WORK PACKAGE 4

REPORT D4.2

Report on a set of energy performance and energy-cost related LCC indicators including adjustment methodologies to be used for property valuation

Authors: Dr. Dag Fjeld Edvardsen SINTEF
dag.fjeld.edvardsen@sintef.no

Ad Work Packages 1: Overview of LCCA concepts and their connection with property valuation

Full title of the Project: Improving the market impact of energy certification by introducing energy efficiency and life-cycle cost into property valuation practice

Acronym of the Project: IMMOVALUE

Agreement N°: IEE/07/553/SI2.499204

Coordinator: KPMG Financial Advisory Services GmbH
Dr. Sven Bienert
sbienert@kpmg.at

Project website: www.immovalue.org

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II. Glossary

LCC .... Life Cycle Costing

LCCA .... Life Cycle Costing Analysis

NPV .... Net Present Value

PV .... Present Value

SW .... Software

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1 Introduction

The valuation approaches as such are explained in greater detail in ImmoValue paper D2 ”International, European and national valuation practices and connecting points to energy performance certificates and LCC assessment”.

In this paper possible links between LCC/LCC-indicators and valuation methodologies are examined. The value of a property can be calculated based on at least three different approaches, and for each of these approaches it is shown how LCC indicators can be used. It is shown that using information about energy performance and other LCC aspects can provide more accurate valuation. Examples of LCC-indicators that might be relevant are shown.

2 Valuing, LCC and LCC-indicators

There are typically three different ways of valuing a building

The cost approach: The value of a property is equal to the cost of the land it is on and the depreciated value of “improvements” (buildings etc) on it. This is similar to “Tobins Q” from economic theory.

The sales comparison approach: The value of a building is equal to, or can be calculated based on, the sales value of other similar buildings

The income approach: The value of a building is equal to the discounted total net profit from the income it generates. In this alternative should be taken into account that the current income from the building is not necessarily the one that maximizes discounted net profit.

When it comes to linkages to LCC alternative (3) stands out, since it directly takes into it the Life Cycle Cost as “the cost part” of the discounted profit (discounted profit = discounted income – LCC).

Below this is incorporated into the formulas for LCC used in paper D4.1.

Formula 3 in D4.1 is:

$$1)\ L = I_o + \sum_{t=1..T} \frac{\sum_{j=1..J}\left(p_t^j * q_t^j\right) + M_t + O_t}{(1+i)^t} + \frac{R}{(1+i)^T}$$

where L = an estimate of life cycle cost, i is the interest rate, t as a subscript or as a superscript is the year (1=first,T=last), j as a superscript is the energy type (numbered from 1 to J). p_t^j is the price of energy type j in time period t, and q_t^j is the quantity of of energy type j in time period t. I is the initial investment, M is maintenance costs, O is the other costs, R is residual cost.

Based on (1) we can define a formula for Present value of a project as

$$2)\ V = Y - L = \sum_{t=1..T} \frac{Y_t}{(1+i)^T} - I_o + \sum_{t=1..T} \frac{\sum_{j=1..J}\left(p_t^j * q_t^j\right) + M_t + O_t}{(1+i)^t} + \frac{R}{(1+i)^T}$$

where V = Economic value of a project, Y = total income (discounted) for the project, and L is an estimate of the Life Cycle Costs of the project.

Based on this it is possible to take into account differences in LCC based on differences in energy-performance, investment costs and running costs when using the income approach. Formula 2 is a good basis for developing LCC-indicators that are relevant for valuation.
It will also be shown that this can be done with all three major valuation approaches.

2.1.1 Using LCC when valuation is done with the income approach

If the valuation of a building is done with the income approach it is still possible to take into account differences in energy performance using LCCA as a tool.

The structure of the income approach is described in the following figure 1. This figure also describes possible areas where LCC can influence the valuation approach.

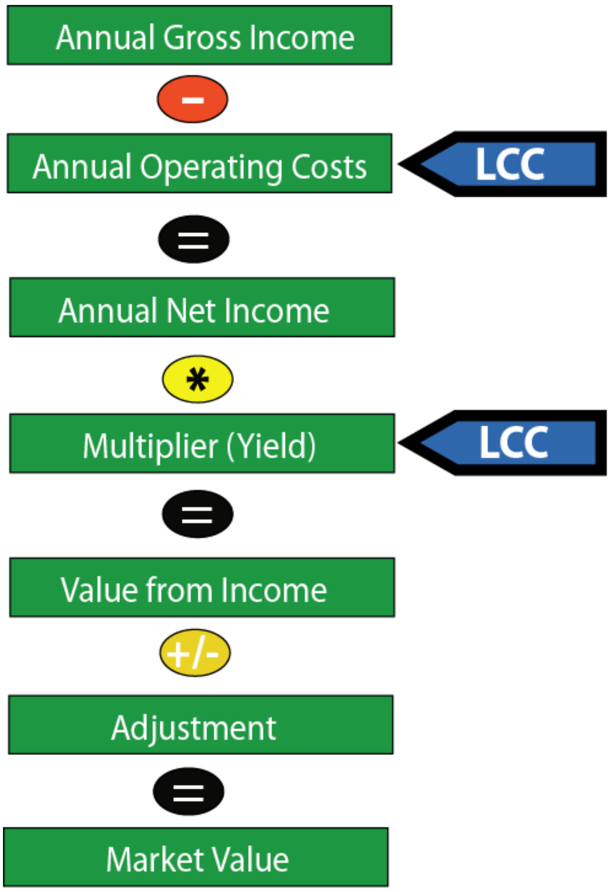

Figure 1: General valuation strategy for the income related approach and some of the possible linkages to LCC

It seems possible to start with valuation based on figure 1 above, and adjust the value based the difference in LCC using differences in investment and other costs. In other words, if the LCC is lower by a certain amount for the alternative we are examining, the value should be higher by the same amount.

The results of an LCCA can be affected by several things relating to EPC and energy performance. The investment cost might be different, as might the maintenance costs and energy costs. There might also be differences relating to regulations like taxes, and the net available area available might change (for instance thicker isolation in the walls can lead to lower net area). Such influences can be directly reflected in the calculation of the "Annual Operating Costs" in Figure 1.

Lower operating costs could also influence the general yield of a building as these costs are not as much influenced by inflation in comparison to a building with higher operating costs. In that case low life cycle costs in general could lead to a decrease of the multiplier in which the general yield of the building is included.

The yield might also be adjusted if the total risk if information from the energy certificates tells us that the building is less sensitive for possible strong increases in the energy price(s). An important point here is that in a market where most buildings are less energy efficient a general increase in energy costs will most likely increase the level of income per m^2, since the owners of the other buildings have to recover their costs. For energy efficient buildings existing in the same market there is a potential for increased net profit in such a situation.

2.1.2 Using LCC when valuation is done with the comparison approach

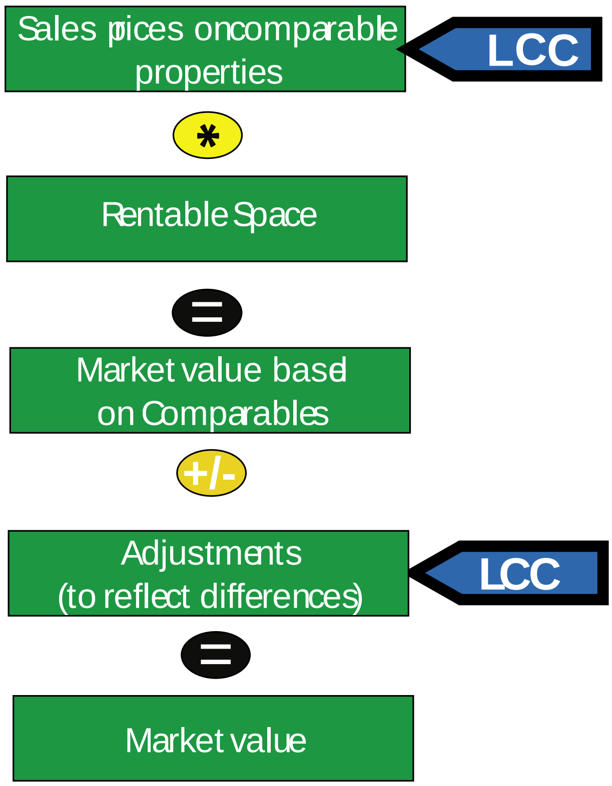

Figure 2: General valuation strategy for the comparison approach and possible linkages to LCC

Figure 2 shows how LCC can be used when valuation is done with the comparison approach. In this valuation approach the sales prices of comparable properties are central. However, when referring to comparable properties it is desirable to compare with properties with similar LCC-indicators. It would be expected from a rational economic perspective that other comparable buildings where the LCC-indicators point to low operating costs would have a higher market value since they ceteris paribus probably would be considered more attractive, but this requires market evidence.

If there are few buildings with comparable values on the LCC-indicators it is possible to use the adjustment factor to take the LCC-indicator values into account. From an economic perspective it can be argued that a property with lower LCC should be adjusted so that it has a high value.

2.1.3 Using LCC when valuation is done with the cost approach

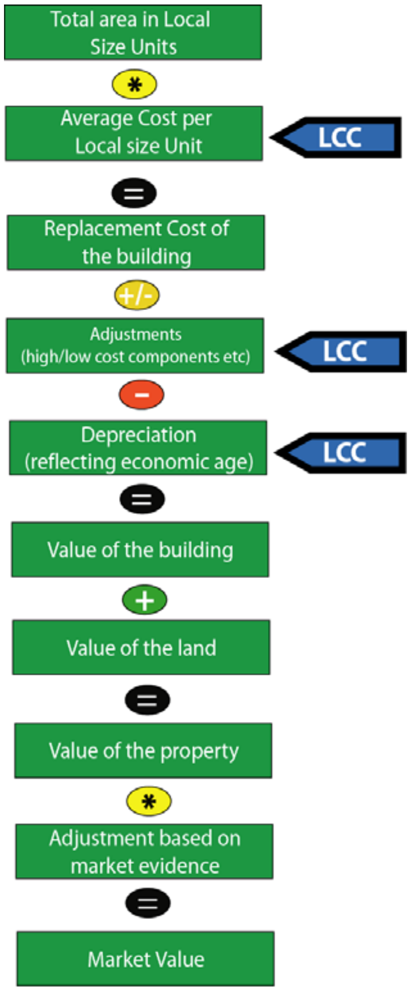

Figure 3: General valuation strategy for the cost related approach and possible linkages to LCC

Figure 3 shows how differences in LCC might affect the estimated market value of a property when using the cost approach.

In this approach the valuer can take into account what it would cost to construct a building with the same qualities (LCC-indicators and other indicators), including for instance the same energy performance level. A high energy performance will typically have a higher cost relating to it, since better quality typically costs more. Another way of looking at it is that there is one extra binding constraint when trying to minimize building cost for a given quality level (from a mathematical optimization perspective).
The cost can also be directly adjusted if there are components which have higher or lower costs.

If the yearly operating cost of a building is lower the depreciation adjustment might be lower, it might be considered more up-to-date technically than what is typical for it age. In addition it might also be more in line with current building codes, which can be desirable since there might be more strict building codes now than when it was constructed.

2.2 Willingness to pay for energy efficiency – in itself?

"**Q**: For the same income and the same cost – is it possible that an energy efficient building have a higher value?
A: Yes and no, depends on whether the market is willing to pay more for it."

This is slightly off topic since this paper focuses on LCC and its links to valuation. It is still worth mentioning to point out that using LCC information in valuation does not rule out estimating "extra willingness-to-pay" for energy efficiency in itself. Extra willingness to pay for energy efficient buildings can be put into the "Annual gross income"-part of figure 1.

One interesting paper examining such effects is Banfi et al. (2008). They report that "The results suggest that the benefits of the energy-saving attributes are significantly valued by the consumers. These benefits include both individual energy savings and environmental benefits as well as comfort benefits namely, thermal comfort, air quality and noise protection". This indicates that it might be correct in some cases to adjust the estimated income ref. figure 1 for energy efficient buildings, and that doing so can partly be seen as a separate operation from the possible LCC-adjustments to the operating costs and the yield.

2.3 Adjustment methodologies

Adjustment obviously has its role when it comes to any valuation. The value of one object might be judged to be the same as another object (or group of objects), but not quite. There might be good reasons to adjust its value up or down with a certain amount if there are significant differences between the objects.

The same can happen when the value of an object is calculated based on a particular standardized formula. It might be that there are particular and significant differences between the object being evaluated and the typical object that the formula is created for.

In addition to the adjustment to the valuation approaches above (adjusting for differences in LCC under different alternatives) there are other adjustments that might be necessary. There can be differences in the willingness to pay in local markets. Quality of data might also raise a need for adjusting the valuation because uncertainty reduces the value for risk averse potential buyers. Invaldsen and Edvardsen (2007, in Norwegian) demonstrates that getting good quality of data can be a challenge even for the project managers when a building project is recently completed, and that seemingly very central measures can be difficult to aquire.
Below some LCC-indicators that can be relevant as adjustment factors are shown.

2.4 Different types of LCC-indicators

As described in paper D4.1 the following potential types of indicators are identified. The examples below show the related to energy performance, but other LCC-indicators are also relevant.

a) Monetary – example: energy cost per square meter for lights and heating
b) Energy based – energy usage per year for light and heating in kwh/m2
c) Decomposed energy based: as (b) but decomposed into different energy sources (for instance units of oil/m2, units of electricity/m2, units of remote heating/m2).
d) Relative to norm (percentage of norm). “80 percent of average kwh/m2 when it comes to kwh/m2)
e) Relative to norm in different “classes”: “90 percent of average for buildings constructed in 2010”.
f) Adjusted relative to norm (nonlinear scale): “Energy performance is in the 90^{th} percentile”

Type (c) is desirable since it allows for comparisons over time, region and currencies, but it should be combined with at set of Energy prices in order to give directly relevant information about the potential economic consequences of different alternatives. It might also be desirable to provide a scenario showing the consequences for the LCC result if energy prices in the future are significantly higher than today.

In addition to energy costs and investments, it is also important to take into account maintenance costs (these can be both higher and lower), possible vacancy loss because of changes in net area, changes in taxes because of different environmental profiles etc.

2.5 Some relevant LCC-indicators

There are many different LCC-indicators that can be relevant, but some examples of relevant indicators are:

a) Energy usage per local area unit – both physically (kwh/m2) and monetary (energy costs/m2).
b) Energy flexibility – what is the cost per local area unit for changing from one energy sources to another (for instance from oil to electricity). This can be relevant if there are major changes in relative prices for the energy sources.
c) Total Operating Cost per local area unit.
d) Maintenance cost per local area unit.
e) Residual Service Life for major building components.
f) Cleaning costs per local area unit
g) Investment costs per local area unit
h) Residual cost at the buildings economic end-of-life, per local area unit
i) LCC-based estimate of investment cost and reduced operating cost per local area unit if the building was to receive a major energy upgrade (an opportunity value).

2.6 Who pays and who gains

There are many situations where regulations or contracts limit the Value of a building for the owner. For instance, it might be that if the owner invests in to increase the energy performance of his/her building, he/she can not reap the benefits of the investments if there are limitations in what can be regained. Situations like these can limit the incentives to reaqh what is in economics referred to as the “social optimum” (larges difference between gain and cost for the society as a whole).

2.7 Comparing across borders using monetary units

Comparing monetary units across borders can be done, but requires many assumptions and comes with large uncertainty for the quality of the results. See Edvardsen and Førsund (2003) for an example of international benchmarking.

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