REVALUE

D 1.2
Comparison of the Valuation Techniques based on the Key Performance Indicators

Final
February 2, 2017

Deliverable	*D 1.2*
Title	*Comparison of the Valuation Techniques based on Key Performance Indicators*
Editor(s):	*LUWOGE consult GmbH*
Contributors:	RICS, Maastricht University, Savills, Vanhier
Reviewer:	RICS, Maastricht University, Savills, Vanhier
Version:	*1*
Date:	*2017/02/03*
Status:	*Final*
Dissemination level:	*Public*
Download page:	*29*
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Deliverable description

The Deliverable, D1.2 The REVALUE Comparison of the Valuation Techniques based on the Key Performance Indicators, provides an overview of valuation techniques existing on National and European levels.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649705. The sole responsibility for the content lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EASME nor the European Commission are responsible for any use that may be made of the information contained therein.

Executive Summary

Key performance indicators can often be linked to energy efficiency (EE). Energy efficiency refurbishment measures influence a building's energy demand and usually, also the energy consumption. Furthermore, EE refurbishments can influence the maintenance condition and the building's modernization status, which has an additional impact on the building's value. There also exist indirect, less tangible influencing KPIs such as thermal comfort and noise protection.

The three basic property valuation approaches, the Income Approach, the Comparative Market Approach and the Cost Approach follow fundamental different principals. In this deliverable, the relevant KPIs and sub-methods of the approaches are described. The general principals, such as income, expenditures and market prices, drive the relevant KPIs and sub methods.

In the income approach, three different sub methods are identified; discounted cash flow, income multiplier and the direct capitalization method. The discounted cash flow method and a compressed version of the income multiplier method provide the best possibilities for consideration of energy efficiency refurbishments in a comprehensive and lasting manner. The comparative market approach requires appropriate comparables with similar characteristics for comparison and value adjustment or a comprising and statistically proven database for being able to find the appropriate comparative and to derive adjustment factors. The cost approach has the lowest market relevance, and because it is based on construction costs, a market correction factor is necessary. For residential properties in most European countries, the cost approach has a relatively small relevance.

Using the information gained during expert sessions, presentations and interviews with professionals in the fields of appraisals and finance, gaps became apparent between the EE information available and the knowledge of the valuers and the tenants. Gaps such as access to relevant energy efficient data and its connection to tenant comfort and any related cost benefits are often not asked for. A consistent barrier in the social and public residential markets is the rent caps set by legislations in the varying countries. The ability of a valuer to keep pace with the ever-changing and fast passed building technology industry is nearly impossible. Limited time allotted to execute an appraisal as well as insufficient training adds to the challenges. The lenders typically direct valuers and therefore a focus should be placed on providing relevant data and information to the lenders regarding energy efficient measures.

In order to provide relevant energy efficient building packages, a system of typologies is assigned to the data provided by housing companies. These residential typologies where selected based on a "Building Typologies" web tool. These typologies, which have been developed within the framework of the Intelligent Energy Europe projects TABULA and EPISCOPE, www.episcope.eu, allow buildings to be categorized based on a coordinated approach of size, age and location. This approach allows the REVALUE team to develop national or regional building typologies. Current financial data, building upgrade information and relevant EE systems data provided by housing companies supplies the information needed for the development of building refurbishment packages. Projections of the future energy consumption, life cycle costs and the most relevant refurbishments for a particular typology will be developed. It is through this analysis that REVALUE hopes to localize what type of EE refurbishments have the greatest impact on value, therefore identifying the EE measures with the greatest impact, so they can be considered during a valuation.

Table of Contents

Chapter 1 Introduction and Scope

1.1 Purpose of Document

The aim of this deliverable is to provide a systematic overview of the Key Performance Indicators (KPIs) used for property valuation. A hierarchy exists within the valuation process for different KPIs. In order to provide an overview and perform a comparison of the valuation approaches in regards to KPIs, it is helpful to classify KPIs. The graph below shows the general structure of how KPIs can be categorized.

Figure 1: Classification of KPIs[1]

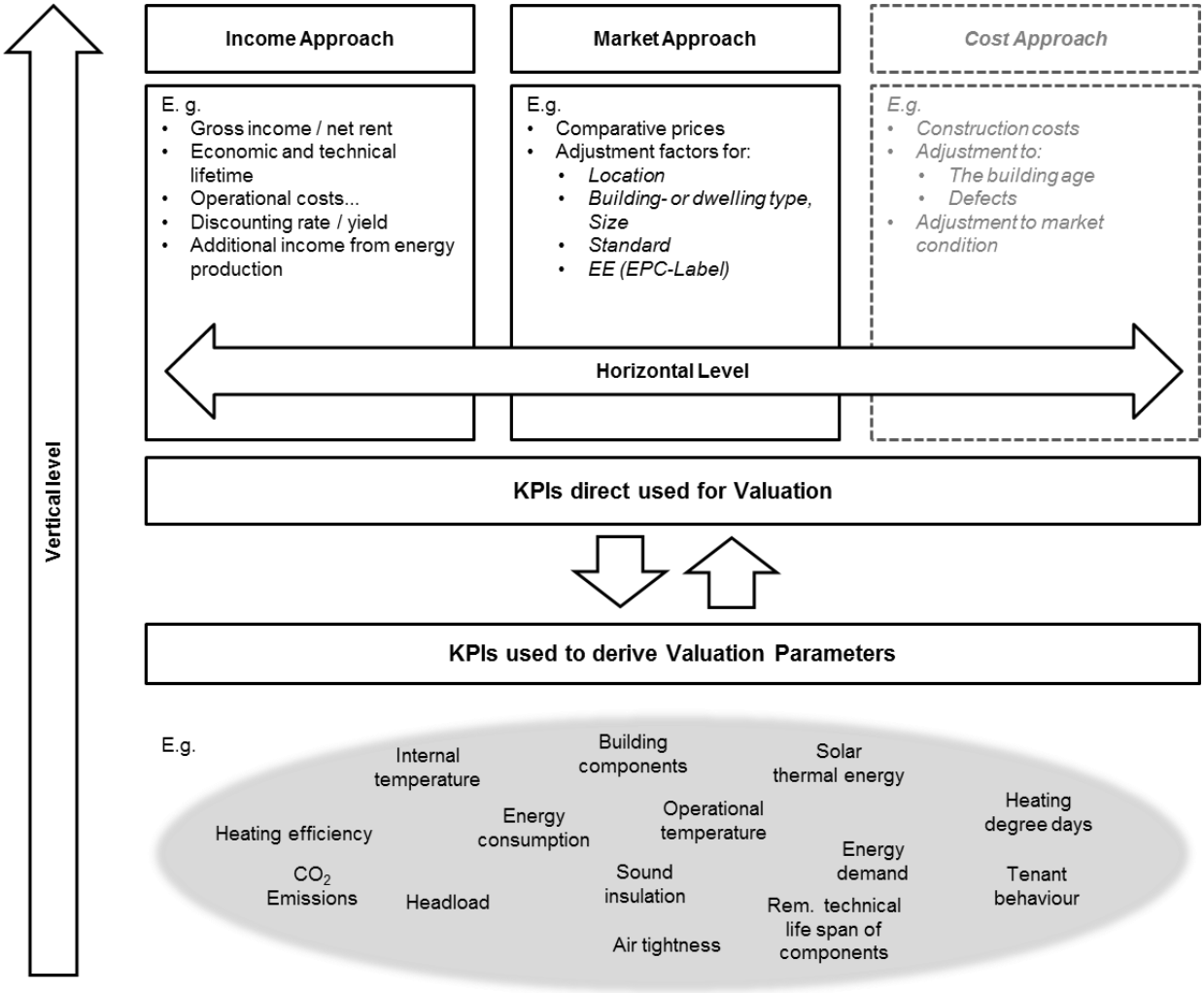


Figure 1

Many of the "top-level" KPIs used for property valuation are derived from subordinated KPIs and correspond via a system of logical functions. An example is the determination of the remaining technical lifespan for a property. Determination of this technical lifespan is derived from the individual building components and each component's remaining usefulness. When building and component maintenance has been neglected, the remaining lifespan of the building may be lower. Therefore, valuers should consider the technical condition of the building components. It may be reflected as a reduced life span, lowered exit value or as higher operational costs for maintenance.

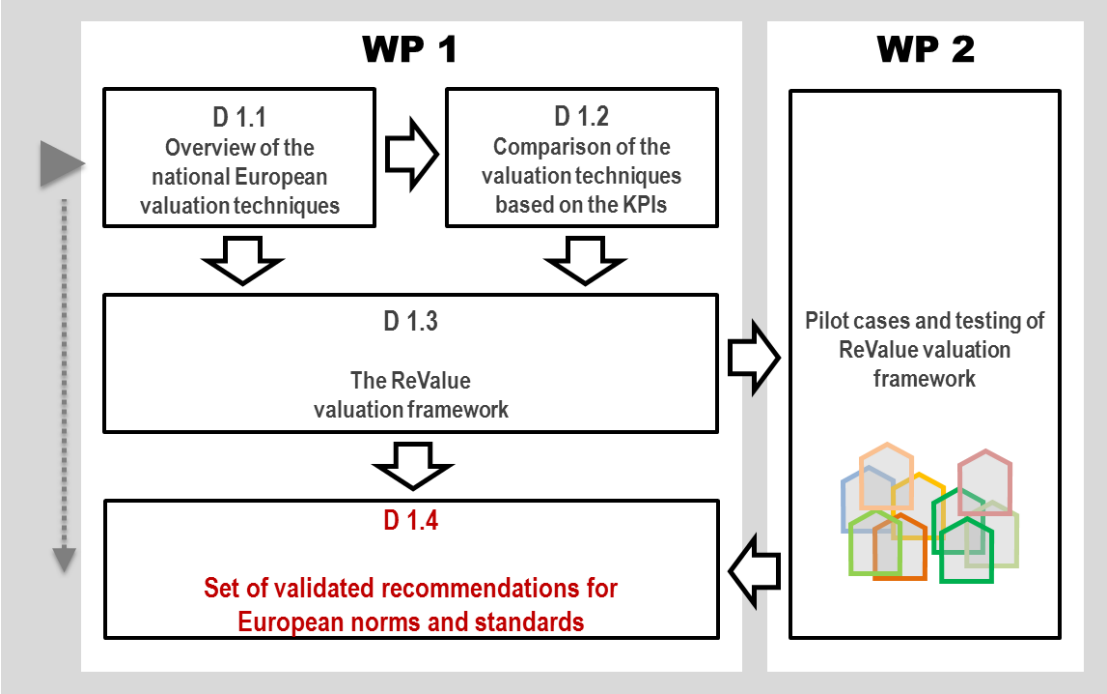
[1] Own illustration, source LUWOGE consult

When these logical functions relate to correlating sustainability and energy efficiency KPIs, the results are often positive. The 'secondary' KPIs, can provide investors and stakeholders avenues in which they may see both qualitative (in the form of comfort and health of the tenants) and quantitative improvements (lower maintenance costs) of residential living situations.

As shown in Figure 1, the most common valuation techniques are the comparative market approach, the income approach (or investment method) and the cost approach. Other approaches are typically derivatives or mixtures of these methods of valuation. For purposes' of the REVALUE Project, it is then relevant to focus on these main valuation approaches.

The description and comparison of KPIs serves as an input for Deliverable 1.3, the REVALUE Valuation Framework, which addresses recommendations for new European valuation norms and standards. The framework will be tested in WP 2 and WP 3 in pilot projects conducted in United Kingdom, Germany, The Netherlands and Sweden.

Figure 2: Towards a set of validated recommendations for European norms and standards



Chapter 2 Key Performance Indicators and Drivers for Value

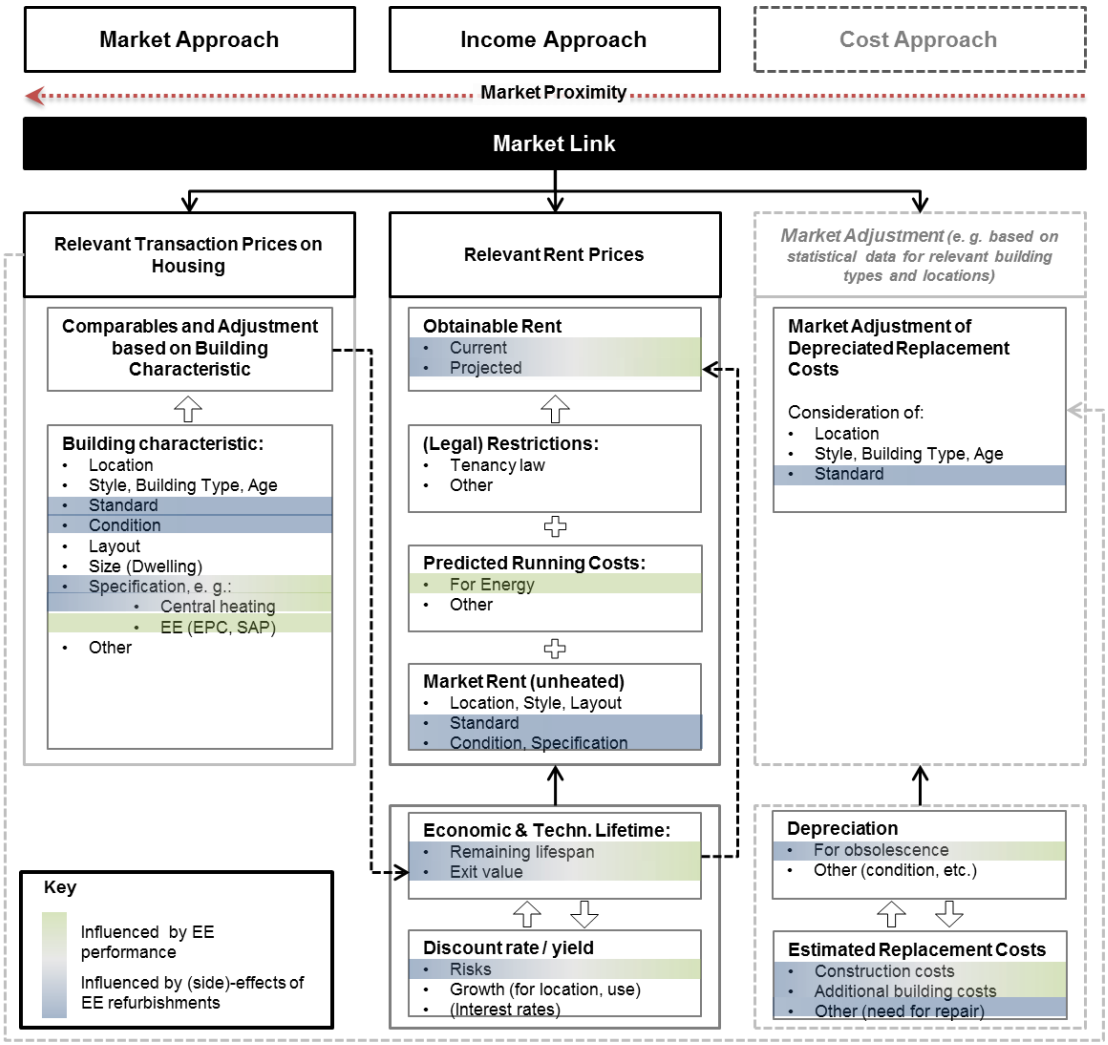
The relevance of the different valuation approaches and methods varies from country to country and depends on the respective occasion for the property valuation. In terms of use, KPIs in general, throughout Europe are similar. Therefore, there is no need to consider all country specific KPI particularities within this investigation.

2.1 Valuation Approaches and Market Relevance

The market value is a 'transfer value' and is defined in the International Valuation Standard (IVS)[2] and the Red Book. In cases where properties are held and transferred for investment, the preferred approach to determine investment value is the income approach.

The cost approach is the least preferred approach and only used in very specific cases when no comparable prices are available. Expert opinions diverge when determining if the cost approach can reflect a market value, but the relevance of the approaches differ throughout Europe. The diagram below provides an overview and comparison of the 'three approaches' in terms of the KPIs connection to the market, EE performance, and EE related characteristics.

Figure 3: KPIs and Market Proximity of the 'Three Approaches'



[2] cf. (RICS Red Book global Guidance, 2014, p. 9)

A core aspect for valuation is in respect to the local market and achievable prices. Within the three approaches, this connection is established differently. In the market approach, values are determined based on the transaction prices of relevant comparables with consideration of the specific valuable characteristics for price adjustments. In the income approach, the obtainable rent determines the income. It is a reflection either of the market rent or in the cases of rent caps / rent regulations, and combined with a high demand, the maximum achievable income.
In cases of valuations based on the cost approach, an adjustment of the deprecated replacement cost is necessary. This adjustment needs to reflect the situation of the relevant market and have statistical evidence of the relevant local market segment and building type.

Improvements of the building EE performance are achieved through EE-interventions. These interventions comprise the change or improvement of technical components such as walls, windows, roof, heating system and the installation of systems to use renewable energy. The majority of all interventions influence (improve) not only the buildings EE-performance, they also have an impact on other parameters relevant for property valuation[3]. Other categories of improvements are:

- Improvement of the building condition (status of building maintenance)
- Standard upgrade and/or reduction of obsolescence and improvement of "currentness" of the property
- Reduction of risks in terms of environmental legislation

2.1.1 KPIs and Characteristics relevant for the Comparative Market Approach

The basis of this method is the 'comparison of like with like'.[4] All properties are unique and are never totally alike. Therefore, finding the correct comparable price is one of the main difficulties of the comparative market approach. Prices of sold properties have to be gathered in a price list. With statistical methods such as the multiple regression analysis, specific adjustment factors can be derived. Important is a comprehensive and coherent database of transactions of equivalent properties in a comparable location. The weighting of the different adjustment factors against each other have to express the respective influence of each factor in a proven manner.

The most important Elements and KPIs for comparison used for the market approach are:

Table 1: Elements and KPIs used for market approach

Elements	Relevance	Items
Transaction Date		Date of signed purchase
Location	Very high	Macro location (Town, Region)
		Micro-Region (district, area)
		Property
Limitations to Use	High	Easements, servitudes, etc.
		Site occupancy index
Quality of Plot	Medium	Parking spaces, etc.
Building Type	High	Size (comparable properties should be of similar size)
		Building age
		Building aesthetics
		Number of apartments within the building

[3] See Figure 3: KPIs and Market Proximity of the 'Three Approaches'
[4] cf. (Shapiro, et al., 2013), p. 136

Elements	Relevance	Items
Dwelling / Layout	High	Layout of dwelling or building Size of the dwelling Number of stories in the dwelling Number of rooms Level of dwelling in the building
Building Standard	Medium	Evaluation of the building standard in relationship to the relevant comparables and market segment based on market specific criteria, e. g. (poor, average, good, very good)
Specification	Medium	Technical specifications such as: – type of heating system (central, decentralized) – type of ventilation – presence of an elevator – presence of renewable energy production – other Energy performance: – EPC rating (A, B, C, D, E, F, G) – Energy demand – Energy performance index
Building Condition	Medium	Maintenance status (Poor, good, Excellent) Implemented refurbishment and retrofitting interventions Remaining life span, age
Legal (houses and apartments for rent)	Medium	Type of tenure Limitations on use
Additional Income from Renewable Energy Sources (RES)	Low	Additional revenues from energy production (e. g. from PV, CHP), valuation based on an income approach

The advantage of the comparative market approach is the empirical market evidence, because valuations are based on real transaction prices.

The market pricing of energy performance certificates requires the availability of statistically proven adjustment factors. Depending on the local market, a bad label can lead to a discount and advanced performance to a premium[5]. In addition to the energy consumption EE-refurbishment measures can influence the standard of a building and the living quality of the tenants.

[5] cf. (Brounen & Kok, 2010), p. 15

2.1.2 KPIs and Characteristics relevant for the Income Approach

The main aspect of the income approach is the valuation based on the cumulated value of the future income stream for a property. For the income approach, there exist three different methods, which are categorized as follows:

- Discounted Cash Flow Method
- Income Multiplier Method
- Direct Capitalization Method

Within the three sub-methods, 'net income stream' is the most important component for a valuation based in the income approach. The net income stream is part of the annual net revenues, which are determined by the gross income minus operational costs. In this context, the maximum duration and quantity of the respective future net revenues determine the value of the income generated by the property and all three methods reflect this. The amount of the net income stream over time depends on the following KPIs:

Table 2: Elements and KPIs used for income approach

Elements	Relevance	Items
Gross income	Very High	Achievable net rent[6] (including service charges, etc.)
		Voids, bad debts, etc.
		Revenues from energy production (e. g. PV)
Development of gross income	Very High	Increase of the net rent over time
		Tenant turnover
		Vacancy, Defaults
Running costs	Medium	Costs for heating and DHW production based on consumption of the previous year
		Property tax, assurances, etc.
		Building cleaning, waste disposal, etc.
		Common electricity, other
Operating costs	High	Costs for maintenance and repair (regular and irregular)
		Management costs
		Running costs for vacant apartments
		Other
Economic and technical lifetime	High	Building age
		Qualities of the location
		Status of maintenance and refurbishment
		"Currentness" of layout (dwelling or building)
		EE-performance (EPC / individual components)

[6] For determination of an 'Achievable Net Rent' the market rent in combination with legal restrictions needs to be taken into account

Elements	Relevance	Items
Discount rate / yield	Very High	Interest rates for capital, opportunity
		Projected Inflation
		Opportunity cost for equity
		Risk adjustment for specific property or type
		Expected interest rates, etc.
		Yield for comparable properties

The previously listed KPIs influence the resulting net present value (NPV) because of the buildings "net income stream" being affected.

2.1.2.1 The Discounted Cash Flow Method (DCF)

The DCF method calculates over a specific amount of defined periods, a stream of costs and income. These costs and income are then discounted monthly or annual. The resulting cash flow is summarised to provide a resulting net present value. The income of the first years has a higher resulting value than the income of later years.[7] The standard duration of the detailed analysis periods is in the range between six and fifteen years[8]. For consideration of income and costs beyond the observation period, various methods are used. The so-called exit value is considered as perpetuity, based on the method applied, (income multiplier method, comparative market value, etc). The exit value should be a reflection of the physical condition and demand of the building within the relevant market.
The projected cash flow should reflect the realistic annual achievable rent of the building with monthly or annual deductions for maintenance, management, etc. The discounting rate or "overall capitalization rate" should reflect the local market conditions. For determination of the general market value, the discount rate has to be a market-derived discount rate.[9]

Equation 1: Income Value (Multi-Periodic Approach)

$$IV = \sum_1^b NI_b \times q^{-b} + \underbrace{RE_i \times (DF_n - DF_b) + GR \times q^{-n}}$$

Example for an exit or salvage value

NI = *Net income*
i = *Discounting rate (or allover capitalization rate)*
q = *1 + i*
n = *Remaining useful lifespan*
b = *Periods under consideration*
GR = *Ground Value*
DF = *Discounting factor (pension cash value factor)*

[7] cf. (Shapiro, et al., 2013), p. 138
[8] cf. (Shapiro, et al., 2013), p. 139
[9] cf. (Shapiro, et al., 2013), p. 136

2.1.2.2 Income Multiplier Method

The principal characteristic of this method is the use of a multiplier to calculate the potential value of a property based on the annual income. The income value is calculated based on a net income and PVA[10] factor.
The PVA or discounting factor should reflect the remaining useful lifespan and the overall capitalization rate.

Equation 2: Discounting factor / PVA factor

$$DF = \frac{q^n - 1}{q^n \times i}$$

i = *Discounting rate (or over all capitalization rate)*
q = *1 + i*
n = *Remaining useful lifespan*

The remaining useful lifespan needs to reflect the actual condition of the building with consideration of the local market and consideration of future developments. Repair backlog and existing defects will typically reduce the remaining lifespan of a building. It has been demonstrated that the remaining life span of existing buildings can be extended through refurbishment measures. These "updates" can reduce the economic and technical obsolescence of the building and the components that have been modernised.

2.1.2.3 Direct capitalization method

For the direct capitalization method, the income has the characteristics of an annuity. This annuity can be stepped, fixed or variable[11].

Equation 3: Income value (multi-periodic approach)

$$CV = \frac{NI}{i}$$

CV = *Capital value*
NI = *Net income*
i = *Yield*

In case of a stepped income the present value of the rent increase, has to be considered because it leads to a value premium. The yield has to be derived from transactions and sales prices of a comparable location and a comparable building type. The determination of the yield is one key element and requires close attention and market expertise. The yield is determined from analysis of prices.[12] Aspects like obsolescence need to be considered indirectly with two possibilities. One that the yield expresses the risk; the market environment and second, that it shows the remaining life span. In the case in which modernizations have been omitted or neglected, a high yield would result. This high yield reduces the value and expresses "the finite nature" of the future income, lowering the net income of a property.

[10] Present value of an annuity
[11] cf. (Baum, et al., 2011), p. 94
[12] cf. (Baum, et al., 2011), p. 90

2.1.2.4 Comparison of Methods within the Income Approach

The table below comprises an overview for the three previously described methods of the income approach with consideration of the following aspects:

- Obsolescence
- Modernization and Refurbishment
- Maintenance (annual and future repairs)
- EE-Efficiency / Energy costs for heating and DHW as operational or running costs

Table 3: Comparison of Income Approach Methods

Aspect	Discounted Cash Flow Method (DCF)	Income Multiplier Method	Direct Capitalization Method
Reduced obsolescence and increased building life span through EE-refurbishment	Considered as: • Higher exit value	Considered as: • Longer remaining useful lifespan	Considered as: • Adjusted (lower) yield or different comparable objects
Improved building condition through EE refurbishment	Considered in: • Higher expected rents and cash flows e. g. due to lower tenancy turnover, better comfort and standard, etc. • Higher exit value	Considered in: • Longer remaining useful lifespan	Considered as: • Adjustment of the yield
Reduced annual and future maintenance due to EE-refurbishment	Considered as: • Reduced operational costs and higher net income • Higher exit value	Considered as: • Reduced operational costs and higher net income • Longer useful lifespan and higher PVA factor	Considered as: • Reduced operational costs and higher net income • Adjustment (lowered) yield
Improved EE and reduced energy demand and consumption as running costs[13]	Considered as: • Achievable / market rent: In case of no legal restrictions, higher achievable rent based on increased EE and saved running costs for energy		
EE-Efficiency / Energy costs as operational costs[14]	Considered as: • Reduced costs for heating and DHW productions lead to lower operational costs and an increased net income • Lower risk and higher "future proof" can be reflected with a reduced interest rate / lower yield		

[13] Paid by the tenant
[14] Paid by the landlord

Energy efficiency measurements normally influence not only the buildings energy demand and consumption; they also influence the maintenance status; the status of the building's obsolescence and modernization. Considering this, the three sub-methods of the Income Approach bring different possibilities for considering EE-refurbishment. The impact of the EE-measures should be considered according to their joint benefits and single benefit considerations should be avoided. For the direct capitalization method, the yield has to reflect many different characteristics of the building within the local market. For this method, the determination of the yield has to follow a clear methodology and be completely documented. The Discounted Cash Flow method and a compressed version of the Income Multiplier Method"[15] provide the best possibilities for consideration of energy efficiency refurbishments in a comprehensive and lasting manner.

[15] Similar to the German Income approach

2.1.3 KPIs and Characteristics Relevant for the Cost Approach

The relevance of the cost approach in residential valuation is relatively low. The cost approach method surmises that the price a buyer should pay for a piece of property should equal the cost to build an equivalent building, either as a reproduction or a replacement. Therefore, energy efficient KPIs can be considered when an appraiser is using the replacement cost approach method. Depending on the local market and country, the cost approach is sometimes used as a supportive method to check one method against the other[16]. The most important KPIs for the cost approach are:

Table 4: Elements and KPIs used for Cost Approach

Elements	Relevance	Items
Land Value	Very High	Value of the building plot / land value based on market value for land with consideration of: • Limitations to use (site occupancy index, etc.) • Quality of plot (parking spaces, etc.)
Specifications	High	Technical specifications such as: • Type of heating system (central, decentralized) • Type of ventilation • Presence of elevator • Presence of renewable energy production • Other Energy performance: • EPC rating (A, B, C, D, E, F, G) • Energy demand • Energy performance index
Building Condition	Medium	Maintenance status (poor, good, excellent) Implemented refurbishment and retrofitting interventions Other
Constructional Costs	Very High	Infrastructural costs Construction costs of the comparable building with consideration of building type, building standard and specifications: • Costs for building envelope, structural work • Costs for fit-outs, etc. • Costs for building technics (HVAC system, electrical system, etc.) • Costs for outdoor facilities, etc. • Other
Additional Building Costs	Medium	Architectural, engineering, permitting, certifications and other additional costs
Depreciation of Estimated Building Costs	Very High	Building age Building type Remaining life span with consideration of implemented refurbishment and retrofitting interventions

[16] cf. (Shapiro, et al., 2013) p. 15

Elements	Relevance	Items
Cost Adjustment to Specific Condition	Medium	Maintenance condition Defects and damages
Market Correction for Location	Very High	Macro location (Town, Region) Micro-Region (district, area) Building type
Additional Income from Renewable Energy Sources (RES)	High	Additional revenues from energy production (e. g. from PV, CHP), valuation based on an income approach

A valuation based on construction costs has the lowest market evidence. Therefore, the use of a market correction factor is necessary. EE-refurbishment measures reduce the building age related value (or cost) deductions and can influence the maintenance condition of the building having the effect of lower deductions for defects and damages.

2.1.4 Gaps and Barriers of Current Valuation Techniques

Lenders are the catalysts which begin the valuation process. Lenders have the ability to direct the appraiser as to the focus of the valuation and bring to their attention the importance of observing and consideration EE in the valuation.

The market approach's greatest barrier is that of not having significant comparison properties on which to base an appraisal. This, at the heart, presents the gap, which REVALUE attempts to address. If properties with EE upgrades have not shown a monetary shift in its appraisal value, then the next building with EE upgrades will also fail in this regard. A barrier within this approach also occurs when no other comparable building exists.

The income approach presents challenges when clear and well tracked histories of a building's variable expenses have not been recorded. Variable expenses or sometimes called operational expenses are things such as management fees, snow removal and sometimes utilities. A gap appears in the case for tracking the impact of energy efficient elements within a building. It is often hard to separate these from the normal maintenance expenses and/or cost of running a building. The income approach reflects the condition on the rental market including relevant regulations such as rent caps and address exclusive-use properties, such as libraries, schools or churches.

In the cost approach, several barriers arise if this method is to be used in the appraisal of an older or significantly outdated building. A related question is whether the building in question is anything that would actually be built again in that market, in that location. Gaps can occur in the method when; some of the basic assumptions, such as is there a sufficient supply of buildable land and is construction a viable alternative to the purchase of an existing property. Another gap is that the cost of constructing an obsolete building isn't considered a relevant factor in the consideration of this approach. It is generally considered that when a building is new and at its best and highest use, it yields the most accurate market value. It is typically not used in the appraisal of residential property.

In general, regardless of method, there are the condition of the local and regional rental markets and legal restrictions which also influence the impact of a building's status within the market. EE is a specific building characteristic which, when substantiated, can influence the value of a property, however, current demand for housing and location are still the main drivers to a buildings appraisal value.

In the case of EE-upgrades and refurbishment packages, (regardless if it is part of general building improvements), the EE-characteristic of the building is changed. These interventions and refurbishment packages have an impact on other value drivers such as building standards, building maintenance and the overall refurbishment conditions.

Chapter 3 Decision-Making in the Process of EE-Refurbishment

3.1 Evaluation of EE-refurbishments

There exist different methods and KPIs to assess EE-refurbishment interventions and packages. The methods used for residential buildings evaluate if interventions are economical sound. Beyond the economical evaluations and the classification of buildings according its Energy Performance Certificate (EPC) and EE-performance, exists other, more complex certifications such as LEED, BREEAM or DGNB. These certifications have specific KPIs that focus on aspects that are more complex and are part of building sustainability schemes. Nevertheless, for residential buildings, the focus for assessment is on economical and energetic aspects. Other relevant qualities like thermal comfort, soundproofing and daylight factors are planned and optimized through architects and engineers based on professional experience, knowledge and existing building codes.

Relevant economical KPIs are:

- Life Cycle Costs
- Cost of saved energy

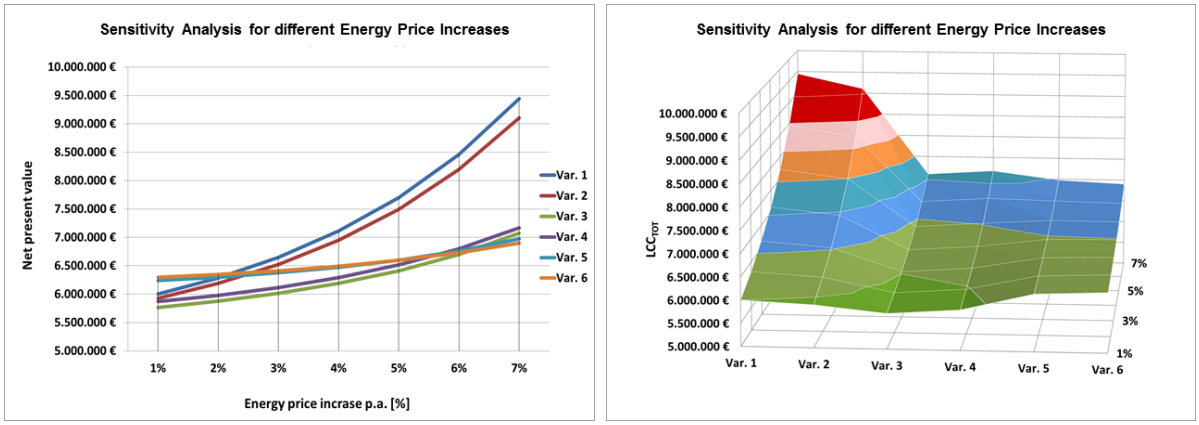
3.1.1 Assessment of EE Interventions and Packages based on Life Cycle Cost (LCC)

Assessments based on Life Cycle Costs (LCC) are relatively complex. The LCC for a building is the process of identifying and documenting all the costs involved over the life of the building. For LCC's of EE, there exist diver definitions and standards[17], however a uniform application in practice does not exist. For evaluation of EE-refurbishment packages, the LCC method is modified in a way that focuses on the refurbishment costs and the upcoming operational costs of the building. Along with the initial investment, expenses for refurbishment and follow-up costs are taken into account. These follow-up costs include operational costs and the most important are:

- Construction costs and additional costs for construction
- Maintenances costs for regular and irregular maintenance
- Energy costs related to heating and DHW production[18]

The determination of energy costs is performed based on demand calculations/EPC labels. The deviation between the demand calculation and consumption, at this point, is often neglected. Another crucial point is the prediction of increases in future energy prices. Therefore, the application of sensitive analyses or the calculation of different price increase scenarios can be useful.

Figure 4: Examples for Sensitivity Analysis for different Energy Price Increases[19]



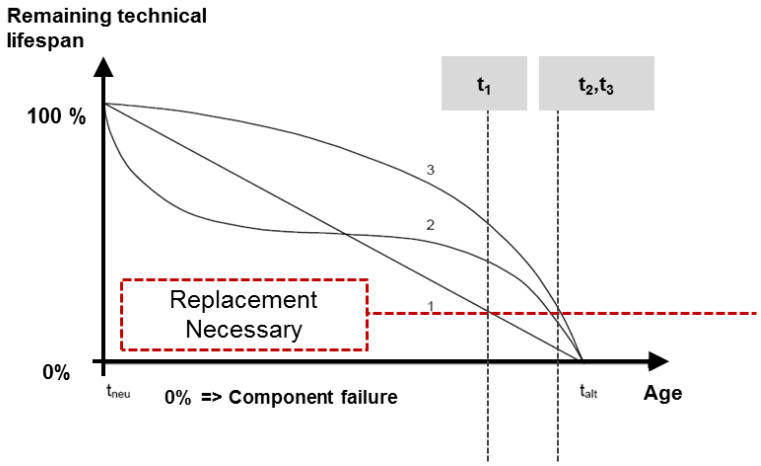
[17] E. G.:
- ISO/TC 59/SC 14 - Design life
- ISO 15686-5 - Buildings and constructed assets - Service life planning - Part 5

[18] Including costs for auxiliary energy

[19] BEEM-UP, Deliverable D 1.5: Design alternative with integrated solutions for each building, LUWOGE consult GmbH

To determine the expected maintenance costs, different procedures are used. In some cases, expected maintenance costs are determined as a share of the total investment costs. This can be misleading, because with EE-investments and upgrades to a building's components, the overall maintenance would assumed to be lower compared with not upgrading a building's components.

Figure 5: Types of Obsolescence for 3 different Building Components[20]



The effort to assess the technical lifespan of relevant building components is relatively high and an efficient investigation requires advanced tools, software and acceptable benchmarks. The advantage of this method is to base decisions 'not only' on energy savings and respective investment costs for packages, but also on having maintenances as part of the decision making process. Life cycle costs (LCC) for assessment and comparison of EE-refurbishment packages can be calculated as follows:

1. Calculation of Periodic Life Cycle Cost Flow[21]

$$LCCf_t = M_t + A_t + E_t - R_t$$

A *Annual operating cost (except energy costs)*
M *Irregular maintenance and repair costs*
E *Annual energy costs*
R *Salvage / Residual value*

2. Calculation of the Life Cycle Cost for refurbishment

$$LCC = I + \sum_{t=1}^{T} (LCCf_t) \cdot (1+i)^{-t}$$

I = *Investment costs*
LCCft = *Life cycle cost flow in t (during the period of observation)*
i = *Discount rate*
T = *Periods under review*

Packages with the lowest LCC would be the most preferable in terms of the techno economic comparison. It is crucial to pay attention to the performance in terms of the targeted residential performance and specific sustainability aspects.

[20] cf. BEEM-UP, Deliverable D 1.5: Design alternative with integrated solutions for each building, LUWOGE consult GmbH
[21] cf. BEEM-UP, Deliverable D 1.1 Intensive kick-off workshop to specify boundary conditions for the sites

3.1.2 Cost of Saved Energy

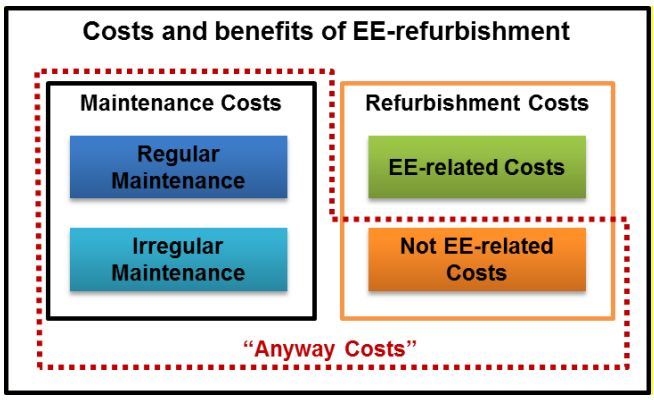
A second techno-economical assessment method is the evaluation based on cost of saved energy. The cost of saved energy is quite simple to apply.

Cost of saved energy focuses on the present value of energy savings and the 'additional costs' of the energy saving measure. It implies that only a specific share of the total investment costs of an intervention is driven by the goal to increase the EE-performance of the component. E.g. the installation of a new window is normally not only done to improve the U-Value of the window, it's done to change an old and mostly obsolescent window with a new well working and aesthetic window. Only the extra cost for selecting a window with better EE and lower U-value compared to a standard product would be countable as an EE related additional cost for energy savings interventions.

$$I_{ADD} = I - I_{AW}$$

I_{ADD} = *Additional costs for EE- interventions*
I = *Investment cost for an specific intervention*
I_{AW} = *Anyway costs (share of the non EE-related costs of the intervention)*

Figure 6: Systematic of Costs for Refurbishments[22]



The 'Cost of the saved kWh energy' can be calculated if the annuity of the additional costs for EE is divided by the annual sum of saved energy. This theoretical 'energy price' based on the investment in EE can be compared with the assumed mid-price of the respective type of energy of the status quo. If the price of the saved kWh is lower than the price for the kWh for the status quo, the intervention or the intervention package would be economical sound.

The determination of the assumed mid-price per kWh and the 'Anyway Costs' has a strong impact on the results. The method is very practical in terms of assessing EE-interventions and related cost benefits but there is no indication of the 'residential value'.

[22] Own illustration, LUWOGE consult

3.2 Typologies

The basis for developing the renovation packages specific to the REVALUE project and the countries represented are based on criteria for building typologies. Residential typologies where selected based on the "Building Typologies", a web tool, which has been developed within the framework of the Intelligent Energy Europe projects TABULA and EPISCOPE[23]. The buildings are categorized based on a coordinated approach, allowing experts to develop national or regional building typologies that are compatible with the common TABULA approach. Each national residential building stock is categorized by building size, age and country. These categories establish TABULA's generic building type matrix and each country's building stock model[24]. These stock models are used to assess the refurbishment processes and project the future energy consumption when refurbishments are undertaken.

There are four general building class sizes: single family houses, terraced houses, multi-family houses and apartment blocks. Climate region, construction period and style specific characteristics have been analysed and "exemplary buildings" have been selected, based on available data of visual appearance, commonly found construction elements and corresponding energetic performance.

The REVALUE project is utilizing the TABULA typology method to categorise the housing stock of the pilot countries. The typologies will be used in a calculation model developed by LUWOGE consult. This model establishes several primary goals. First, the individual ratio of the building envelope to the surface areas of the respective reference floor area in the building. This information in combination with the "typical" U-value of the building's envelope thermal performance to be compared to the U-Value of the envelope after renovation. Next, the model addresses building services. The results of the model gives an overview of the energy cost savings that can be achieved by standard refurbishment measures and the savings due to combining the efforts of both envelope refurbishment and services replacement. A visual of how typologies are determined and how they are used is in appendix 5.1.

[23] http://episcope.eu/
[24] cf. (EPISCOPE [http://episcope.eu/], 2012-2016)

Conclusion

The role of energy efficiency and sustainability in the built environment play differing roles in relationship to the professionals involved. Energy consultants, valuers, investors and users all differ in how they use and think about EE and sustainability and each of these groups place differing worth on it as well. The valuation methods discussed, attempt to place an objective view on buildings and the role, which EE contributes to the built environment.

Energy consultants stick mainly to savings of energy, related investment costs and specific refurbishment concepts. They work closely with engineers, architects, as well as investors, housing associations and owners. Energy consultants research, strategize and experiment with the latest materials and products in the field of energy efficiency and sustainability. Their focus is not so much on the improvement of the "residential value" and the general standard of the building; it is rather on the technical side to improve building EE, building maintenance and the health and comfort of the occupants.

Valuers strive to reflect the complete value of a building. They do not evaluate just a part or a specific characteristic. Energy Efficiency refurbishments are only a part of the valuation package and not the strongest value driver. Property valuations have to reflect the overall residential value of properties together with all other characteristics. Resources to carry out valuations are limited and building specific technical information is not always available. The interpretation of the contribution of EE technical characteristic to the building value is difficult, and often times still subjective. Valuers need to widen their scope of the investigation to ask for EE and other sustainability related information.

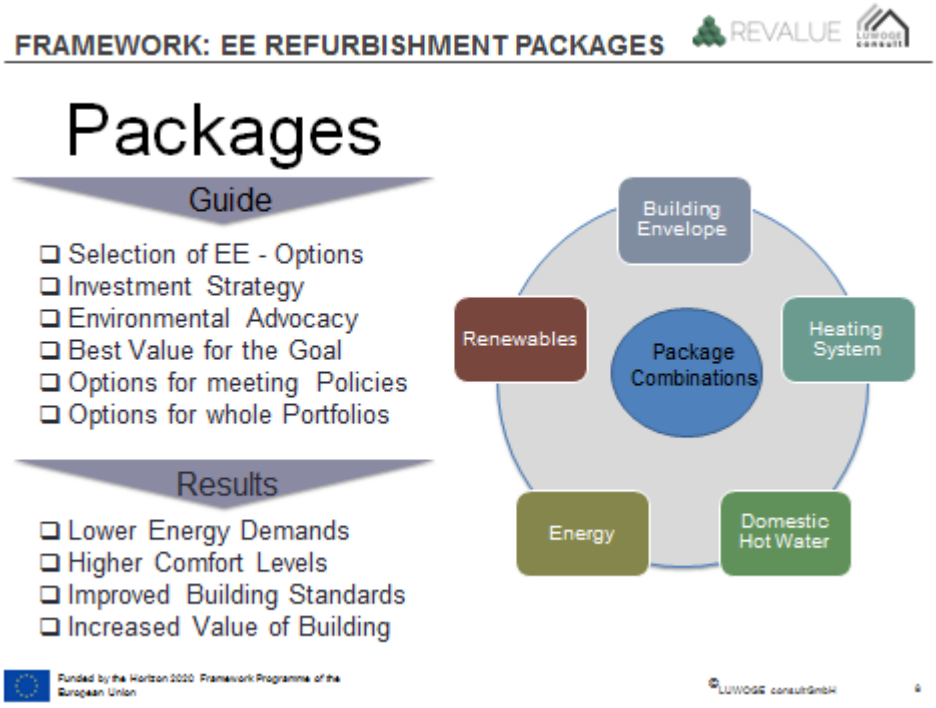
Legislation, along with the financing side of the process, steer the implementation of EE in the building process. Without these two elements, even clients with the best intentions would have difficulty justifying the up-front expenses typically incurred with an EE refurbishment. Evidence, regardless of valuation method, needs to reflect building performance and the associated costs of EE refurbishment.

Critical to the process of establishing EE as a normal and expected outcome of a refurbishment, the key performance indicators and their effect on the various valuation techniques should be understood. Life cycle costs do not adequately reflect the potential of higher revenues; therefore, in REVALUE Deliverable 2.2 analysis will be executed to demonstrate the potential of EE-refurbishment, determine what measures may have the biggest impact and help establish benchmarks in the investment scope and their financial performance in the refurbishment process.

In conclusion, regardless of valuation method used, there are the local and regional rental market conditions and legal restrictions which influence the impact of a building's status within the market. With EE-upgrades, the characteristics of the building are changed. These interventions have an impact on other value drivers such as building standards, building maintenance and the overall refurbishment conditions. When these characteristics are substantiated, they can influence the value of a property. Current demand for housing and location are still the main drivers to a building's appraisal value and for a tenant's selection of housing.

Chapter 4 Appendix

4.1 Systems of Typologies and EE-Packages



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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.[25]
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.[26]
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.[27]
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)[28]
Building typology	A classification for existing residential buildings according to age, size and construction parameters.[29]
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

[25] (RICS Red Book global Guidance, 2014, p. 8)
[26] (Investopedia, n.d.)
[27] (RICS, Glossary and acronyms of PropTech terms, 2016)
[28] (RICS, Sustainability and residential property valuation, 2011, p. 4)
[29] (EPISCOPE [http://episcope.eu/], 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.[30]
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.[31]
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.[32]
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. [33]
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.[34]
Gross rents	The total income received prior to any deductions for operating costs.[35]
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.[36]

[30] (RICS, Professional guidance, 2015)
[31] cf. (RICS guidance note - Discounted cash flow for commercial property investment, 2010, p. 3)
[32] (IEA-Internaltional Energy Agency - Energy efficiency, n.d.)
[33] cf. (RICS, Sustainability and residential property valuation, 2011, p. 21)
[34] (RICS guidance note - Discounted cash flow for commercial property investment, 2010, p. 3)
[35] (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 21)
[36] (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.[37]
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.)[38]
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.[39]
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.[40]
Net operating income (NOI)	The total rental income after deducting operating expenses, but before deducting capital expenditure, tax and interest.[41]
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.[42]
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.[43]
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.[44]
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[45]

[37] (RICS Red Book global Guidance, 2014, p. 7)
[38] (RICS-UK valuation standards, 2014, p. 8)
[39] (RICS Red Book global Guidance, 2014, p. 8)
[40] (RICS Red Book global Guidance, 2014, p. 9)
[41] (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 22)
[42] (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 22)
[43] (Ellabban, et al., 2014, p. 748–764)
[44] cf. (RICS information paper, England and Wales, Valuing residential property purpose built for renting, 2014, p. 12)
[45] (RICS Red Book global Guidance, 2014, p. 103)