Green Public Procurement for Buildings
WP 4.3 – Procedures and guidelines

Life Cycle Costing of Buildings

Version: 22/07/2021

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Introduction

This guideline provides the most important information on life cycle costs and builds the connection to sustainable public procurement on a European level, as well as the respective implementation in the national legislation in Austria and Italy. It addresses the application of life cycle costing in building construction and shows the connection to ecological criteria in Italy and Austria. The most important terms and definitions on the subject of life cycle costs are explained and linked with sustainable public procurement. The different calculation methods and a list of calculation tools for the building sector are presented.

The information is prepared in a way that it can be used by small and medium-sized enterprises (SMEs) on the one hand and by public procurers (e.g.municipalities, cities etc.) on the other.

List of abbreviations and definitions

BVerG 2018	Federal Procurement Act 2018 of Austria
GFA	Gross Floor Area
GHG	Green house gases
GPP	Green Public Procurement
LCC	Life Cycle Costs
MEC (CAM)	Minimum Environmental Criteria (Criteri Ambientali Minimi), Italy
naBe action plan	Action Plan for Green Public Procurement, Austria
SME	Small and medium sized enterprises

Definitions

Best offer principle	The best offer principle is used to select the award based on the technically and economically most advantageous offer. Two different methods can be used to determine the technically and economically most advantageous tender: the best price-performance ratio on the based on a cost system or on the based on pre-announced award criteria. For determining the best price-performance ratio in the best offer principle, the BVerG gives the opportunity to use life cycle costing as an option in §92 BVergG 2018.
Lowest offer principle	The basis for determining the most economically advantageous offer (lowest offer) consists of the manufacturing and acquisition costs of the service, but operating costs and other cost categories can also be included in the evaluation.

Introduction to life cycle costing

1. Definition of life cycle costs

Life cycle costs refer to costs arising over the entire life cycle of a product or service. In short, they are basically a full follow-up cost calculation for building investments.(IG LEBENSZYKLUS BAU 2016).

This life cycle is divided into different life cycle phases. The European Standard *EN 15804:2020 Sustainability of construction works - Environmental product declarations - Basic rules for the product category construction products* distinguishes between the phases of manufacture and construction, usage and disposal or deconstruction.The different life cycle phases can again be subdivided into individual sub-steps. Costs incurr in the individual phases, such as construction costs and follow-up costs for usage and operation as well as demolition or deconstruction.Figure 1 outlines the connection of the life cycle phases and the life cycle costs incurring during these phases.

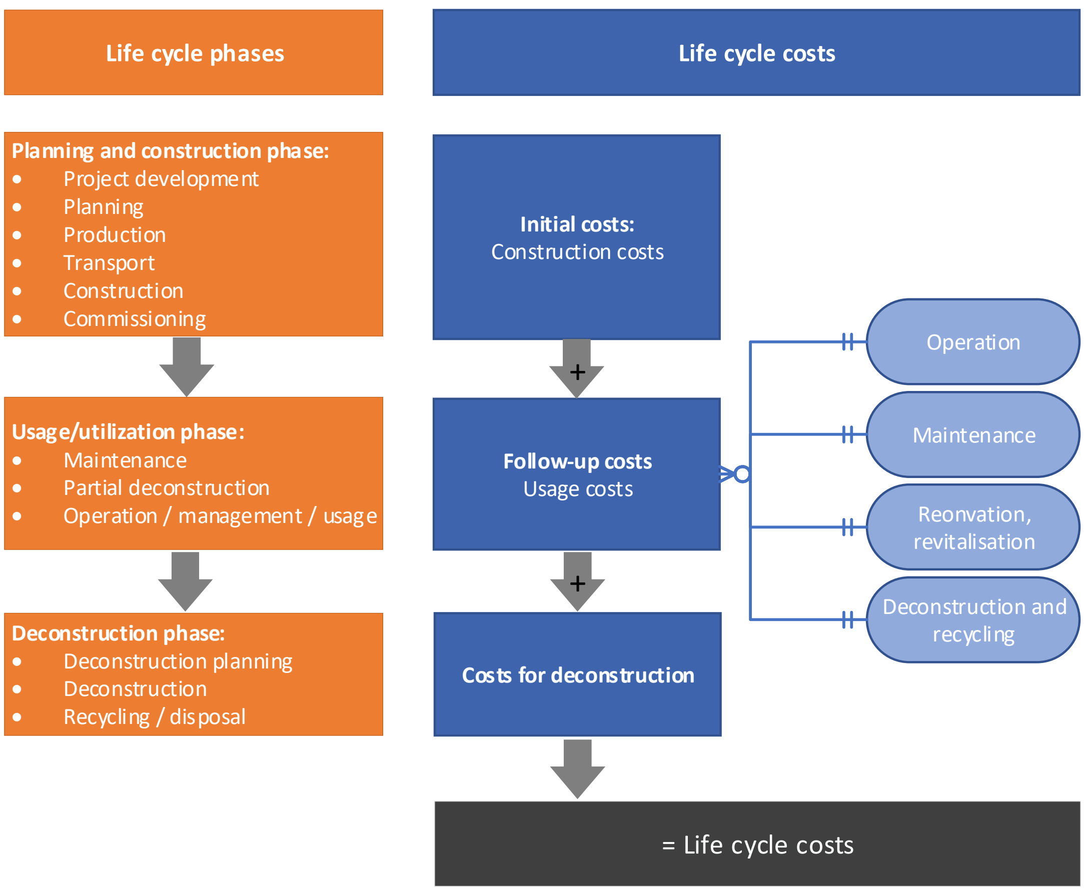

Figure 1 Life cycle phases and life cycle costs (Heim et al. 2019; Lützkendorf 2007)

1.1. Influence of life cycle costs on the usage costs

The great influence of follow-up costs on the overall costs arising after the construction of a building is undisputed. In most cases, the follow-up costs are many times higher than the initial construction costs. The results of a study by IG Lebenszyklus Bau showed that for an office building with a life span of 70 years after 50 years, the amount of the construction costs is already spent on renewal and maintenance costs alone (green bar in Figure 2). Furthermore, over the usage phase, the sum of user-specific follow-up costs (e.g. postal services or security services), costs for facility management (cleaning and maintenance), technical operation of the building as well as costs for supply and disposal account for approx. 80 % of the overall life cycle costs. The construction costs therefore account for only one fifth of the overall costs (Figure 2).

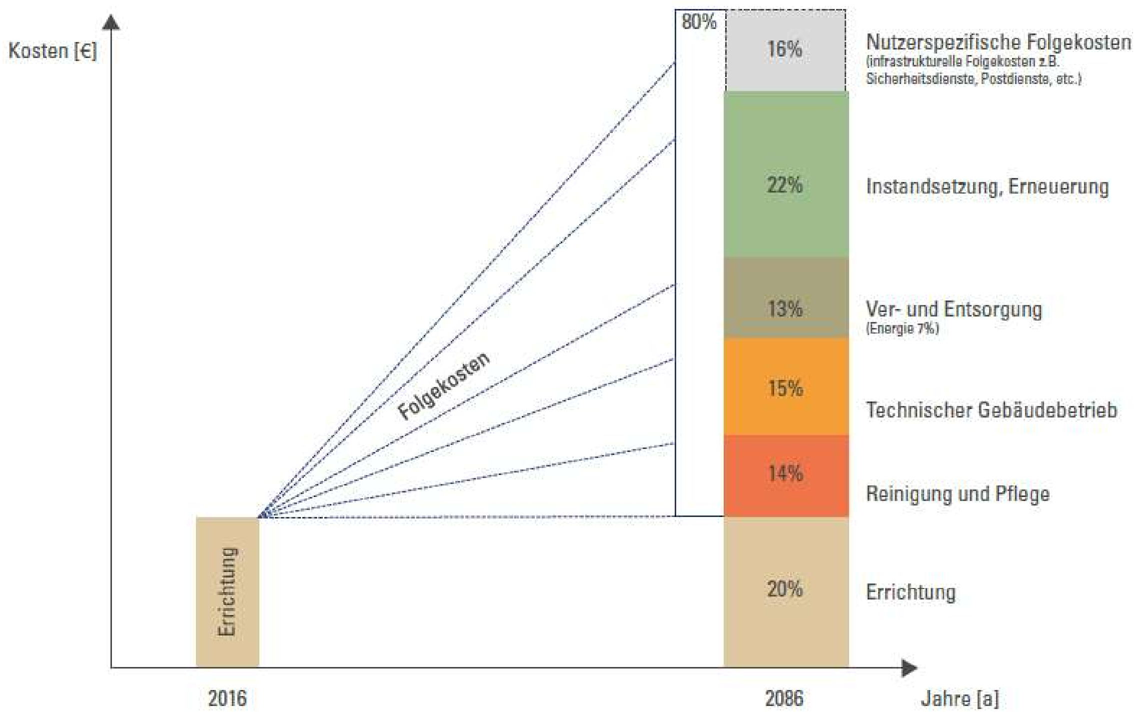

Figure 2 Ratio of construction costs to follow-up costs for an office building with a life span of 70 years (taking into account price increases and discounting on the basis of 2016 prices) (IG LEBENSZYKLUS BAU 2016)

When considering life-cycle costs in residential buildings a similar but not as significant ratio of construction costs to follow-up costs emerges.

A comparative study by König 2017 on behalf of the Bavarian State Office for Environment came to the following results: In a comparison of four different construction methods with wood pellet heating (constructions of brick, sand-lime brick, hybrid with concrete & wood and wood), the follow-up costs contribute at least 50 % to the overall costs for all four construction methods, assuming a lifespan of 50 years. The discounted cash flow method was used for the calculation of this comparative study. This example also shows that the largest contribution to the follow-up costs can be attributed to maintenance and renovation, followed by the energy costs and the technical operation of the building (König 2017).

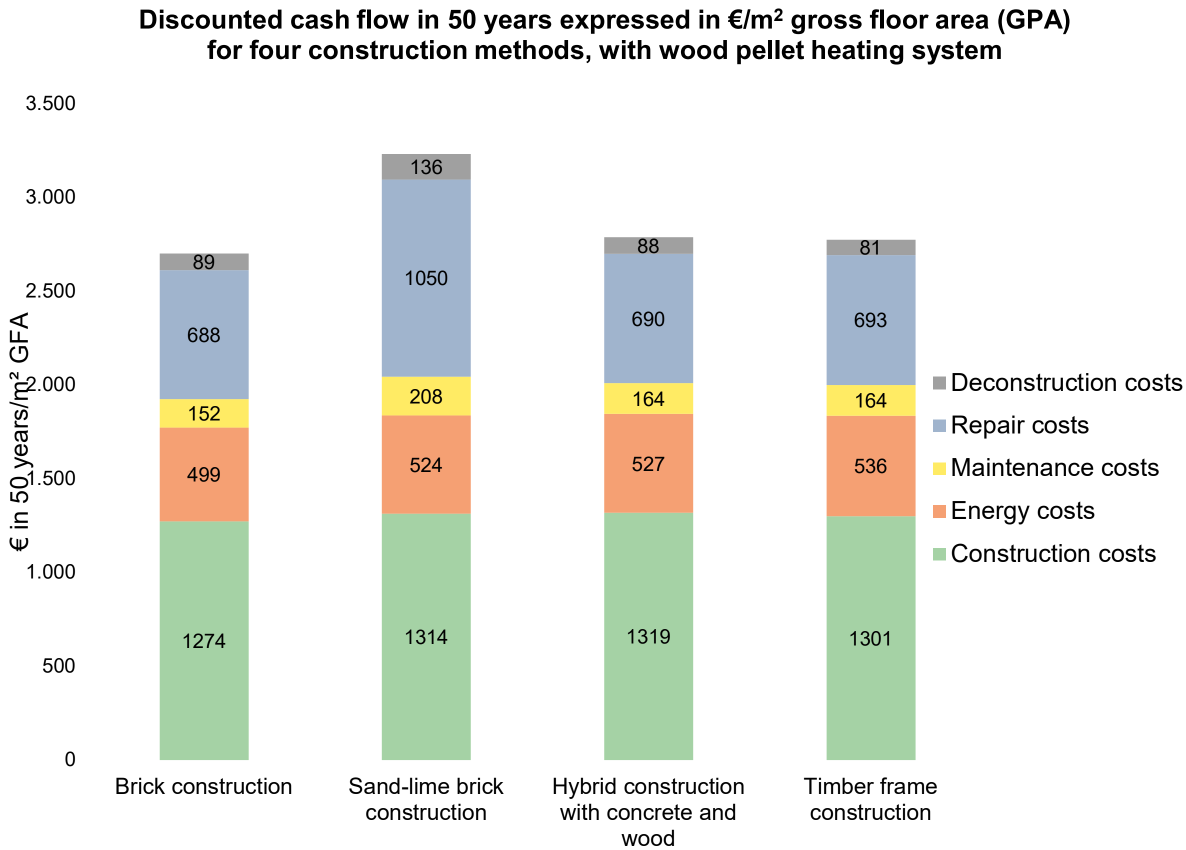

Figure 3 Discounted cash flow in 50 years expressed in €/m2 gross floor area (GFA) for four construction methods, with wood pellet heating system (König 2017)

These two examples show the importance of the consideration of life-cycle costs, such as usage costs and deconstruction costs in public procurement procedures - not only when awarding the contract to the economically most advantageous bid in the lowest offer procedure, but also when awarding the contract according to the economically and technically most advantageous bid in the best offer procedure.

Basics of life cycle costing

2. Legal framework in the European Union

The legal basis for life cycle costing at European level consists of the two EU Directives on public procurement. On the one hand, the *EU Directive 2014/24/EU on public procurement* and, on the other hand, the *EU Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors* (sector contracting entities). More specifically, Article 67 of the EU Directive 2014/24/EU mentions the calculation of life cycle costs to determine the most economically advantageous tender in public procurement, as well as Articles 82 and 83 of the Directive for sector contracting authorities (Directive 2014/25/EU): the determination of the most economically advantageous tender can be made on a voluntary basis by means of an evaluation based on price or costs, using a cost-effectiveness approach, such as life cycle costing (2014/24/EU; 2014/25/EU).

3. Legal framework in Austria

The EU Directives are transposed at national level in Austria through the Austrian Federal Procurement Act 2018 (in short: BVerG 2018). It specifies the extent to which the calculation of life cycle costs can be included in procurement procedures in Austria. According to the Federal Procurement Act, the calculation of life cycle costs can be used as a cost model to determine the best price-performance ratio of a tender. The BVerG 2018 also does not mandatorily specify which cost components must be included, but lists costs such as purchasing costs, usage costs, maintenance costs, costs at the end of life, as well as costs resulting from external effects of environmental pollution, as examples in Section 92 (1) of the BVerG 2018 (BVerG 2018). The Federal Procurement Act thus makes it possible to include not only the initial purchase costs, but also additional follow-up costs when calculating the most economically advantageous offer (BVerG 2018).

4. Legal framework in Italy

The EU Directives are transposed at national level in Italy through the Decreto Legislativo 18 Aprile 2016, n.50. It specifies the extent to which the calculation of life cycle costs can be included in procurement procedures in Italy.

Article 96 of the decree describes life cycle costs as all or parts of the following costs related to the life cycle of a product, service or work. In particular:

a. Costs incurred by the contracting authority or other users, such as:

    i. Costs related to acquisition

    ii. Costs related to use, such as consumption of energy and other resources;

    iii. Maintenance costs;

    iv. End-of-life costs, such as collection, disposal and recycling costs;

b. Costs attributed to environmental externalities related to products, services or works during their life cycle, provided their monetary value can be determined and verified. Such costs may include the costs of emissions of greenhouse gases and other pollutants, as well as other costs associated with climate change mitigation.

5. Technical regulations

The reference standards at international and European level for the calculation of life cycle costs of the different life cycle phases are

- *EN 15459:2017 Energy performance of buildings - Economic evaluation procedure for energy systems in buildings - Part 1: Calculation methods, module M1-4,*
- *EN 16627:2015 Sustainability of buildings - Assessment of economic performance of buildings - Calculation methods, and*
- *ISO 15686-5:2017 Building and constructed assets - Service life planning - Part 5: Life cycle costing.*

ISO 15686-8:2008 Building and constructed assets - Service life planning - Part 8: Reference service life and service life estimation additionally provides a methodology for calculating and estimating the service life of elements and individual components.

5.1. Technical regulations in Austria

The standard ÖNORM B 1801 has been implemented in Austria in 1995 as the basis for calculating costs and the categorisation of costs. The currently valid version is *ÖNORM B 1801-1:2021 Bauprojekt- und Objektmanagement – Teil 1: Objekterrichtung (Construction project and building management - Part 1: Construction of buildings)*. In this standard the cost categorisation is clearly shown and represents the basis for comprehensible cost estimates and forecasts for construction costs (IG LEBENSZYKLUS BAU 2016).

Since 2011 there has been a standardisation for the calculation of follow-up costs. The currently valid version is the *ÖNORM B1801-2:2011 Bauprojekt- und Objektmanagement - Teil 2: Objekt-Folgekosten (Construction project and building management – Part 2: Follow-up costs).* This standard also specifies that the life cycle costs are to be calculated as the sum (cash flow value) of the construction costs and the follow-up costs of the object (IG LEBENSZYKLUS BAU 2016). *Part 4: Calculation of life cycle costs of ÖNORM B 1801* represents the main part for life cycle costing calculations and defines the different calculation methods and system boundaries (e.g. including or excluding the usage phase etc.).

5.2. Technical regulations in Italy

The Italian standardisation body UNI has now implemented the standards *UNI CEN/TR 15459-2:2018 Prestazione energetica degli edifici - Procedura di valutazione economica per i sistemi energetici negli edifici - Parte 2: Spiegazione e motivazione della EN 15459-1, Modulo M1-14* and *UNI EN 16627:2015 Sostenibilità nelle costruzioni - Valutazione della prestazione economica degli edifici - Metodi di calcolo*.

6. Methods of life cycle costing

At European level, the calculation principles for the assessment of the economic quality of buildings have been defined in *EN 16627:2015 Sustainability of buildings*. The principles of the calculation methods and structure of the international standard ISO 15686 were taken into account by the EU, but extended for sustainability assessment in a European context. In accordance with the CEN-CENELEC Internal Regulations, the national standards institutes of the Member States of the European Union were advised to transpose or incorporate the European standard into national standards.

EN 16627 basically describes two calculation approaches for the assessment of economic quality (EN 16627:2015):

a) Life cycle costing
b) Economic assessment over the life cycle: life cycle costs and additional revenues over the life cycle and at the end of life stage

It also contains chapters addressing the following topics (EN 16627:2015):

- Description of the purpose of the assessment
- System boundaries
- Scope and procedures to be applied
- Indicators and procedures for calculating the indicators
- Requirements for the display of results in reporting and communication
- Requirements concerning the data used for the calculations

As mentioned in section 0, the individual Member States have defined national standards on life cycle costing that are aligned with cost categorisations or cost groups of the construction sector in the individual Member States. Accordingly, the respective methods and calculation rules for life cycle costing of the national standards in Italy and Austria are described below.

Static and dynamic procedures

However, it is important to first distinguish between static and dynamic calculation methods. In static calculations, the expected annual follow-up costs at today's prices are aggregated over the life period under consideration, i.e. the dates at which future payments are due are not taken into account. Static methods are rather used for private single and double family houses in early planning phases, as they provide quick and coarse results´(Ipser et al. 2017).

With dynamic methods on the other hand a more detailed cost forecast can be made. In comparison to static methods, price increases (nominal value method) and the discounting of future costs over a life period (discounted cash flow method) are taken into account. The specific date of the individual costs is therefore not insignificant for the result of life cycle costing calculation with dynamic methods.(Ipser et al. 2017).

6.1. Methods of life cycle costing in Austria

The calculation of life cycle costs in Austria is based on the cost categorisation of ÖNORM B 1801-1 (construction costs) and B 1801-2 (follow-up costs) as well as on the calculation rules of *ÖNORM B 1801-4 Calculation of life cycle costs*. As mentioned in section 5.2, the normative specifications for comparable life cycle cost calculations of buildings and building components are defined in this standard.

The calculation methods defined in the standard are listed below. Three dynamic calculation methods are differentiated:

Method 1: Accumulation of nominal costs (Nominal value method)

In contrast to the whole building the various building components often have different service life durations. With the nominal value method, the shorter service lifes are taken into account and included as a so-called replacement investments after the end of life of the respective building components. Price increases must be taken into account accordingly for these future costs. In addition, the life cycle costs are listed according to cost categories and cumulated according to the life cycle under consideration (Kowatsch 2017).

By including the rate of price increase *(p)*, the price increase factor is obtained as $q = 1 + p$. With annual costs (k_0) the nominal value (k_n) over years of service life *(n)* results in

$$k_n = k \cdot q\,\frac{q^n - 1}{q - 1}$$

Method 2: Discounted Cash Flow method

The discounted cash flow method is one of the classic methods of considering life cycle costs. Here, a time reference point is defined to which the costs of future payments are discounted (Figure 4). The cash flow value is therefore the discounted value of future payments based on the defined time reference point (OENORM B 1801-4:2014) .

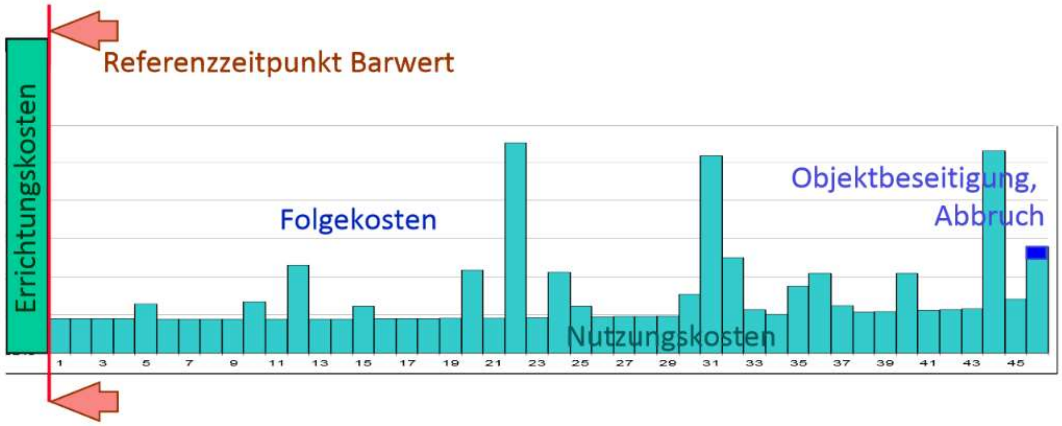

Figure 4 Graphical representation of the discounted cash flow method (based on OENORM B 1801-4:2014, S. 7)

The life cycle costs are expressed as the sum of all present cash values of the costs (Figure 4). If r is defined as the annual return on the capital employed, the discount factor d results in $d = 1 + r$. With annual costs k_0 the discounted cash flow k_n in n years is given by

$$k_n = k_0 \left(\frac{q}{d}\right) \frac{\left(\left(\frac{q}{d}\right)^n - 1\right)}{\left(\left(\frac{q}{d}\right) - 1\right)}$$

The discount factor d and the rate of price increase q are therefore counterparts. If the price increase is equal to the discount factor $(q = d)$ then k_n results in k_n zu $k_n = k_0 * n$. The discount factor d is the same for all cost categories, but q must be set in the different cost categories (OENORM B 1801-4:2014). The higher an interest rate is set for the discounted cash flow method, the less the payments that lie further in the future contribute to the overall life cycle costs. The respective interest rate thus results in a weighting of the costs according to the time at which they are incurred (Ipser et al. 2017).

Method 3: Depreciation and financing (Annuity method)

The third popular method is the annuity method, which is based on the cash flow method. In this method, the costs (cash flows) are converted into annuities using an annuity factor (Figure 5). The cash flow of the project is thus allocated equally to predefined periods (usually one year). Thus, the costs are not capitalised and depreciated at a specific date, but at the time they occur. Therefore, no construction costs or production costs are calculated, but only the annual or periodic depreciation (Kowatsch 2017). The subsequent costs are to be assessed with the estimated future price increases. If the service life of objects is longer than the depreciation period, the values of the accounting depreciation (according to § 8 EstG 1988 para. 1) must be used. If the service life is shorter than the depreciation period, the depreciation periods must be equal to the service life of the object.

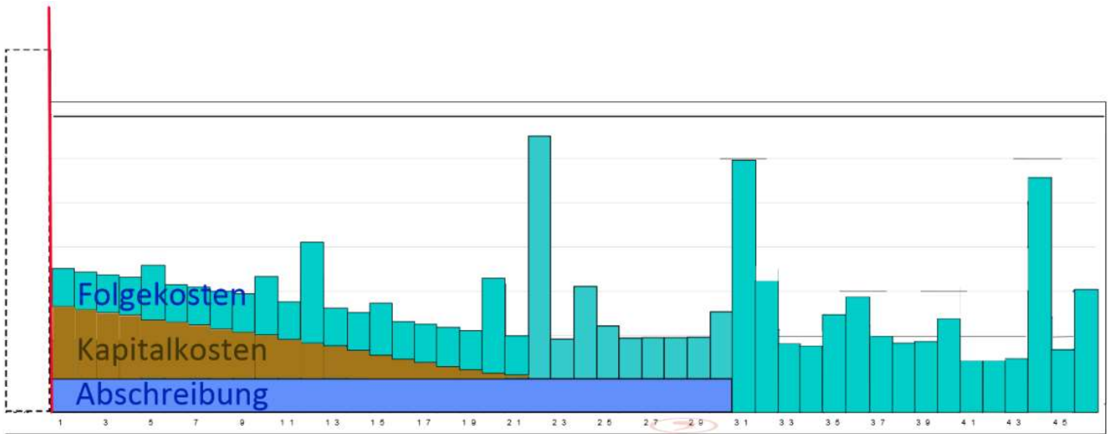

Figure 5: Life cycle costs with depriciation and financing (OENORM B 1801-4:2014, S. 8)

6.2. Methods of life cycle costing in Italy

According to art.96 of Decreto Legislativo 18 Aprile 2016, n.50, when assessing costs using a life-cycle costing system, contracting authorities shall indicate in the tender documents the data to be provided by tenderers and the method that the contracting authority will use to determine life-cycle costs on the basis of these data. For the assessment of costs attributed to environmental externalities, the method shall meet all of the following conditions:

a. Be based on objective, verifiable and non-discriminatory criteria. discriminatory criteria. If the method has not been designed for repeated or continuous application, the method shall not not unduly favour or disadvantage certain economic certain economic operators;

b. Be accessible to all interested parties;

c. The requested data must be capable of being supplied with reasonable effort by normally diligent economic operators, including economic operators of other Member States, third countries party to the GPA or other international agreements to which the Union is bound or ratified by Italy.

The decree therefore does not refer to specific methodologies for the assessment of LCC, but defines its requirements. For this reason, by way of example, reference can be made to the methods described in §4.1.

Life cycle costing and public procurement

Due to the European Public Procurement Directives 2014/24/EU and 2014/25/EU, there is a direct link between public procurement and life cycle costing. Article 67 of Directive 2014/24/EU mentions the calculation of life cycle costs to determine the most economically advantageous tender in public procurement (2014/24/EU).

With regard to public procurement, life cycle costing according to EU Directive 2014/24/EU Article 68 includes the following cost categories, but does not specify the exact scope that must be included in the calculation (2014/24/EU):

a) Costs borne by the contracting authority or other users:

- Purchase costs
- costs of usage, e.g. consumption of energy and other resources
- maintenance costs
- Costs at the end of the service life, such as recycling costs, deconstruction etc.

(b) costs arising from pollution associated with the construction during its life cycle (as far as their its monetary value can be determined and verified, such as costs of greenhouse gas (GHG) emissions and other pollutants).

Life-cycle costing is included in the Directive for sector contracting authorities (2014/25/EU) in Articles 82 and 83 of the Directive - the determination of the most economically advantageous tender can, according to Directive 2014/25/EU, be carried out with an assessment based on price or cost, using a cost-effectiveness approach, such as life-cycle costing (2014/25/EU).

Furthermore, the EU Directive 2014/24/EU stipulates that the data to be provided by the tenderer for the calculation of life cycle costs as well as the method used by the contracting authority to determine the life-cycle costs must be stated in the procurement documents (2014/24/EU).

The requirements of the two EU Directives on public procurement have been transposed into national laws and implemented in the Austrian Federal Public Procurement Act in Austria. The requirements of the EU Directives are transposed at the italian national level through the Decreto Legislativo 18 Aprile 2016, n.50 (https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2016-04-19&atto.codiceRedazionale=16G00062).

As a support measure for the application of life cycle costing the European Commission has developed various calculation tools to facilitate the use of life cycle costing by public purchasers in specific sectors. In this context, tools are listed for the product categories "vending machines", "imaging equipment", "computers and monitors" as well as for "indoor and outdoor lighting". Furthermore, the European Commission refers to different publications from various EU-funded research projects in which further information, good practice examples and tools for other product categories are available.

In this context, an overview of the current status of life cycle costing in Europe is provided by the 2017 "State of the Art Report - Life Cycle Costing", which was published in the as part of "SPP Regions". SPP Regions is an EU-funded initiative for the establishment and strengthening of seven European regional networks of municipalities working together on sustainable and innovative public procurement. The report summarises existing tools (see section *Life cycle costing calculation tools and user manuals*), publications and the basics on life cycle costing.

7. Life cycle costing and public procurement in Austria

According to the Federal Procurement Act in Austria the calculation of life cycle costs can be used as a cost model to determine the best price-performance ratio of a tender. The Federal Procurement Act 2018 also does not stipulate which cost components must be included, but lists costs such as initial purchasing costs, usage costs, maintenance costs, costs at the end of the service life, as well as costs arising from external effects of environmental pollution in Section 92 (1) of the Federal Procurement Act 2018 (BVerG 2018). The Federal Procurement Act thus makes it possible to include not only the initial purchasing costs, but also additional follow-up costs when calculating the most economically advantageous offer.

It should be noted that when using life-cycle costing to determine the most economically advantageous offer, the contracting authority must announce and specify the cost model to be used to calculate the life-cycle costs as well as the data to be provided by the bidders in the tender documents. The cost model for the analysis must fulfil the following requirements in order to be permissible according to the BVerG 2018:

- The model must be based on objectively verifiable and non-discriminatory criteria.
- The cost model must be accessible to all interested companies
- The required data can be provided by the respective companies with reasonable effort.

Life cycle costing in the naBe Action plan 2020

In the Austrian Action Plan for Sustainable Public Procurement (naBe action plan) a consideration of life cycle cost components has been incorporated in the building construction criteria since the first publication (2010) within the the criterion *Economic evaluation procedure"*. The new core criteria (2020) were published with a delay in June 2021, in which the criterion *15.4 Economic evaluation procedure* is formulated as follows:

> *„In order to take into account not only the construction costs but also the costs incurred over the service life of the building (energy, maintenance, servicing etc.), economic evaluations for at least two alternatives of the building or for at least two options for a minimum of two energy-relevant building components or building services components must be prepared at the (preliminary or) design stage."*

The criterion only refers to new construction projects and no refurbishments. In the criterion, the economic evaluation procedure is thus to be calculated for one of the following comparison scenarios:

- Calculation and comparison of the economic evaluation of different designs (e.g. in the course of an architectural competition) or
- Calculation and comparison of the economic evaluation of variations (of the entire building, of different building component qualities, of a building services component) when executed in an increased energy level with a reference version (which for example fulfils the minimum requirements of OIB Guideline 6).

The following cost elements are to be considered in the calculation according to the criterion:

- Construction costs
- Energy costs during use
- Replacement investments for building parts/components that have to be replaced before the end of the service life under consideration (recommendation 30-50 years)
- Residual values of building parts/components whose technical service life exceeds the period under considerationWartungs- und Instandhaltungskosten

As methods for calculating the economic evaluation, the *net present value method* (corresponds to the discounted cash flow method) or the *amortisation time method* (corresponds to the annuity method) (the latter only when considering individual components) are listed in the criterion, which can be calculated using the cost-free tool *econ-calc*. However, other suitable calculation tools can also be used.

8. Life cycle costing and public procurement in Italy

According to Decreto Legislativo 18 Aprile 2016, n.50 the calculation of life cycle costs can be used as a cost model to determine the best price-performance ratio of a tender.

According to article 23, the design of public works must be aimed at ensuring, among other things, the evaluation of the life cycle of the works and their maintainability.

Article 95 on contract award criteria emphasises that, without prejudice to laws, regulations or administrative provisions on the price of certain supplies or the remuneration of specific services, contracting authorities, in accordance with the principles of transparency, non-discrimination and equal treatment shall award contracts and design contests on the basis of the criterion of the most economically advantageous tender identified on the basis of the best value for money or on the basis of the price or cost element, using a comparative cost-effectiveness criterion such as life-cycle costing.

In particular, the criteria may also include the cost of use and maintenance, also taking into account the consumption of energy and natural resources, polluting emissions and overall costs, including external costs and mitigation of climate change impacts, related to the entire life cycle of the work, good or service, with the strategic objective of a more efficient use of resources and a circular economy that promotes environment and employment.

Life cycle costing in the Minimum Environmental Criteria for Buildings

This section analyses the implementation of the LCC in the context of the Minimum Environmental Criteria (MEC) for the contracting of design and work services for the new construction, renovation and maintenance of public buildings introduced by ministerial decree DM 11/10/2017.

In the objectives of the National Action Plan on GPP, the use of MEC allows the contracting authority to reduce the environmental impacts of new construction, renovation and maintenance of buildings, considered from a life cycle perspective.

Before defining a contract, the contracting authority must make a careful analysis of its needs, in compliance with the urban planning instruments in force, verifying the coherence between the territorial planning and the criteria set out in DM 11/10/20117, and consequently assessing the real need to construct new buildings, against the possibility of adapting existing ones and the possibility of improving the quality of the built environment, also considering the extension of the useful life cycle of buildings, also favouring the recovery of architectural complexes of historical and artistic value. The decision whether to retrofit existing buildings or build new ones should be taken on a case-by-case basis, assessing the conditions of use, the current costs and future savings achievable with the different interventions, and the environmental impact of the different alternatives throughout the life cycle of the buildings in question.

Life cycle costing calculation tools and user manuals

The following table summarises tools that have been developed either as general tools for the application across different product categories, or specifically for the building sector. This table is an extension of a list published by Estevan und Schaefer.

Table 1 Calculation tools for life cycle costing in the building sector (Extension of Estevan und Schaefer 2017)

Name/description	Product categories	Link	Version /year
LCC Tool of the European Commission	• Vending machines • Imaging equipment • Computer and monitors • Indoor lightning • Outdoor lightning	https://ec.europa.eu/environment/gpp/lcc.htm	2019
SMART-SPP EU project LCC and CO_2 Tool and Users Guide.	General tool	https://smart-spp.eu/index.php?id=6988	2011
Swedish Environmental Management Council (SEMCO), currently The National Agency for Public Procurement, excel tools.	General tool	https://www.upphandlingsmyndigheten.se/om-hallbar-upphandling/ekonomiskt-hallbar-upphandling/lcc-for-langsiktigt-hallbara-inkop/lcc-verktyg/	2016
German Environmental Agency (UBA) Excel Tool	General tool	http://www.umweltbundesamt.de/sites/default/files/medien/515/dokumente/lcc_tool.xls	2006
US National Institute of Standards and Technology (NIST) Building Life Cycle Cost Programs	Buildings	https://www.energy.gov/eere/femp/building-life-cycle-cost-programs	2008
Econ-calc Energy Institute, Vorarlberg	Buildings	https://www.energieinstitut.at/unternehmen/energie-und-umweltwissen/werkzeugkasten/wirtschaftlichkeitsrechner-econ-calc/	-
ISO 15686-5:2008 Buildings and Constructed Assets. Service Life Planning. Lifecycle Costing.	Building components	https://www.iso.org/standard/39843.html	2019
BDM (Sustainable buildings in the Mediterranean)	Buildings	http://www.enviroboite.net/outil-collaboratif-bdm-de-cout-global-et-de-benefices-durables	2008
Cravezero	Zero energy buildings	https://www.cravezero.eu/pboard/Downloads/LCCTool.htm	2005

Good Practice Examples

Two examples of the application of life cycle costing in the planning phase of new buildings are listed below. Further good practice examples as well as publications on the topic are available under the following link of the European Commission: https://ec.europa.eu/environment/gpp/lcc.htm

9. Smart City Campus Wiener Netze, Vienna

Building category: Bürogebäude / Unternehmenszentrale Wiener Netze

Year of construction: 2015

Usage of life cycle costing in the planning phase

In order to be able to economically compare measures for reducing energy consumption, the investment and operating costs of different technological equipment of a reference room were collected and compared. However, only the costs for visualisation, MSR, etc. were considered and not the basic building services equipment, which was the same for all options. The installation and cabling costs were also included in the investment costs. For the operating costs, maintenance and repair costs as well as costs for energy consumption were included. Several options were compared. In addition to the basic option with a low technical or "normal" equipment standard, four other options were calculated and compared. The level of the equipment standard was increased by individual technical extensions for each option (i.e. level of equipment option 1 < option 2 < option 3 < option 4) (Steczowicz et al. 2013).

Results

The increasing life cycle costs in connection with the increasing degree of technology standard per option and increasing investment costs were clearly visible. However, Figure 6 also shows that when considering the total life cycle costs over 30 years, the options with measures for energy-efficient utilisation caused lower costs than the basic option. This result was due to reduced energy costs during the usage phase as a result of the increased level of technology.

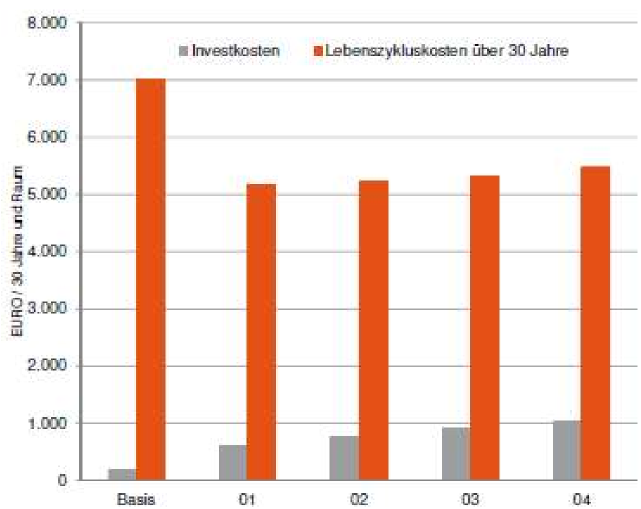

Figure 6 Results of the life cycle cost calculation of the Smart Campus per room for a service life period of 30 years (Steczowicz et al. 2013, S. 13)

10. Ludwig-Börne-School, Frankfurt

Building category: School

Year of construction: 2011

Usage of life cycle costing in the planning phase

Before the start of the project the City of Frankfurt conducted a life cycle cost calculation. The calculation was used to determine whether it is more cost-effective to design the school building in the standard according to the Energy Saving Ordinance (EnEV) 2009 or in a more energy-efficient option according to the Passive House Standard. The aim was to check whether additional costs incurred by achieving the passive house standard could be compensated by savings in energy consumption due to increased energy efficiency in the passive house standard during the service life of the building. The following award criterion was subsequently implemented in the award procedure: The contract was awarded to the bidder who could demonstrate the lowest life cycle costs for the construction and operation of the building.. The client asked for the following cost categories: investment costs, maintenance costs, energy demand and a forecast of the average increase in energy costs per year (Hochbauamt Stadt Frankfurt 2014; Europäische Kommission 2015).

Results

The overall costs of the passive house option were 13.3 million euros, which was around 0.5 million euros more than the standard option according to EnEV 2009. Based on the life cycle comparison and the bidders' offers, it was predicted that the passive house standard would have a savings potential of around 1.5 million euros due to its increased energy efficiency (Hochbauamt Stadt Frankfurt 2014; Europäische Kommission 2015).

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