged approach to sustainability is referred to as triple bottom line (TBL)[51]
Building typology	A classification for existing residential buildings according to age, size and construction parameters.[52]
Cold rent contracts	Is used to describe a housing rental contract which only includes the amount which is paid to the property owner for the living accommodation. All other costs are in addition to this and paid by the renter. The tenant's energy costs are based on actual consumption. Tenants are motivated to save energy through own behaviour and by having energy efficient homes.
Comfort	Comfort stands in this document for thermal comfort including surface temperatures, draft and temperature asymmetries (for winter- and summer) and aspects like sound protection, acoustic comfort and visual comfort (daylight factor and daylight quality influenced through shading and glazing). EE refurbishment influence the building comfort of the building, insulation increases surface temperatures, improved air-tidiness reduces draft, better windows improve the sound protection

[48] (RICS Red Book global Guidance, 2014, p. 8)
[49] (Investopedia, n.d.)
[50] (RICS, Glossary and acronyms of PropTech terms, 2016)
[51] (RICS, Sustainability and residential property valuation, 2011, p. 4)
[52] (IWU, 2012-2016)

Comparables, Comparable evidence	Comparable evidence comprises a set of similarities or differences when looking at local properties that are used in support of the valuation. A comparable is used during the valuation process as evidence in support of the valuation of different items of the same general type.[53]
DCF valuation, Discounted cash flow valuation	DCF valuation involves projecting estimated cash flows over an assumed investment holding period, plus an exit value at the end of that period, usually arrived at on a conventional all risk yield basis. The cash flow is then discounted back to the present day at a discount rate.[54]
Delayed maintenance	Is used to describe real estate that has not been maintained to current codes or standard maintenance. Delayed maintenance can reduce the economic lifespan and value of a property.
Direct capitalization method, Capitalisation method	Converting income into a capital sum based on the net income or gross income divided through the capitalization rate for this type of property of the area.
Domestic hot water, DHW	Is potable hot water (temperature between 40 and 60°C) used for domestic purposes like sanitation and personal hygiene, food preparation, etc.
EE, Energy Efficiency, Building EE	Energy Efficiency is a way of managing and restraining the growth in energy consumption. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input.[55]
EE improvements, EE measures, EE-interventions	EE measures, interventions or improvements stands for the techniques to improve the EE-performance of buildings such as insulation of the thermal envelope, installation of efficient technical systems like HVAC components or ventilation systems, ICT systems and the use of renewable energy.
Energy Performance Certificate (EPC)	The EPC is a measure introduced across EU member states under the European Energy Performance of Buildings Directive (EPBD, Directive 2002/91/EC) to help improve the energy efficiency of buildings. It measures the asset rating of a building in terms of its energy performance and is produced the first time that a building is let or sold from the date of implementation of the directive. The EPC is accompanied by an advisory report that sets out recommendations for improving the building's energy rating. The assessment methods to appoint EPC rating differ from country to country. [56]
Exit value	The exit value reflect anticipated rental growth, the reversionary nature and unexpired terms of the leases at the exit date, and the application of an appropriate all risk yield. Depending on the holding period this may be forecast or based on equilibrium market conditions.[57]
Gross rents	The total income received prior to any deductions for operating costs.[58]
Hazardous material	Is any item or agent (biological, chemical, radiological, and/or physical), which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.[59]

[53] (RICS, Professional guidance, 2015)
[54] cf. (RICS guidance note - Discounted cash flow for commercial property investment, 2010, p. 3)
[55] (IEA-Internaltional Energy Agency - Energy efficiency, n.d.)
[56] cf. (RICS, Sustainability and residential property valuation, 2011, p. 21)
[57] (RICS guidance note - Discounted cash flow for commercial property investment, 2010, p. 3)
[58] (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 21)
[59] (IHMM, What Are Hazardous Materials, 2015)

Income approach	An approach that provides an indication of value by converting future cash flows to a single current capital value.[60]
Investment value, or worth	The value of an asset to the owner or a prospective owner for individual investment or operational objectives. (May also be known as worth.)[61]
Maintenance improvements, building maintenance, maintenance status	Measurements / improvements to a building that are required to maintain a safe, healthy and useable building. The maintenance status assesses the quality of the building maintenance.
Market approach	An approach that provides an indication of value by comparing the subject asset with identical or similar assets for which price information is available.[62]
Market value (MV)	The estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion.[63]
Net operating income (NOI)	The total rental income after deducting operating expenses, but before deducting capital expenditure, tax and interest.[64]
Obsolescence	The process of becoming obsolete or falling into disuse, or becoming out of date. Most obsolescence is curable through capital expenditure. Some obsolescence, where resulting from something outside the property, such as a new road, may be permanent.[65]
Renewable energy, Alternate sources of energy, RES	Renewable energy is generally defined as energy that is collected from resources which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.[66]
Renovation packages	Sets of suggested interventions to implement with specific costs, targets, and goals. Upgrades of building-EE, maintenance status and building standard are usually in the package.
Running costs for the tenant	The amount of money that is regularly spent, by the tenant, on things such as utilities; heating, lighting, water, and rent
Tenancy turnover	The rate at which properties are re-let or tenants renew their tenancies (can also affect the rental income). As a result of the units being empty between lettings (void periods), rental income is reduced. Where tenants vacate, a property may be refreshed for letting purposes and costs incurred as a result.[67]
Useful economic life, economic and technical lifetime	To be quantified by the valuer and determined by the shortest of the following: the physical life, the functional life, technological life, economic life and the legal life[68]

[60] (RICS Red Book global Guidance, 2014, p. 7)
[61] (RICS-UK valuation standards, 2014, p. 8)
[62] (RICS Red Book global Guidance, 2014, p. 8)
[63] (RICS Red Book global Guidance, 2014, p. 9)
[64] (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 22)
[65] (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 22)
[66] (Ellabban, et al., 2014, p. 748–764)
[67] cf. (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 12)
[68] (RICS Red Book global Guidance, 2014, p. 103)