

**Intelligent Energy**  **Europe**

Executive Agency for Competitiveness and Innovation  
(EACI)

**LCC-DATA**

LCC-DATA

Life-Cycle-Costs in the Planning Process. Constructing Energy Efficient  
Buildings taking running costs into account

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**Recommendations for standardisation**

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## Definitions and Abbreviations

### Definitions

No necessary definitions

### Abbreviations

IBI	“Immobilien Benchmark Institut” (German speaking) - institute for benchmarking buildings, Kufstein University, Austria
LCC	Life Cycle Costs
D	deliverable (added by the number according to project contract)
WP	work package
HVAC	Heating Ventilation Air Conditioning
VDI	Verein Deutscher Ingenieure (German Speaking) Association of German Engineers
ON	Österreichisches Normungsinstitut (German Speaking) Austrian Standards Institute
ISO	International Organisation for Standardization

## 1 Executive Summary

In this report, the recommendations for standardisation focus on the existing national (Norway, Germany) and international standards covering LCC calculation and use of LCC for buildings and infrastructure, and ongoing European standardisation works focusing on economic assessment as LCC in connection with energy savings and more sustainable built environment.

The standardisation work focusing on Facility management is not covered.

The deliverable also cover existing calculation methods used in practice.

An outlook is given regarding how to generate practical, useable calculation models and how to achieve comparable calculation results.

## 2 Introduction

In this report, the recommendations for standardisation focus on the existing national (Norway, Germany) and international standards covering LCC calculation and use of LCC for buildings and infrastructure, and ongoing European standardisation works focusing on economic assessment as LCC in connection with energy savings and more sustainable built environment.

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The deliverable also cover existing calculation methods used in practice.

An outlook is given regarding how to generate practical, useable calculation models and how to achieve comparable calculation results.

This document deals with the national standardisation for LCC calculations, and also with the practical approaches of planners (HVAC engineers, structural engineers, etc.) and developers taken to calculate the LCC of their part of a building, and the building as a whole, respectively. Recommendations are given on how these methods can be standardised and how the existing standards can be further developed to form “easy to use” calculation methods. The objective is to facilitate LCC calculations in the early planning stage and to allow for comparable calculation results.

## 3 Existing National Standards and challenges

In Austria no general standard for LCC calculations on the building level currently exists. However, there are specific standards for defined parts of the building which are described in this chapter. These standards are used as the point of departure for developing a method for calculating LCC on the building level.

In Norway there is an existing standard for LCC calculations, and the recommendations later are input to the started process of updating this standard.

As input to use of LCC in standards covering energy performance, the recommendations given directly to the development of ÖNORMS are valid for all national energy standards as well as European standards (CEN).

### **3.1 ON M 7140**

#### ***Economic comparison calculation of energy systems based on the extended annuity-method – Definition, calculation scheme***

This national standard provides a practicable method to compare the life cycle costs of different heating systems for new buildings and for system changes in existing buildings.

It also describes how to calculate LCC of other energy systems such as air conditioning or ventilation systems. If there is no experience on the annual use efficiency of these systems, the LCC calculation according to ON M 7140 will not be applicable for new systems because, in this case, ON M 7140 refers to the VDI 2067 standard Part 3 to 7 where annual use efficiencies are listed – however, these parts of the VDI 2067 are not available. Therefore the ON M 7140 combined with the VDI 2067 in its present form is only applicable for users with benchmarks on annual use efficiency and for existing systems upon which past energy consumption criteria can be used to define the consumption of the building.

### **3.2 ON B 8110-4**

#### ***Thermal insulation in building construction – Economic optimization of thermal insulation***

The ON N 8110-4 is still in a developing stage and is therefore called VORNORM.

A calculation method is described regarding how to compare two different thermal insulation solutions, using the present value method. The calculation according to ON B 8110-4 is applied to assess the life cycle costs of the parts of the building envelope (external walls, windows, upper floor ceiling, cellar ceiling / ground floor). The total of the assessment results referring to building parts represents the life cycle cost of the building envelope as a whole. This standard covers only heated buildings. This calculation will not be applicable if an air conditioned building has to be evaluated.

Currently, several weak spots of the method are under discussion, and this will probably result in further developing ON B 8110-4 soon.

### **3.3 ÖNORM EN 15459**

#### ***Energy Performance of buildings - Economic evaluation procedure for energy systems in buildings***

The European Standard developed describes a calculation method for heating systems and also provides a possibility to evaluate the correspondence between heat energy demand (thermal insulation) and the energy efficiency of an heating system.

The energy consumption has to be made according to EN 15603 - Energy performance of buildings – overall energy use and definition of energy ratings.

This standard covers heated buildings and by using the method described in EN 15603 it can also be used for air conditioning systems.

This approach is very time consuming at the early planning stage in order to ensure that detailed consumption data of a high standard can be gathered, standards used by planners and project developers.

In Austria, several self developed tools are used by planners, consultants and project developers. They have also created benchmark figures generated from experience gained in former projects. In addition, in such cases collaborators often focus on the part of the building they are interested in. For example, an HVAC engineer can often provide quite precise data on the LCC of different air conditioning solutions because he or she has the experience and the benchmarks available.

### **3.4 NS3454 Life Cycle Costing**

The updating of the standard has to goals, ensuring suitable cost classification system covering needs from both investors or building owners when planning a building and also suitable in Facility management when operating and maintaining the building, for instance in bench marking.

The first issue to be solved is the dividing in the building related costs and costs linked to services, as the for many services are a linkage between what is build in to the building (the investment) and the supply costs, for example for security – division of building, security systems/keys, and the human costs.

For bench marking in operation, the main costs as cleaning, energy supply and waste, would be of interest, and they should therefore be main categories, or at least high in the cost classification hierarchy. This is taken care of in the cost categorisation system given in LCC DATA.

For the bench marking process it is also useful to be able to sort out who are responsible for what costs. Comparing energy costs, it is a key issue to ensure that all costs are included, or at least comparable, as some costs are paid by the user and some by the owner. As some of the costs are more user related, as technical equipment, and some more building related, as heating demand/use.

The division between operation, maintenance and refurbishment may be difficult in a bench marking process, and the rules for definitions have to be clear and strict, but still flexible enough to meat the needs of different building owners and building categories. For example, hospital buildings more or less go though a constant change due to changes in needs. The maintenance costs may then be extremely low.

When using collected information for creating key numbers for use in initial LCC calculations, this is not that critical, as we are looking for the total costs.

## 4 Recommendations for Standardisation

### 4.1 Recommendations for national standards

The existing national standards for LCC calculations are not practicable for comprehensive LCC calculations of buildings. As such it is recommended that level 1 analysis is integrated into the national standards as described in the ISO 15686-5: Buildings and constructed assets – Service life planning Part 5 – Life cycle costing.

Excerpt of ISO 15686-5:

#### “5.2.2 Benchmark Level Analysis

Typically an initial (budget) level cost analysis will be based on the total area of the asset (in square metres) or on the number of persons accommodated (e.g. in a school, prison or office). This may be developed into an elemental level analysis using an agreed cost structure. Caution is needed to ensure that previous projects used as the basis for rates (at asset or elemental level) are comparable with the proposed asset. The estimate will also need to reflect changes in costs since the previous project was undertaken, and any other local variables relevant to the new project. This estimate will normally be progressively refined during the design development phase, but may be retained only as a check once detailed design is completed.”

This level 1 analysis can serve as an interim solution till the LCC standards have developed far enough to provide a detailed LCC appraisal for a whole building.

Taking into account ON EN 15459, the two Austrian Standards ON M 7140 and ON B 8110-4 should be adapted and interlinked so that LCC of different design concepts which influence both, the thermal insulation and the heating system, can be calculated together.

This LCC Standard should then be expanded for building services devices and other parts of the building. The ON B 1801-1 (Building Costs- Cost breakdown), ON B 1801-2 (Civil engineering and building construction costs –Building data – User costs), and ON B 1801-3 (Project Management in Construction – Characteristic Values) can be integrated to categorise the costs of buildings.

### 4.2 Recommendations for standards used in praxis

The experiences made by planners and project developers should be brought together to harmonise the existing practical tools and to generate a voluntary standard which is easily applicable and generates comparable results. A guidebook has to be developed to disseminate this user friendly and practicable approach.

If index values and interest rates need to be inserted for calculation, links to official information sources such as ONB (Österreichische Nationalbank), e-control (energy regulatory authority), BMWFJ (Ministry of Economics) should be provided to get comparable, realistic and up to date results.

The national standards for LCC calculations of buildings and the calculation methods should grow together in a medium-range time perspective to form a consistent calculation model.

A level one analysis needs to be established in parallel to provide a user friendly, time saving method for decision makers. The key figures generated out of the IBI Benchmark Database should be used to perform this level one analysis and should be kept up to date and publicly available.

### **4.3 Recommendations to CEN TC350 Sustainability in Construction – economic assessment**

The framework for economic assessment of sustainable performance of buildings should have the same stages as the main framework, meaning;

- Product stage, including transportation
- Construction stage
- Use stage
- End of life

The difference between the environmental assessment and the economic assessment is that costs can't be regarded as input-output flows, some one are taking money in or out of the system.

Doing LCC on building level, the investment are the costs including the construction stage, the investor will seldom be able to, or interested in, the cost on the preliminary processes.

The same can be said about the end of life stage, the owner pays for having the building demolished, including getting rid of the materials and waste. The investor could still be interested in planning a building that would have a low end of life cost, for instance since materials and products are reusable, and nothing has to be disposed.

The use stage should then follow the cost categories suggested in LCC DATA, where is taken into account which categories that mainly linked to human resources and fees (management, administration, taxes), and those linked to use of resources and emissions (energy use, cleaning, maintenance..).

This way of dividing the costs would also improve the relation with more sustainable buildings and costs.

Input to standardisation is provided through the working group in CEN TC 350 working with economic assessment.

Inputs are also given to the work done by Davis Langdon linked to Lead Market Initiative.