OECD Public Governance Reviews

Life-Cycle Costing in Public Procurement in Hungary

STOCKTAKING OF GOOD PRACTICES

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BETTER POLICIES FOR BETTER LIVES

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Foreword

Used strategically, public procurement can contribute to the implementation of the 2030 Agenda on Sustainable Development (SDGs) as it can support achieving broader policy objectives in many domains, from innovation to social and economic dimensions. Additionally, public procurement is a powerful tool for fulfilling the objectives of the European Green Deal, which emphasises the need to take climate and environmental criteria into account in all policy areas and calls upon governments to lead by example by investing in environmentally friendly technologies, ensuring the energy efficiency of buildings, and using sustainable and green public procurement.

As expressed in the 2015 OECD Recommendation on Public Procurement, this policy tool can indeed be used to support a more resource-efficient economy, stimulate innovation, support SMEs and promote social values, but it requires quality-based evaluation frameworks that go beyond the lowest price as award criteria. Another prerequisite for the strategic use of public procurement is having skilled procurement professionals, backed up with operational tools and practical guidance.

Governments across the OECD are increasingly focusing on sustainability and using their purchasing power (12% of GDP on average) to steer their economies towards greater consideration of environmental and social aspects. However, while public procurement frameworks largely provide a legal basis for this type of action, the practical implementation of sustainability-oriented approaches is more complex. Practitioners cite the lack of political support, negative perceptions (such as sustainable purchases being more expensive), lack of expertise in applying the existing regulations and criteria, lack of practical tools and training as the main obstacles for mainstreaming strategic procurement. Therefore, developing and disseminating supporting tools and methodologies that enable contracting authorities to use these approaches in their daily work are of utmost importance to support the greater uptake of strategic public procurement in general and green procurement in particular.

In Hungary, many contracting authorities do not consider public procurement as a strategic tool and the uptake of green and sustainable procurement is still moderate, despite an enabling policy and regulatory environment. Life-cycle costing (LCC) methods, which allow to consider the full set of costs over the lifecycle and are an important tool for green public procurement, are very rarely used. As in many other OECD countries, the main obstacle to the greater uptake of green public procurement and specifically LCC is the lack of competence within contracting authorities to define meaningful green criteria and conduct LCC.

This Report maps the current practices of LCC use in Hungary and existing LCC tools in other OECD countries, with a view of drawing insights to promote the development and uptake of LCC tools. It was developed under the project “Promoting green public procurement in Hungary with a focus on life-cycle costing”, designed between Hungary, the OECD and the European Commission (EC), and funded through EU’s DG REFORM services. It supports the Government of Hungary in establishing comprehensive and user-friendly methodologies and tools for green criteria in public procurement, especially for LCC and to increase awareness amongst Hungarian contracting authorities, business sector and other relevant stakeholders about the value of using LCC methodology.

The project is part of OECD overall work on strategic public procurement that supports governments deliver major policy outcomes in response to today's societal, environmental and economic challenges, especially when it comes to creating sustainable growth and jobs. It also builds on the 2015 OECD Recommendation on Public Procurement.

Data for the Report has been gathered by conducting desk-research of existing LCC tools and guidance on the matter, conducting a survey of Hungarian contracting authorities and interviews with the European Commission and practitioners from OECD members (including Hungary).

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Delegates from the Working Party of Leading Practitioners on Public Procurement were invited to review the document.

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Abbreviations and acronyms

DFØ – Norwegian Government Agency for Financial Management

EC – European Commission

ECI – Environmental Cost Indicator

EPD – Environmental Product Declaration

EWA – European Water Association

GDPR – General Data Protection Regulation

GHG – Green House Gas

GPP – Green Public Procurement

HWA – Hungarian Water Association

LCA – Life-Cycle Assessment

LCC – Life-Cycle Costing

LCIA – Life-cycle impact assessment

MEAT – Most Economically Advantageous Tender

NAP – National Action Plan

NCDS – National Clean Development Strategy

PMO – Prime Minister Office

PPA – Public Procurement Authority of Hungary

PPL – Public Procurement Law

RRP – Hungarian Recovery and Resilience Plan

SKAO – Foundation for climate friendly procurement and business

SPP – Sustainable Public Procurement

TCO – Total Cost of Ownership

ÖBB – Austrian Federal Railways

UNFCCC – United Nations Framework Convention on Climate Change

WLC – Whole Life Costing

Executive summary

Several methodologies help contracting authorities promote sustainability in procurement and take into account the environmental impacts of their purchases. One of these tools is life-cycle costing (LCC). The LCC approach moves beyond the initial purchase price and evaluates all other significant cost flows over the entire life period of works, supplies or services, such as installation, operation, maintenance and end-of-life (disposal) costs. A comprehensive LCC analysis also may take into consideration the costs of mitigating external environmental impacts.

The Report presents the concept of LCC and its links to the wider sustainable procurement agenda. The Report maps available LCC tools across EU and OECD countries and provides an in-depth analysis of selected tools. It also provides guidance on the practical implementation of LCC based on practitioner's feedback. The Report also looks at the Hungarian context, analysing the policy framework and current practices related to LCC. Finally, the Report provides evidence-based strategic policy advice for the Hungarian Government on how to move towards a more structured and co-ordinated approach in the use of green public procurement criteria and especially the use of LCC.

Key findings

The use of LCC in Hungary

- Although Hungary does not yet have a dedicated green public procurement strategy, the overall strategic framework is conducive to green public procurement and the use of LCC. A Green Public Procurement Strategy is currently being formulated, focusing on the development and dissemination of methodologies and tools that support contracting authorities with the uptake of strategic and green public procurement (GPP).
- The Hungarian regulatory framework for public procurement provides ample room for the use of green public procurement approaches and LCC methodologies. Using public procurement to achieve sustainability is widely promoted; however, the uptake of green public procurement is still lagging. Further operational support for contracting authorities is needed to help them implement green public procurement.
- There is little to no experience with using LCC tools in public procurement procedures, although there are some good examples. The main obstacles to the practical use of LCC are the lack of practical knowledge and expertise in conducting LCC, the lack of access to comprehensive LCC methodology and other supporting tools, the unavailability of relevant data for LCC calculations, and the fear of audit risks. Finally, the weak appreciation of the benefits of using LCC in public procurement is not conducive to greater efforts in LCC adoption.

LCC tools in OECD countries

- Overall, the adoption of LCC remains low across many OECD countries, despite the fact that many made commitments to green and/or sustainable public procurement (SPP). The mapping of LCC tools showed that the vast majority of analysed countries had GPP/SPP strategies in place, while only 48% introduced LCC tools.
- Countries tend to introduce 'ready-made' and 'product-specific' tools, which simplify the LCC calculation for non-expert users based on select product groups. Common product groups for LCC tools include energy-intensive and frequently purchased products, such as indoor and outdoor lighting, IT equipment, vehicles, appliances, etc.
- Tools vary in their complexity, with examples of highly complex tools available in some countries. The inclusion of externalities in the LCC calculation remains a challenge, in particular due to a lack of consensus on how to incorporate environmental costs. Practices and approaches are often more advanced in the infrastructure and construction sector.
- Time pressures and capacity gaps are major barriers to wider adoption by practitioners. Furthermore, tools are a necessary, but not sufficient, condition for success. They need to be user-friendly supported by a favourable policy climate. Practitioners need to trust the methodological soundness of tools and have access to specific training in their use.

Policy recommendations

To unlock the potential of public procurement to drive more sustainable growth and promote the greater uptake of LCC use, the Hungarian Government should:

- Demonstrate political leadership for sustainable public procurement by accelerating the adoption of a Green Public Procurement Strategy and assign clear ownership for relevant functions.
- Establish a formal or informal inter-institutional co-operation mechanism, which would enable policy makers as well as supervisory and audit bodies to discuss the progress and challenges in promoting GPP and LCC, and align relevant practices.
- Adopt a phase-based approach to LCC-related obligations, with a first phase focusing on establishing mature LCC practices by providing support structures (e.g. guidance and tools, communities of practice, pilot projects).
- Set the ultimate objectives of the adoption and promotion of LCC in the context of the planned Green Public Procurement Strategy and define the criteria for identifying high-impact areas that could benefit from the application of the LCC in the future.
- Ensure the collection of evidence and data on LCC use by creating a monitoring mechanism, preferably integrated in the e-procurement system.
- Enhance co-operation for the standardisation of parameters and enable the transfer of expert knowledge through dedicated structures (networks, working groups, partnerships).
- Update LCC tools and supporting frameworks by:
    - mobilising a practitioner's platform (network, forum) for sharing practices and experiences and encouraging peer learning in conducting sustainable public procurement.
    - establishing a dedicated competence centre on sustainable public procurement that could act as a main agent in ensuring assistance to public buyers.
    - creating structures that would enable the regular review of existing tools to tackle GPP and LCC-related issues (working groups, partnerships, etc.).

1. Life-cycle costing as a tool in mainstreaming green public procurement

This chapter introduces the concept of life-cycle costing (LCC) and its links to the wider sustainable procurement agenda. It looks at the definition of LCC and how it has emerged as a tool for both cost savings and reducing environmental impact. The chapter also establishes the difference between LCC and similar concepts applying the life cycle approach, and discusses how they interact. Finally, it explains how LCC can be used throughout the public procurement cycle.

Current public procurement policies aim at achieving the best value for money, while also delivering in terms of broader policy objectives that entail social and environmental considerations. These developments call for a novel approach towards the typical procurement practices, especially in the light of the sustainable recovery and growth, with green public procurement gaining a momentum to become a driving force in the process.

Green public procurement is defined as *a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured* (European Commission, 2008[1]). In the green public procurement context, LCC emerges as a tool that can deliver both savings and reduced environmental impacts. The terms green public procurement (GPP) and sustainable procurement (SPP) are often used as synonyms, however they have different scope. While GPP considers only the environmental impacts of purchasing decisions, sustainable procurement considers all aspects of sustainability to achieve the appropriate balance between the three pillars – economic, social and environmental – of sustainable development[1].

Public procurement practice has already demonstrated that the traditional savings-oriented concept of procurement efficiency fails to address the factual spending that occurs after the original contract has been finalised. If not addressed in the appropriate phase of the procurement, the costs generated throughout the lifetime of the purchase put an additional financial burden on the public buyer or the end-user, meaning, they may even hinder the success of a particular project by significantly raising the costs of its implementation. Such situations inevitably raise a question of the economic advantageousness of the decision from the long-term perspective.

LCC is a methodology that estimates the expenditures for a specific purchase during its lifetime, reaching beyond the initial price tag and taking into account other relevant costs incurred, such as installation, operation and maintenance including the regularly reoccurring replacement, renewal of components, financing and disposal.

Historically, the concept of LCC originates in the construction industry, where in the middle of the 20th century, large-scale constructions and military investments generated the need to compare decision alternatives in a way that also takes into account the impact of initial investment decisions on the operational phase. This "traditional" form of LCC focuses on direct, internal costs, and is similar in content to the Total Cost of Ownership (TCO) concept[2].

LCC deviates from the conventional approach that considers the initial purchasing costs of the product, works or services as the key factor, determining the decisions in awarding a public contract. A comprehensive LCC analysis also takes into consideration the costs of mitigating or reducing (external) environmental impacts, meaning that the best solution is identified based on both economic and environmental aspects. Furthermore, by taking into account the costs related to the energy consumption during the lifecycle, energy-efficient solutions can be favoured with an LCC approach. In turn, this has a favourable impact on the environment given that less resources are consumed, and use of emission-generating energy (e.g. fuel or electricity) is reduced.

By allowing a structured comparison between goods and services at various stages of the procurement process, LCC is a well-suited instrument for ensuring value for money. Beyond that, the potential of LCC in achieving green public procurement goals is increasingly being recognised and promoted. The use of LCC can specifically contribute to the implementation of green objectives and deliver value for money if it is combined with the incorporation of minimum green requirements in the tender procedures.

The European Union's public procurement framework explicitly mentions LCC as a method to evaluate the cost-effectiveness of the tender. For instance, Directive 2014/24/EU, Art. 68, sets out the legal framework for using LCC in public procurement and recognises the European Commission's mandate to establish mandatory methods for the calculation of LCC. The explicit mention of LCC as a method to evaluate the

most economically advantageous tender appears in the Directives as a novelty and encouragement to the public buyers to think outside of the box in the context of sustainable public procurement. In addition, the European Commission puts consistent effort to assist procurement practitioners with the application of the relevant articles by developing several ready-to-use LCC tools and related guidance.

However, LCC, as a method to evaluate the cost-effectiveness, was not initially geared towards sustainability *per se*. For many years, LCC was considered a financial appraisal tool, enabling a better assessment of the long-term cost implications of options under consideration (total cost for acquiring, operating, supporting and disposing of a specific purchase during its lifetime), based on forecasts of the future. Improved analysis and simulation of costs resulted into the current understanding of LCC that may include, in addition to the costs over the life-cycle, the monetised cost of environmental externalities and therefore can be used for sustainability purposes.

For example, such understanding is reflected in Directive 2014/24/EU. Article 68 of the Directive explicitly states that life cycle costing shall, to the extent relevant, cover parts or all of the following costs over the life cycle of a product, service or works: (1) costs, borne by the contracting authority or other users such as: costs relating to acquisition, costs of use, such as consumption of energy and other resources, maintenance costs, end of life costs, such as collection and recycling costs; (2) costs imputed to environmental externalities linked to the product, service or works during its life cycle, provided their monetary value can be determined and verified; such costs may include the cost of emissions of greenhouse gases and of other pollutant emissions and other climate change mitigation costs.

However, in practice, such approach that includes the monetization of externalities and demonstrating the economic effect of choosing more sustainable purchases is often considered challenging due to the lack of commonly accepted methodologies and reference data on how to translate such impacts into monetary values.

Practitioners can oftentimes come across similarly sounding concepts, such as total cost of ownership (TCO), whole life costing (WLC) or life cycle assessment (LCA). All of these methodologies apply life-cycle approach, however their purpose and scope differ.

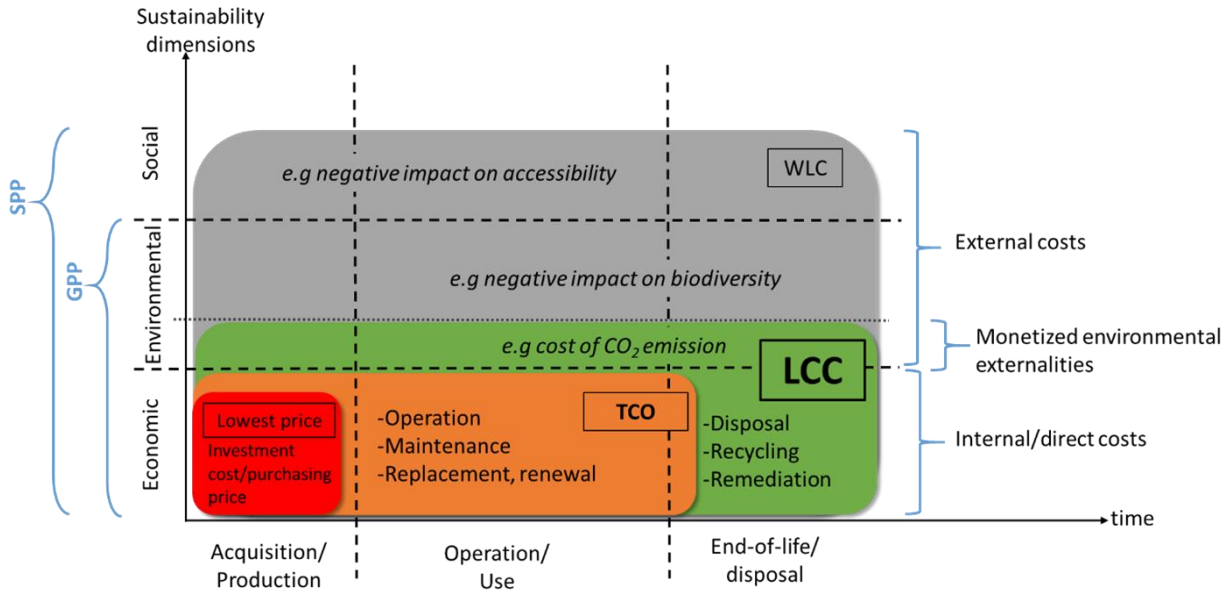
Firstly, we have to distinguish LCA, which is an environmental evaluation method, while the other methods focus on economic aspects. LCA is a systematic analysis of the potential environmental, social, health and resource impacts of products or services during their entire life cycle, such as, for example, global warming potential in manufacturing a product. However, contrary to the LCC, LCA does not attempt to quantify all externalities and monetise them, while LCC is not meant for environmental assessment as such. (Czarnezki, 2019[2])

TCO (Total Cost of Ownership) is only concerned with the costs after the system or product is purchased (costs of operation, maintenance and disposal), excluding the costs of development and other costs that are not internalised by the specific market actor (in this case – public buyer) in some way. Social and environmental externalities are not accounted for in a TCO calculation. It is also focused on the time period of ownership, which is not necessarily the same as the life span of the product.

WLC (Whole Life Costing) is considered to have a broader scope than LCC, with emphasis not only on economic life-span but also the entire span of property existence, taking into account all the relevant costs or expenses and also - the income and benefits gained over the period of analysis (for example, business costs, income from disposals, external social/environmental costs and benefits).

The main differences between these methodologies lies in their purpose and in the range of cost elements considered. The figure below maps out these similar economic methodologies based on the cost elements they consider (Figure 1.1). It also indicates the scope of GPP and SPP, which certainly can have other tools than LCC to avoid or reduce negative environmental, social externalities and direct public procurement towards sustainability.

Figure 1.1. Economic methodologies applying life-cycle approach

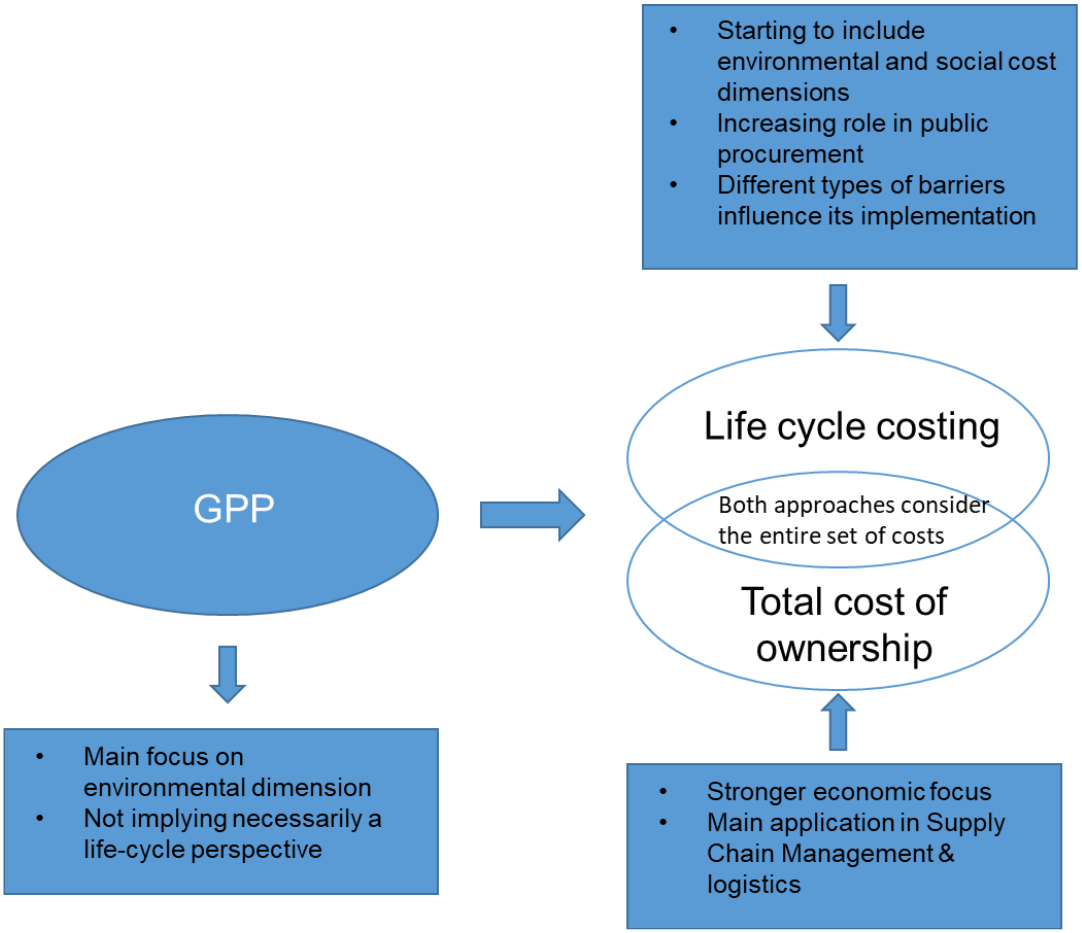


In the context of public procurement (the obligation for the public buyers to select the most economically advantageous tender) and the background for this report further focus will be on LCC. While the literature appears to show relative consistency in the application of the terminology around LCC, the same does not seem to hold true in conversation with procurement stakeholders and practitioners. Namely, as witnessed from fact-finding meetings with stakeholders, the terminology appears to be applied loosely and interchangeably, with LCC being the 'catch-all' term for approaches that strictly speaking would fall either under TCO or WLC. Vice-versa, some stakeholders use the TCO terminology to underline the fact that the methodology applied does not consider externalities. While these interpretations can be all correct as the figure above indicates, a slight confusion still can be detected in international comparison. However, this has no significant consequence in the practice as far as different terminologies are applied consistently at local level. For example, a TCO which takes into account end-of-life costs and an LCC which does not include external costs are practically the same thing.

It is important to highlight the interplay between GPP, TCO and LCC, as displayed in Figure 1.2 below. Namely, GPP does not necessarily imply life-cycle considerations, and is primarily focused on an environmental perspective. In contrast, both TCO and LCC are primarily focused with costs over the life-cycle. Furthermore, both LCC and TCO are linked with GPP in that sense that cost considerations over the life-cycle may lead to resource-efficient choices, which in turn are more environmentally friendly. Beyond that, LCC may also include the environmental and social cost dimensions, while TCO has almost exclusively economic focus, also due to the fact that its main application can be found in supply chain management and logistics (De Giacomo et al., 2019[3]).

In the procurement community, the commonly used term is LCC, even though the full consideration of externalities is rarely being implemented. For the purposes of simplification, this report refers to LCC tools without specific differentiation whether they consider externalities or not. While this report is focused on LCC tools, other tools that are not considered LCC tools in a strict sense are also discussed on occasion, given their relevance in the overall context of promoting LCC and GPP.

Figure 1.2. Interplay between GPP, TCO and LCC



Source: Adapted from (De Giacomo et al., 2019[3])

LCC is susceptible for the use in different stages of the public procurement cycle, allowing to gain better understanding of the full sets of costs stemming from any good, service or work in the preparation phase, conduct objective evaluation and comparison of the tenders in the award phase, and ensure consistent evaluation of the results during the contract implementation (Figure 1.3).

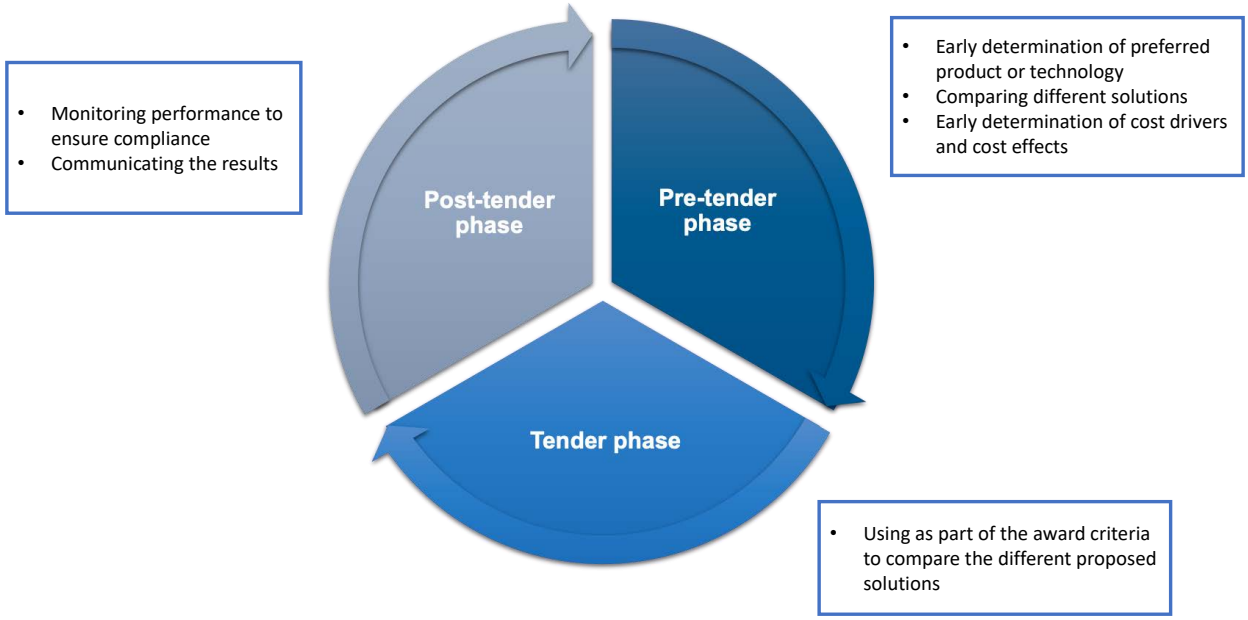
Specifically, in the pre-tender phase, LCC can be used in the option analysis to help contracting authorities roughly evaluate the different technical solutions to be considered or select the type of solution to purchase. In particular, it can be used to compare the cost drivers of different solutions, and getting an understanding of which cost categories are most relevant. For this purpose, public buyers may be using preliminary data gathered in the consultation process with the relevant parties, such as end-users, other departments in the organisation, and potential suppliers. Through a better understanding of cost drivers in a given procurement, LCC can help in designing tender specifications that reflect resource efficiency and are more environmentally-friendly. Importantly, LCC allows justifying the purchase of environmentally and/or socially responsible alternatives that require a high purchasing cost but would provide the best value for money across the life cycle.

LCC can be used during the tendering process for evaluating offers. Namely, it allows to consider different cost categories instead of the pure acquisition price and to evaluate all other significant cost flows over the entire life cycle of the supply, service or works, such as installation, operation, maintenance and end-of-life (disposal) costs or even to consider the anticipated CO_2 emissions of different offers. As such, the LCC

approach allows selecting the most cost-effective option, thereby generating value for money (LCC can be included in the award criteria if a specific cost can be monetised and verified accordingly, resulting in an objective, non-discriminatory and accessible methodology).

Finally, in the post-tender (contract implementation) phase, if LCC was part of the tender, LCC can be used for monitoring performance to ensure compliance with claims made by contractors (comparison whether the effectiveness and costs proclaimed by the supplier during the tendering procedure have actually been achieved). If LCC was not included in the tender, it can be used as a tool to evaluate the cost effectiveness of the purchased product in comparison to other available options on the market.

Figure 1.3. LCC use throughout the public procurement cycle



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European Commission (2008), "Public procurement for a better environment", *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52008DC0400. [1]

Notes

[1] Clement, S., Semple, A., (2016): The Procura+ Manual: A Guide to Implementing Sustainable Procurement, 3rd Edition, ICLEI – Local Governments for Sustainability, European Secretariat

[2] For the explanation of the TCO, please see further in the text.

2. State-of-the-art in adopting life-cycle costing in Hungary

This chapter discusses the Hungarian policy and strategic framework on public procurement and its adequacy for the strategic use of public procurement and life-cycle costing (LCC). It also looks at the actions and initiatives to promote sustainable public procurement in Hungary and the existing operational support in implementing GPP. This chapter also analyses the uptake of green public procurement and LCC in the practice, building on the results of the survey conducted by the OECD on the use of LCC by contracting authorities in Hungary, identifying the key barriers for a greater uptake of LCC.

2.1. Hungarian policy and regulatory framework on green public procurement and on LCC

In general, the current Hungarian policy and strategic framework on public procurement (in alignment with the European Union's framework) enables the strategic use of public procurement.

An overall strategy for the development of the public procurement system or for the strategic use of public procurement do not yet exist in Hungary. However, the Government Resolution 1027/2021 on the necessary measures to improve the efficiency of the public procurement system[1] listed the Government's most important strategic priorities in terms of development of the public procurement system. These include actions that can address challenges in the Hungarian system, such as decreasing the number of single-bid procedures, improving the access of SMEs to public procurement opportunities, developing a comprehensive methodology to measure the efficiency of the Hungarian public procurement system, fighting against anti-competitive behaviour in public procurement and increasing the use of green public procurement. To implement the lastly mentioned goal, the Government Resolution mandated the Minister leading the Prime Minister's Office to develop – in collaboration with relevant line ministers – Hungary's green public procurement strategy that enables the incorporation of environmental considerations into public procurement procedures.

The development of the Green Public Procurement Strategy for the period 2022-2027 is currently ongoing. It set to be submitted to the government for adoption in 2022. As contracting authorities need to have the capacity and confidence to evaluate the quality, including sustainability aspects of the tenders, the draft Strategy puts more focus on the development and dissemination of methodologies, tools that support contracting authorities with the greater uptake of strategic public procurement and especially the use of green criteria in public procurement. Amongst others, the draft Strategy intends to promote the use of LCC methods. Furthermore, the draft Strategy entails an action plan, which includes, among others, as a possible measure the examination of introduction of mandatory green criteria for specific purchasing categories and contracting authorities, and the designation of a competence centre within the administration. The action plan also sets out the responsible actors and deadlines for the implementation of the planned measures.

Even if there is still no strategy dedicated to green public procurement, a quite comprehensive strategic framework on climate change and environmental protection defines the directions for actions in public procurement:

The Fundamental Law[2] of Hungary includes a clear commitment to achieving the goals of climate change and environmental protection.

On 31 October 2018, the Hungarian Parliament adopted the Second National Climate Change Strategy for the period of 2018 – 2030, with an outlook to 2050, which was followed by the First Climate Action Plan for the year of 2020 for the implementation of the National Climate Change Strategy on 20 January 2020. In line with the sectoral themes of the Second National Climate Change Strategy, the Action Plan identified key areas where significant progress can be achieved in short term. The Action Plan focuses on the procurement of electric buses, the acceleration of their deployment and development, distance heating based on renewable energy, renewable energy production, improving the energy efficiency of public and residential buildings, tightening controls on the compliance of vehicles with environmental regulations, developing cycling and public transport. The tasks set out in the Action Plan show that considering green energy in green procurement can significantly contribute to environmental protection measures.

On 3 September 2021, the Government of Hungary adopted the National Clean Development Strategy (NCDS), which is instrumental in achieving the 2050 net zero goal for Hungary set in the Climate Protection Law adopted in 2020 by the Hungarian Parliament. The NCDS is Hungary's long-term low greenhouse gas (GHG) emission development strategy (LTS) that countries need to adopt based on Article 4 of the Paris

Climate Agreement. The NCDS sets the path for the decarbonisation of Hungary's economy by 2050. The Strategy is based on an integrated modelling approach to explore the emission trajectories of the sectors as well as the system-wide and cross-sectoral dynamics of the decarbonisation process. A green transition driven by decarbonisation is likely to have a number of benefits in addition to the initial investment costs, which will also contribute to global efforts to limit global warming and support the national economy and the planet. The adopted Hungarian NCDS has been submitted and posted to the official website of the United Nations Framework Convention on Climate Change (UNFCCC)[3].

Another crucial element of green transformation policy is the focus on transitioning to the circular economy. Hungary has taken significant steps to reduce waste in order to create a circular economy. In particular, the use of plastics and the recycling model were revised when the country's waste management system was reformed. The reform of the waste management system operates with "concessions", which means that the concession company is responsible for the entire recycling process, while the government has also limited the prices that the company can charge. The transformation of waste management is one element of the reform, while the other element is the effort to reduce the total amount of plastic used in the economy. The reduction in plastic use stems from EU law. From July 4, 2021, the use of plastic plates, forks, spoons, cotton buds and drinking straws are banned and are not allowed into the EU's Single Market. The European Commission adopted its first circular economy action plan in 2015, which was completed by the end of 2019, and the next action plan was launched in March 2020. Hungary's actions in this area are linked to the trends at the EU level.

In 2018, the third OECD Environmental Performance Review of Hungary (OECD, 2018[4]) that evaluated progress towards sustainable development and green growth, with special features on waste, material management, circular economy and biodiversity highlighted that Hungary has made significant progress in decoupling its output growth from main environmental pressures, largely due to implementing requirements of EU directives. However, the Review also highlighted that there is still a lot to do and recommended that Hungary could accelerate the transition towards a low-carbon and greener economy, particularly by investing in residential energy efficiency and sound waste and material management, and better mainstreaming of biodiversity protection into sectoral economic policies. In terms of green public procurement, the Review highlighted that there is still little domestic market demand for good environmental performance and the potential of green public procurement to promote green business practices and generate economic opportunities is not fully exploited. Therefore, more efforts are needed on the demand side, such as green public procurement, that would stimulate innovative investment and enlarge environmental markets. The Review recommended the swift adoption and implementation of a national action plan for green public procurement. This would help stimulate demand for greener products and services, and encourage innovation.

2.1.1. The Hungarian regulatory framework on public procurement gives ample room for the use of green public procurement approaches

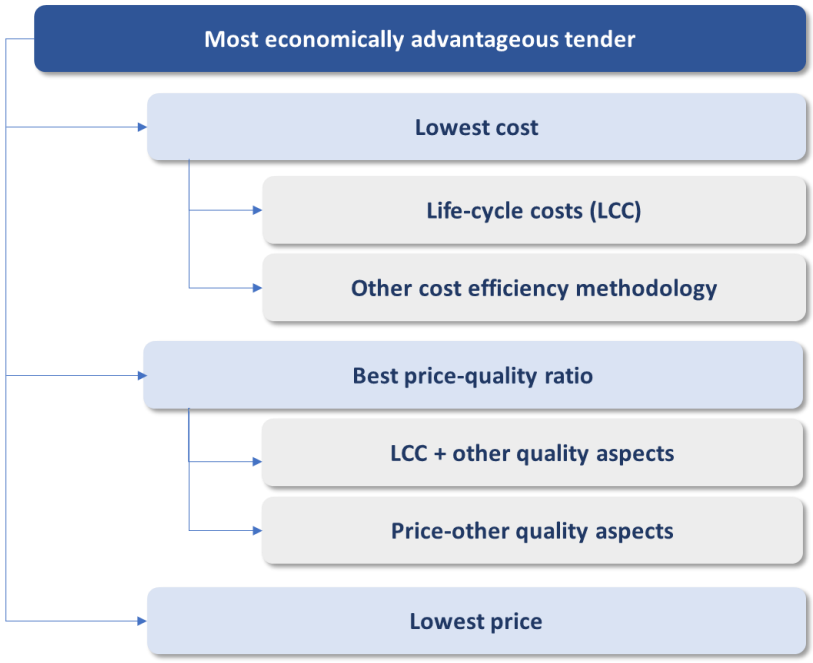
The Public Procurement Law[4] (Law CXLIII of 2015 on Public Procurement, PPL) defines the Hungarian regulatory framework on public procurement. The law is complemented by several implementing regulations that define detailed rules for different aspects of public procurement. The PPL is transposing the 2014 EU Directives on public procurement and it is effective from the 1st of November 2015 (since then, it was modified several times).

Overall, the Hungarian legal framework provides ample room for the use of sustainable and inclusive public procurement approaches. The PPL enables contracting authorities to use green criteria in their tenders and to take into account quality and sustainability dimensions that are related to the subject matter of the contract. LCC can play a role in these criteria.

With price criteria becoming one of the ways of choosing the most economically advantageous tender (MEAT) (see Figure 2.1), the Hungarian PPL favours the use of the best price-quality ratio over the price

criteria, explicitly stating that contracting authorities shall be bound to apply the award criteria for the lowest cost or the best price-quality ratio. Use of price criteria is banned in case of design, engineering and architectural services or public works. However, price criteria remains to be used in cases when the contracting authority's needs can only be met by a particular supply or service which is able to satisfy specifically identified qualitative and technical requirements, and further quality characteristics would not be helpful in selecting the best option (PPL Section X).

Figure 2.1. Public procurement award criteria as set out in Article 76 of the Hungarian PPL



Source: Adapted from Guideline on Life-Cycle Costing of the Public Procurement Council of Hungary

In case of design, engineering and architectural services or public works, the PPL excludes the use of the lowest price as the sole award criteria and a separate implementing regulation, the Government Decree 322/2015 (X. 30.) lays down the detailed rules on the award criteria and the methods to be applied. This rule applies to both EU level and national public procurement procedures. The Government Decree obliges contracting authorities to choose the winner based on the best price-quality ratio as well as encourages contracting authorities to add environmental and sustainability related sub-criteria to the evaluation framework. These obligations and opportunities are further explained in the Guidelines on the rules for public works[5] issued by the PPA in September 2021. The Guidelines in general gives guidance to contracting authorities on how to implement the provisions of the PPL and the Government Decree in the practice, and a special section is dedicated to the evaluation framework and award criteria. At the same time, the PPL allows the application of the lowest cost criterion more widely than the lowest price criterion, as decisions based on the lowest cost are also possible for the selection of a designer and engineer or in case of public works.

In the case of competitive dialogues and innovation partnerships, based on Sections 90 (6) and 96 (4) of the PPL, the contract must be awarded on the sole basis of the best price-quality ratio criteria.

In case of the lowest cost as an award criterion, the most economically advantageous tender must be selected by using the cost-efficiency method determined by the contracting authority to calculate the lowest cost. Among the cost-effectiveness methods, the PPL highlights and regulates in detail the application of the life cycle costing method (Section 78 of the PPL), defining the terms life cycle (Section 3 (7) of the

PPL) and the life cycle cost (Section 78 (2) of the PPL) (Box 2.1). When contracting authorities assess the costs of the supply, service or works during the evaluation using a life cycle costing approach, it shall refer to it in the notice launching the procedure (Section 78 (1) of the PPL). However, it is sufficient for the contracting authority to indicate in the procurement documents, what type of data are be provided by the tenderers and what method will be used by the contracting authority to determine the life cycle costs based on those data.

Box 2.1. Life-cycle costing in the Hungarian Public Procurement Law

Definition of life cycle – Section 3 (7)

'life cycle': all consecutive and/or interlinked stages, including research and development to be carried out, production, trading and its conditions, transport, use and maintenance, throughout the use of the product, provision of the service or existence of the works, from raw material acquisition or generation of resources to disposal, clearance and end of service or utilisation;

Selection of the winning tenderer – Section 78 (1)-(4)of PPL

1. Where contracting authorities assess the costs – taken into account in the course of the evaluation – of the supply, service or works using a life-cycle costing approach, they shall refer to it in the notice launching the procedure and shall indicate in the procurement documents the data to be provided by the tenderers and the method which the contracting authority will use to determine the life-cycle costs on the basis of those data.
2. Life-cycle costing shall, to the extent relevant, cover parts or all of the following costs over the life cycle of a product, service or works:
    a. costs, borne by the contracting authority or other users, such as:
        i. costs relating to acquisition,
        ii. costs of use, such as consumption of energy and other resources,
        iii. maintenance costs,
        iv. end of life costs (in particular collection and recycling costs),
    b. costs imputed to environmental externalities linked to the product, service or works during its life cycle, provided their monetary value can be determined and verified; such costs may include the cost of emissions of greenhouse gases and of other pollutant emissions and other climate change mitigation costs.
3. The method used for the assessment of costs imputed to environmental externalities shall fulfil all of the following conditions:
    a. it is based on objectively verifiable criteria which ensure compliance with the principles set out in Article 2(1)-(3) and (5), furthermore, which shall not unduly favour or disadvantage certain economic operators;
    b. the method is predetermined, is accessible to all interested parties and is not tailored to one specific procedure, can be used in other procedures as well;
    c. the data required can be provided with reasonable effort by normally diligent economic operators.
4. The Public Procurement Authority shall publish guidelines on the methods for the calculation of life-cycle costs and, where appropriate, it shall indicate that a common method for the calculation of life-cycle costs has been made mandatory by a legislative act of the European Union. In the case of certain subject-matters of procurement, mandatory methods for the

calculation of life-cycle costs may be prescribed by a legislative act drawn up on the basis of the empowerment of this Act.

Source: Law CXLIII of 2015 on Public Procurement, non-official translation by the PPA

Besides the requirement of the best price-quality ratio, the PPL and its implementing decrees contain further provisions that support the application of green, social and quality aspects in public procurement, such as the rules on the preparation of procedures (Section 28(1) PPL), the possibility to require environmental criteria in the technical specifications (Section 48(2) PPL), the possibility to use labels and certificates (Section 59(1) PPL), exclusion criteria (Section 63(1)(a) PPL) or defining special contract performance conditions (Section 132(1) PPL).

Government Decree 321/2015[6] includes detailed provisions on how to define technical specifications and it specifically includes the possibility to require environmental criteria in the technical specifications (Section 48(2)).

The PPL gives authorisation to the Government to set the detailed rules of the environmental, sustainability and energy efficiency requirements in a decree, however, such decree has not been adopted yet by the Government. The authorisation provides the legal basis to the Government decree to define the details of the award criteria and the method with respect to certain subject matters of public procurement, the determination of cases where there is an obligation to integrate social, in particular employment-related and environmental, sustainability, energy efficiency considerations in the procurement procedures, including the mandatory application of reserved public procurement.

Further to the PPL, other legislative acts also mandate and enable GPP, for example:

- The Law on Energy Efficiency mandates public bodies to purchase highly energy efficient services, products and works if the estimated value of a procurement exceeds the EU thresholds. Government Resolution 1849/2014 on Energy Efficiency and the guideline of the Ministry of National Development on energy effective procurements[7] further details these requirements.
- Government Decree 48/2011 on the Promotion of Environmentally Friendly and Energy Efficient Vehicles[8] stipulates that contracting authorities and public service providers shall purchase environmentally friendly and energy effective vehicles.

2.2. Using public procurement to deliver on sustainability is promoted widely

The PPA, within its mandate, promotes the strategic use of public procurement to deliver on sustainability. The PPA created a dedicated website for sustainable public procurement[9] to disseminate sustainability related information by publishing the latest studies and other publications (including the electronic newsletter, the GPP News Alert, edited and published monthly by the European Commission's Directorate General for Environment). The PPA also promotes the latest policy papers of the European Commission and capacity building opportunities (e.g. webinar) that may help contracting authorities incorporating sustainable considerations into their purchasing strategies and tender documentations while procuring certain product groups. It also disseminates relevant information in the "Daily Public Procurement" mobile application.

The dedicated sustainable public procurement website of the PPA includes a separate section on life cycle costing, where PPA shares information about LCC, including tools and guidelines developed by the European Commission or other EU member states.

To support the effective implementation of the PPL and to share good practices, the PPA organises conferences and seminars (recently webinars) to present legislation in force and solutions to problems

detected in practice, and share practical experience with the public. Some of these events were specifically dedicated to the topic of sustainability or green public procurement. The conference materials are shared with the public after the events.

The PPA established two prizes, such as the Public Procurement Prize and the Public Procurement Excellence Award. In 2020, candidates could apply for the Public Procurement Prize by submitting successful public procurement procedures that used sustainability criteria. In 2020, when the PPA and the Public Procurement Arbitration Board celebrated their 25th anniversary, 16 applications were submitted, more than ever before. PPA's co-operating partner, the Blue Planet Foundation for Climate Protection (in Hungarian: Kék Bolygó Alapítvány)[10] offered a further prize for the winners in the topic of sustainability.

In 2020, the PPA concluded a cooperation agreement with the Blue Planet Foundation for Climate Protection, which is a non-profit organisation seeking to raise environmental awareness within and beyond the borders of Hungary. The Foundation is committed to sustainability, sustainable development and climate protection. The cooperation agreement, which is published on the webpage of the PPA[11], aims to mutually help each other's tasks and to implement the aspects of sustainable development as widely as possible.

In 2021, the PPA launched the "Programme for Sustainable Hungary" in order to further promote the application of sustainability aspects in public procurement. The main aim of the program is to shape the attitudes of public procurement market actors, strengthen professional dialogue as well as disseminate domestic and international good practices. As a first step to implement the Programme, the PPA established a Sustainability Working Group and prepared a Code of Ethics on Green Public Procurement[12] (Környezetvédelmi Közbeszerzési Etikai Kódex in Hungarian).

The Sustainability Working Group includes delegates from all major domestic contracting authorities, such as the Hungarian Railway Company (MAV Zrt.), the National Infrastructure Development Company (NIF Zrt.) and organisations cooperating with the PPA on sustainability issues. The aim of the working group is to create a forum to share existing, but not widely known good practices, as well as to discuss practical problems encountered in applying sustainable aspects in public procurement procedures, and to create a practical knowledge base that can be of real help to procurement practitioners.

The purpose of the Code of Ethics on Green Public Procurement is to provide guidance to contracting authorities on how they can contribute to promote and implement environmental objectives by incorporating green, sustainable considerations into their public procurement practices and procedures. (Box 2.2) Adoption of the Code is voluntary. Contracting authorities who join the Code commit themselves to consider environmental (green) aspects in their public procurement procedures as well as to respect the values and principles listed in the Code. On its website, the PPA publishes the list of the contracting authorities who joined the Code. The PPA considers these contracting authorities as key partners for the Programme for Sustainable Hungary and enable them to use its logo. Contracting authorities covered by the Code undertake to report to the PPA by the beginning of the financial year, but 31 March at the latest about the green public procurement procedures, they conducted in the previous year, including a summary of other procedures where environmental aspect was not applied. The PPA publishes the reports on its website. The Code is effective from 1 September 2021; therefore, it is still too early to assess its implementation and its impact.

Box 2.2. Code of Ethics on Green Public Procurement

1. Principles of the Code

Contracting authorities covered by the Code undertake to pay increased attention in their procurement procedures to the following core values:

Green public procurement: procurement of goods, services and works, which have a lower environmental impact compared to similar goods, services and works of the same use.

Circular economy: the implementation of an economic model that is based on closed energy and material cycles in the supply chain instead of the linear "extract, produce, dispose" approach. Minimising – and avoiding as far as possible – the negative environmental impacts, it seeks to maximise to keep the value of the products and raw materials used throughout their life cycle. Waste generation and resource use should be minimised, and resources in products that have reached the end of their useful life are retained in the economy, creating additional value through reuse.

Minimise waste generation: the contracting authority shall seek to ensure that its procurement procedures contribute to preserving the value of products, materials and resources in the economy as long as possible and to reduce the generation of waste.

Reducing energy use: the contracting authority will seek to ensure that its procurement procedures contribute to minimising and reducing energy consumption through its procurement procedures.

Reduction of water consumption: the contracting authority will seek to minimise and reduce water consumption through its public procurement procedures.

Reduction of carbon dioxide emissions: the contracting authority will seek to use its procurement procedures to contribute to the minimisation and reduction of carbon dioxide emissions.

Life cycle approach: In designing the procurement procedure, the contracting authority shall take into account all the successive or interrelated phases of the use of the product, the provision of the service or the existence of the works, including the research and development, the production, trade and its conditions, the transportation, the use and the maintenance to be carried out, from the acquisition of raw materials or the creation of resources to the removal, disposal, restoration to their original state or the end of the service or use.

2. Rules of conduct during the public procurement procedure

The Code sets up rules of conduct for the different phases of the public procurement cycle:

1. Planning public procurement procedures:
    a. *Identifying green procurement priorities and objectives:* Contracting authorities shall define their green public procurement priorities and objectives, in the short and long term. Their annual procurement plan shall take account of these priorities and objectives.
    b. *Preparation of procurement procedures:* The contracting authority should seek to ensure the conditions for performance of high quality, to take into account the sustainability aspects, and to prevent contract modifications affecting the subject matter of the procurement. The procuring entity may use the method of value analysis.
2. Implementation of public procurement procedures:

Contracting authorities may apply green procurement criteria in the technical specifications, exclusion criteria, suitability criteria and evaluation criteria and in the contract performance conditions. The

contracting authority shall ensure that the green procurement criterion used result in the most environmentally friendly solution.

In terms of the evaluation framework, contracting authorities shall commit themselves to the use of the lowest cost of best price quality ratio as award criteria and the avoidance of the use of the lowest price as sole award criteria. The contracting authorities shall also commit to the use of life cycle costing approach as far as possible in case they choose the use of lowest cost as award criteria.

3. Performance of public contracts

When the contracting authority defines green contract performance conditions, it shall pay particular attention to check, monitor and verify compliance with these conditions and to ensure the proper documentation of their performance.

Source: https://www.kozbeszerzes.hu/documents/2487/kornyezetvedelmi_kozbeszerzesi_etikai_kodex.pdf

The PPA's commitments to sustainable public procurement are reflected in its efforts to incorporate sustainability into its own operation and procurement practices. To set a good example on green public procurement, the PPA applies green criteria in its own purchases. For instance in 2020 in the procedure for the procurement of cleaning services green criteria were defined as contractual clause: the winning tenderer had to commit to ensure that 40% of the cleaning products used must qualify as an environmentally friendly product. When defining the green criteria, the PPA looked at the EU GPP criteria for indoor cleaning services as an inspiration.

Many municipalities – mainly larger ones – have joined or are members of sustainability and environmental initiatives and organisations, such as the EU Covenant of Mayors for Climate & Energy and the International Council for Local Environmental Initiatives. Furthermore, some have a green strategy document or action plan on varying degrees of elaboration, which, among other things, also formulate the need for the strategic use of public procurement. Financial means can also play an important role in the promotion of GPP. Among the funding programmes which contribute to the uptake of green public procurement, the Green Bus Programme – launched in 2019 – aims to replace the buses used in local public transport. The multi-annual programme is currently funded with HUF 35.9 billion of domestic resources, which the government plans to supplement in the future with additional resources available under the Hungarian Recovery and Resilience Plan (RRP) and the Multiannual Financial Framework.

The Hungarian RRP and the operational programmes for the EU budget cycle 2021-2027 will also aim to promote green public procurement by encouraging the applicants/beneficiaries to conduct environmentally friendly public procurement procedures whereby the applicants/beneficiaries as contracting authorities should give preference to procurement of goods, services and works that have a lower environmental impact compared to other goods, services and works of the same type.

2.3. Operational support to contracting authorities on how to implement green public procurement exists; however, further efforts are needed

The PPA issued a guideline on the application of the evaluation criteria for the selection of the successful tenderer in 2016.

The Prime Minister's Office (PMO) issued a guideline[13] about the proper use of environmental and social award criteria in public procurement procedures related to projects co-funded by EU and a guidance[14] based on EU audit experience regarding the use of strategic award criteria. The purpose of these guidelines is primarily to provide the information required for the application of the provisions of the PPL on award criteria. There is a special section on the monitoring and sanctioning of evaluation criteria, as the contracting authority has to ensure that the commitments of individual tenderers can be monitored, but the

legal consequences of non-compliance with the commitments have to be announced in the tender documentations.

In March 2017, the PPA issued a detailed *Guideline on life-cycle costing methods*[15]. The Guideline presents the Hungarian regulatory background for the use of LCC, also placing it in the wider context of quality-based evaluation and sustainable development goals. It explains the theoretical background for LCC, the common use-cases of LCC and methodologies for LCC calculations (e.g. assumptions in LCC calculations, types of costs to be included). It also explains the enabling factors for the successful use of the LCC in practice. Finally, the Guideline includes two examples on the use of LCC. The guideline also aims to provide guidance to tenderers intending to participate in public procurement procedures in which the contracting authority opted for using life cycle costing. The Guideline, however, does not include (as it is beyond its goal) product- or service-specific LCC tools.

While the PPA's *Guideline on life-cycle costing methods* established the methodological framework and explained the legal background for the confident application of the LCC in procurement procedures, it could not address all issues in terms of LCC. It was also not intended to be a textbook on LCC methodologies, therefore its role in education and capacity-building efforts are limited. However, there were some sectors where the Guideline paved the way for further capacity building on LCC as well as for the development of the further guiding documents. (Box 2.3).

Box 2.3. Capacity building efforts on LCC in the Hungarian water sector

Development and support of knowledge related to the use of the life cycle approach has long been on the agenda of the Hungarian water-related professional organizations. A previous capacity building effort of the Hungarian Water Association (HWA) in 2011 targeted the preparation phase of infrastructural investments by promoting the application of life cycle approach and interdisciplinary approach in option analyses and cost-efficiency analyses. Detailed guidelines have been issued and a series of workshops took place. Building on the experiences of the capacity building workshops and the feedback on the use of the guidelines, and with the aim of complementing the PPA's official guide (the Guideline on life-cycle costing methods) and further supporting capacity building efforts on LCC, the HWA has issued an LCC guide in 2016[16]. This guide promotes cooperation between various specialist (legal, technical, economic) involved in the implementation of water-related projects and provides a joint toolkit for these different actors. However, the guide is not specific to water related procedures, it rather focuses on the methodology of life-cycle approach and it can serve both as a textbook for LCC training programmes and as a useful handbook for procurement practitioners to support their everyday work.

One of the main obstacles to the spread of the life cycle approach is the lack of a "common language" and mutual understanding of the LCC methodology between different experts involved, as well as the lack of skills to interpret LCC calculation and its results in a transparent, standardized way that is understandable for engineers, procurements experts and economists alike.

The HWA's LCC guide:

- summarizes the economic principles essential for understanding and application on LCC,
- defines the concepts of life cycle cost and cost-efficiency,
- presents a simple, transparent, easy-to-learn technique for performing the LCC calculation,
- schematizes the calculation process and the cost structure,
- contributes to a functional, uniform and transparent evaluation, thereby facilitating the application of the method and the verifiability of the results,
- can be used both during trainings, educational programs and practical work
- creates an opportunity to develop interdisciplinary expertise, improve the efficiency and

effectiveness of communication and cooperation between different fields of expertise.

The HWA LCC Guide received international attention at the IFAT 2016, where the European Water Association (EWA) organized an LCC symposium. Recommendations of the symposium have been recognized by Procura+[17] and several other professional organizations. However, it resulted in only one LCC workshop in Hungary at the Budapest Water Works, pointing out the necessity of further policy support and product specific LCC tools for the uptake of this methodology in Hungary.

Source: Information collected during the fact finding missions.

2.4. Uptake of green public procurement is still lagging behind

As the annual reports of the PPA show, Hungarian contracting authorities increasingly apply green public procurement criteria, however, they are still underrepresented, and LCC methods specifically remain very rarely used.

In Hungary, since 2012, the national regulatory framework enables the collection of data on procedures applying green and social aspects. However, data collection is possible only in terms of procedures below EU thresholds. Due to the characteristics of standard forms issued by the European Commission, data are currently not available for procedures reaching or exceeding EU thresholds. Namely, the EU forms do not capture information about green or social criteria. Nevertheless, the introduction of the new EU standard forms (eForms) will enable such data collection by integrating reporting on GPP/SPP. For the same reason, the PPA does not collect data specifically on the use of LCC, as there is no dedicated entry for this in the standard forms. This practice will also change with the adoption of the new standard forms.

The PPA compiles the statistics of Hungarian public procurement procedures based on contract award notices. The national standard form (which is obligatory for the below EU threshold procurement) of the contract award notice includes data fields where contracting authorities can indicate if the procurement has included:

- social and/or environmental clauses as contractual clause;
- social and/or environmental award criteria;
- social and/or environmental requirements as part of the technical specifications;
- environmental measures or compliance with environmental management schemes within the framework of the selection criteria.

However, as EU standard forms do not include such data fields these statistics contain only green procurement procedures launched above national threshold and below EU threshold.

As the PPA's 2020 Annual Report (Public Procurement Authority of Hungary, 2020[5]) shows, in 2020, contracting authorities conducted 474 green public procurement procedures, spending in total HUF 68.5 billion. This meant that compared to previous years both the number and value of public procurement procedures applying environmental criteria dropped to almost their half. However, the decrease is not as pronounced if the share of green public procurement is compared to total public procurement (including above EU thresholds).

In fact, 10.3% of the public procurement procedures below EU thresholds applied environmental criteria in 2020; thus, the proportion of such procedures lowered by 2.3% compared to the rate in 2019 (12.6%). Similarly, in 2020, 13.1% of the total value of public procurement procedures below EU thresholds applied environmental criteria, which is only a 1.4% decrease compared to the proportion of the previous year (14.5%).

Contracting authorities applied environmental criteria mostly in procurement of public works: in terms of the number of the public procurement procedures, this represents 15.2% of public works below EU thresholds and 14.7% in terms of the value of procedures.

Figure 2.2 shows the changing trends of the uptake of GPP in Hungary during the period of 2012 and 2020. It shows that there is a drop in the number and volume of green public procurement since 2018.

Figure 2.2. The number and value of procedures applying green criteria between 2012 and 2020

Source: 2020 Annual Report of the Public Procurement Authority

2.5. Experience with the use of LCC tools in public procurement procedures is almost non-existent; however, there are some good examples

To understand the current use of LCC tools by Hungarian contracting authorities, OECD conducted a survey on the use of LCC by contracting authorities in Hungary (between 19th of November 2021 and 15th January 2022). The survey[18] covered several aspects, such as the respondents' experience on LCC tools, availability of supporting tools on the LCC use, their perception of the role of LCC in the context of strategic public procurement and the main challenges they face. Twenty respondents answered the 20 questions.

The survey results confirmed the initial presumption that the main obstacle to the practical use of LCC is the assumption that LCC requires specialised knowledge.

The survey results also show that LCC methodology is not yet considered to be a critical component of the public procurement process in Hungary and is very limited both in terms of use and practical appreciation. In fact, only four respondents out of twenty used LCC in their public procurement in the last five years. Half of them applied LCC only once, to purchase public supplies and public works, either when determining preferred product or technology, or during the award of the contract as award criteria. Regarding the method used for LCC calculations, the respondents mentioned Excel tools and found using LCC methodology in their public procurement process very difficult.

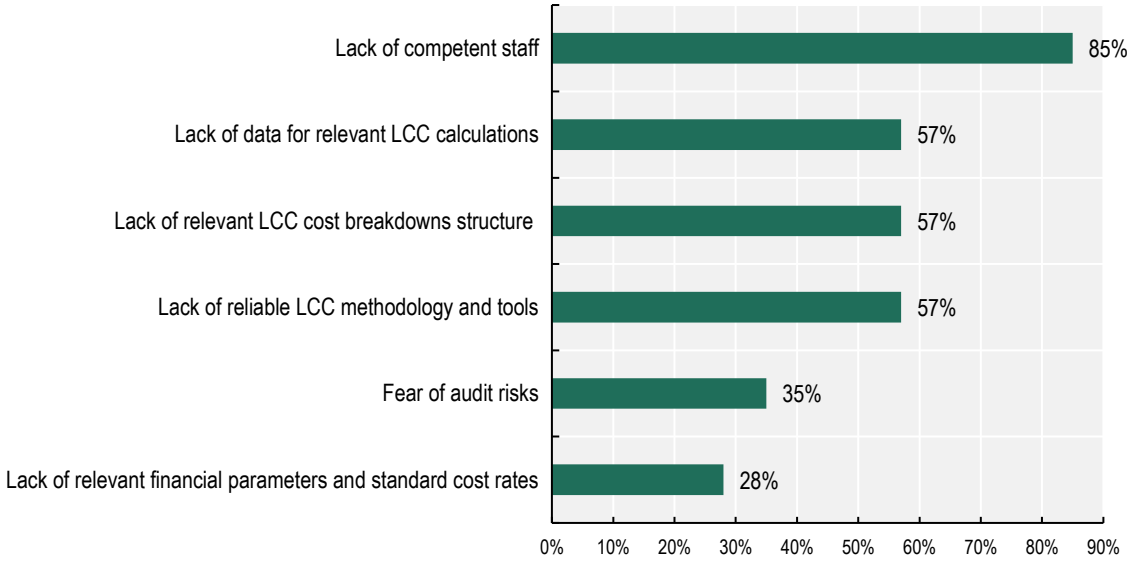
Key findings of the Survey

- Only 4 out of the 20 respondents applied LCC methodology in their public procurement in the last five years and found it difficult to use. The survey results highlight that the use of LCC methodology in public procurement is almost non-existent in Hungary. This is mainly due to a lack of reliable LCC methodology and supporting tools, a presumption that LCC is too complicated to use for the staff, and difficulties in accessing relevant data for LCC calculations.
- Respondents agreed that LCC tools should be developed for the following purchasing categories: supplies (35%), public works (23%) and IT equipment (23%). Although those responses are the most recurrent ones, 3 respondents mentioned the purchase of environmentally friendly equipment.
- **35% of the respondents are indifferent or only partially agree that LCC contributes to sustainable public procurement**. The survey results reveal the mitigated appreciation of the benefits of using LCC in the public procurement process. A non-negligible number of respondents only partially agreed that LCC contribute to sustainable public procurement, and that it is important for budget allocation/financial planning, and for selecting the best value offer in the public procurement process.
- **68% of the respondents would use LCC guidelines and supporting tools if they were developed.** They consider that they do not have staff that would be confident with using LCC at the moment. They believe that comprehensive LCC guidelines and practical trainings should be developed to support them, and to respond to the lack of expertise of contracting authorities, tenderers and control bodies regarding LCC.

2.5.1. The main reasons for the very low uptake of the LCC methodology in Hungary

The survey asked respondents about the main challenges contracting authorities face regarding the use of LCC (Figure 2.3)

Figure 2.3. Challenges encountered by Hungarian contracting authorities in using LCC in their public procurement



Source: OECD survey on the use of life-cycle costing (LCC) by contracting authorities in Hungary.

Lack of practical knowledge and expertise in conducting LCC

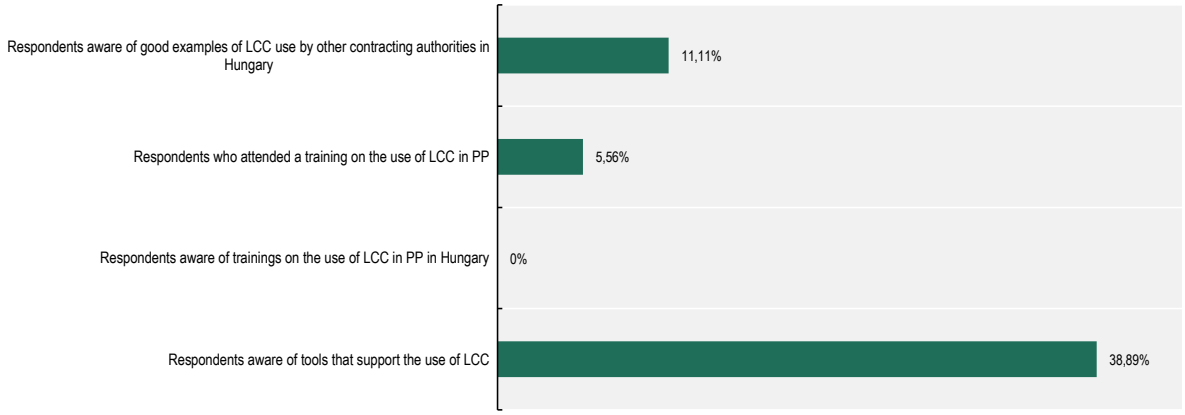
According to the survey results, the lack of knowledge and expertise among contracting authorities' staff is one of the main reasons for not using LCC in their public procurement. There is a general idea that using LCC is too difficult and too demanding for the staff. Respondents consider that LCC methodology is more difficult than the application of other award criteria and discourages market players. While 88% of the respondents have a staff member with expertise in public procurement who will determine the elements that require technical knowledge, they are usually not in a position to provide information on practical issues concerning LCC.

Furthermore, when respondents were asked why they would use LCC in their public procurement, only two of them provided a reply explaining that they would use LCC in their public procurement to assess costs beyond the initial purchase price of a good, service or work and to evaluate all other significant cost flows over the entire life cycle, but only one of them mentioned considering externalities such as environmental costs while using LCC.

Lack of access to a comprehensive LLC methodology and the insufficiency of supporting tools

The survey results indicate that there are serious gaps in the development of, and access to LCC guidelines and supporting tools in Hungary. In fact, at least 61% of the respondents are not aware of the existence of any guidelines to support the use of LCC. Only one contracting authority of the twenty respondents has participated in a training on LCC use in public procurement, and only two are aware of good examples of LCC used by other contracting authorities. (Figure 2.4)

Figure 2.4. Availability and access to LCC supporting tools

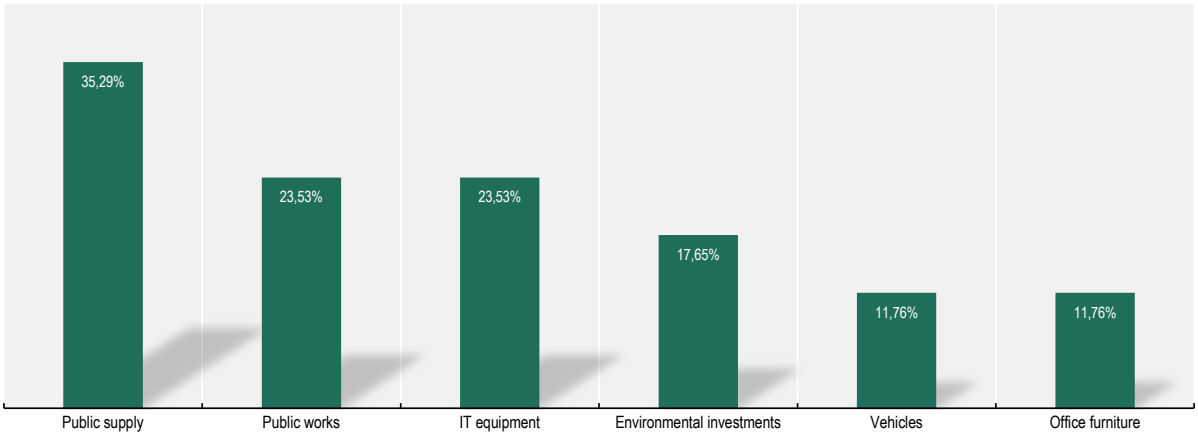


Source: OECD survey on the use of life-cycle costing (LCC) by contracting authorities in Hungary.

One of the respondents suggested that trainings on LCC should highlight its usefulness, especially for management staff. They also mentioned that the PPA does not always have a staff member who can provide them with information on a practical issue concerning LCC, and feel like they cannot rely on it due to its lack of expertise on the subject, while other respondents would like to have a list of LCC experts drawn up whom contracting authorities could involve in the preparation of the procedures as external experts.

Furthermore, the respondents believe that many purchasing categories would benefit significantly from the development of LCC tools, including vehicles, environmental investments, and office supplies, but the three most cited purchasing categories are supplies, public works, and IT equipment. (Figure 2.5) Unfortunately, some of the respondents did not indicate concrete purchasing categories, but only indicated the general subject-matter supply (“árubeszerzés” in Hungarian).

Figure 2.5. Purchasing categories that would benefit the most from the development of LCC tools



Source: OECD survey on the use of life-cycle costing (LCC) by contracting authorities in Hungary.

Unavailability of relevant data for LCC calculations

LCC methodology involves collecting and entering the data, which is needed in order to perform cost breakdowns, calculation and comparison. Contracting authorities in Hungary, however, mentioned that the needed data is either unavailable or not easily accessible. While not many details were provided by the respondents, it seems that having access to databases that would provide benchmarks for the calculation of costs is a real challenge in Hungary.

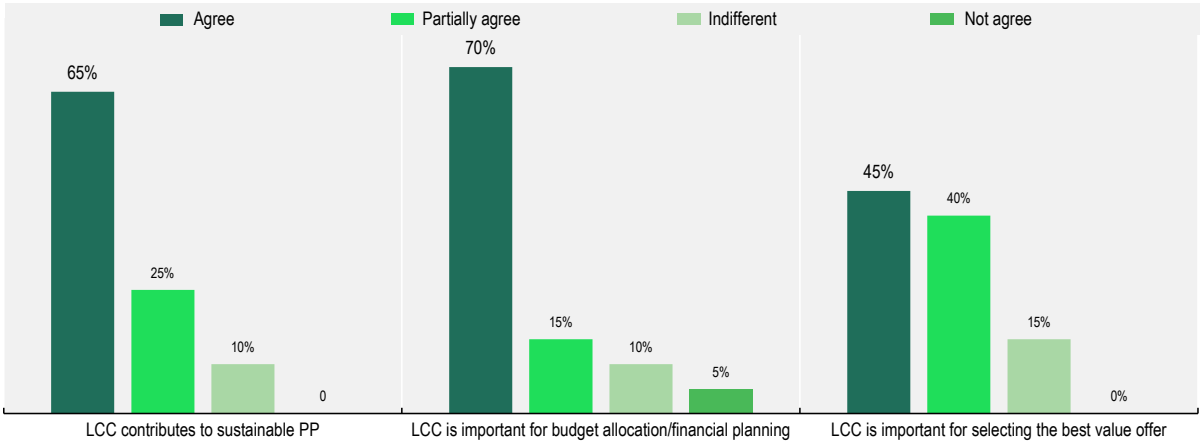
Fear of audits risks

35% of the respondents do not apply LCC because they have concerns that auditing institutions will be critical of the way LCC is used. Contracting authorities are under pressure to demonstrate that tax payers' money is being well spent and tend to choose the best value for money at the time of the purchase rather than using LCC, which may involve larger capital outlays that will be compensated by reduced operating and maintenance cost as well as avoided environmental risks across the project/product life cycle.

A weak appreciation of the benefits of using LCC in public procurement

The low uptake of LCC methodology in Hungary in also due to a lack of general appreciation of the importance of LCC in the public procurement process. The survey results reveal that all the respondents do not yet perceive the benefits of using LCC in their public procurement. The fact that LCC can serve as a cost-effective tool to achieve an optimum use of public funds and sustainable public procurement needs to be emphasised in future tools (Figure 2.6).

Figure 2.6. The appreciation of the benefits of using LCC in public procurement



Key takeaways from the Survey

- LCC tools should be developed and existing guidelines and good practices should be widely promoted. LCC tools and guidance should be as simple as possible, and explain that the application of LCC is not more difficult than the application of other award criteria.
- Capacity buildings activities such as trainings, providing tips on practical use of LCC in public procurement and sharing real life examples are very important to overcome the initial difficulties and complexities of applying LCC.
- A general appreciation for LCC is essential if the public procurement mindset is to shift from focusing solely on financial returns to considering wider socio-economic and environmental gains across the project/product life cycle, which can be assessed by using LCC.

Other sources (discussions with other stakeholders and procurement practitioners, reports by international organisations and practice of national institutions) also re-affirm the survey's findings in terms of the main challenges in the greater uptake of GPP in general, and specifically in terms of the use of LCC. Practitioners for example confirmed that Hungarian contracting authorities focus almost exclusively on the initial purchasing price, and do not consider any other cost elements in their evaluation framework. In addition, contracting authorities have the perception that green products are more expensive than "traditional" goods, and the higher initial costs and tight budgets, often applied through a single year perspective, provide a constraint to purchasing sustainable products. Additionally, like in many other OECD countries, different budget ownership and appropriation throughout the procurement cycle make it difficult to apply a uniform approach for the procurement procedure. Finally, for contracting authorities, the use of LCC is perceived as a significant audit risk, which they want to avoid.

Practitioners therefore stressed that only the mandatory application of LCC could accelerate the greater uptake of LCC in public procurement procedures. Currently, procurement officers, even with high level sustainability ambitions, do not receive support for the use of LCC neither from the leadership in their organisation nor other departments, units involved in the preparation of the public procurement procedures. However, if there is an obligation defined in the legal framework to use LCC either in the preparatory stage of the public procurement procedure or as part of the evaluation framework as an award criteria, contracting authorities will use it as they want to comply with the legislation. Gradual introduction of this obligation could even help to build up the capacity of contracting authorities and special LCC experts. However, the mandatory application would require clear, robust and legally secure methodology.

Practitioners also highlighted that sharing real life examples on the use of LCC would be a great help. However, these good examples could only help if all the details of the public procurement procedure (e.g. technical specification, the comprehensive evaluation framework) and the contract implementation are available and not only a summary of two-three pages.

The European Commission 2020 Country Report also highlighted, that in practice, the integration of environmental and social policy goals into public procurement process, including supplier qualification, technical specifications, award criteria and contract conditions remains a challenge for contracting authorities[19]. The European Commission's audits also show that the use of strategic criteria often leads to issues concerning compliance with competition and equal treatment principles. The European Commission emphasises that raising awareness through training and guidance materials on the use of quality-based criteria in tender selection is essential for ensuring that contracting authorities, especially at the local level, are able to use public procurement correctly and as a strategic tool for sustainable development.

The Hungarian Government is also aware of the low uptake of sustainable public procurement (SPP), as it pointed out clearly in its 2021 Monitoring Report submitted to the European Commission[20]. The PMO

regularly analyses the experience of its control activities in terms of public procurement procedures, and identifies the key challenges of setting up SPP criteria. The lack of knowledge and the risk-averse behaviour of contracting authorities have also been listed as the main obstacles to SPP. This reluctance regarding the use of social and green aspects is more tangible in the case of EU-funded projects due to the strict and overly restricting approach of audits carried out for EU-funded public procurements in terms of the appropriate use of green and social aspects as award criteria or special conditions for the contract performance. As a result, contracting authorities tend to keep their procurement procedure "simple". In addition, among the contracting authorities persists the misconception that the application of SPP aspects is complicated and contributes to lengthy procedures and increased prices.

These findings echo what the OECD also found in terms of innovation enhancing public procurement in 2017 in Hungary. The OECD report highlighted that public organisations tend to stick to old routines and are very distrustful of new procurement processes[21]. This attitude has not really changed in the recent years.

The 2021 Monitoring Report also stressed that public procurement practitioners and contracting authorities do not pay enough attention and time to the preparation and planning of public procurement procedures. The lack of proper preparation results in various problems, such as the technical specification and other requirements do not respond properly to the exact needs of the contracting authority and/or do not reflect the realities of the market.

Adding one additional challenge to the above, the PPA highlights the limited capabilities of the potential users in applying the existing LCC tools, emphasising the relevance of developing simple LCC tools with detailed guidance for their use, accompanied by sufficient training and capacity building activities in order to address the issue. Training programmes should include however, not only contracting authorities' staff members, but also the business sector as well as control and monitoring bodies' staff members.

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17 https://procuraplus.org/fileadmin/user_upload/Activities_files/Events/Rome_2016/LCC_Group/ildiko-czegledi-lcc-water.pdf

18 The survey has been prepared in English and translated to Hungarian (by the Hungarian Public Procurement Authority with quality review by the Prime Minister's Office) to gain wider participation. It has been published on the website of the Hungarian Public Procurement Authority on the 19th of November 2021. The deadline set for responding to the survey was the 15th of December 2021 that was extended until 15th January 2022. The survey was promoted by the PPA and the Prime Minister's Office at different conferences, events

19 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020SC0516&from=EN; page 43

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3. Mapping life-cycle costing tools and practices

This chapter presents a mapping of available life-cycle costing (LCC) tools and methodologies, providing insights into the approaches EU and OECD countries and organisations have taken towards LCC, focusing on LCC calculation methodologies, cost parameters, and features of the tools. It also presents a deep-dive comparative analysis of selected tools and extract essential user-friendly features of common LCC tools to support the development process of LCC tools in Hungary. Finally, this chapter describes the uptake of LCC use based on practical experience from contracting authorities and policymakers, highlights the challenges and draws recommendations for a way forward to improve the uptake of this practice.

3.1. Mapping of available tools and methodologies to support the use of LCC

Calculating LCC is a complex endeavour, as it requires setting parameters based on realistic assumptions about potential future costs, such as energy prices, reparation and maintenance needs, or usage time. To support the uptake of LCC approaches in the procurement process, countries have developed so-called LCC tools. These tools provide a structured framework in which relevant costs of specific purchasing categories are pre-defined and can be assessed. With the support of these tools, practitioners can easily compare the LCC of various products.

Mapping available LCC tools provides insights into the approaches countries and organisations have taken with LCC, and allows building on the existing knowledge base for future development of LCC tools. In particular, the mapping exercise allows a structured comparison of LCC tools based on several dimensions, such as calculation methodologies, cost parameters, features of LCC tools, etc. As such, the analysis aims at systematically reviewing key characteristics of LCC tools, with a view to identifying elements and features that make tools most user-friendly and effective to use. The mapping exercise is complemented by input from fact-finding meetings with stakeholders that have been involved in the development process of LCC tools, or are currently responsible for advancing LCC use in procurement. While the mapping exercise focuses primarily on LCC tools, other relevant tools are also part of the analysis, as there are often links between various types of tools that broadly support GPP objectives (e.g. LCA tools or similar).

This chapter is structured as follows: first, a mapping of available LCC tools in EU and OECD countries based on desktop research is conducted; second, a deep-dive comparative analysis of selected tools is presented. Finally, the last section describes the uptake of LCC use based on practical experience from contracting authorities and policymakers.

3.1.1. Availability of LCC tools in the broader GPP policy context

To understand the development of LCC tools, it is important to consider the broader context of GPP policy. As such, the mapping exercise also takes into account several policy dimensions, in addition to identifying LCC tools. In particular, information was collected on whether countries have introduced a strategy dedicated to GPP or Sustainable Public Procurement (SPP), and whether guidance for SPP/GPP is available, as well as whether dedicated guidance for LCC has been developed in the countries analysed (Table 3.2).

Based on a sample of 33 countries covering EU and OECD countries[1], it emerged that SPP/GPP is broadly anchored in the strategic policy framework of many countries with close to 75% of them having introduced a dedicated strategy on GPP/SPP. In the EU, as of December 2021, 85% of EU Member States have adopted a Green Public Procurement (GPP) National Action Plan (NAP) or an equivalent document[2]. Estonia, Luxembourg, Romania and Hungary are the four remaining States with no existing NAP.

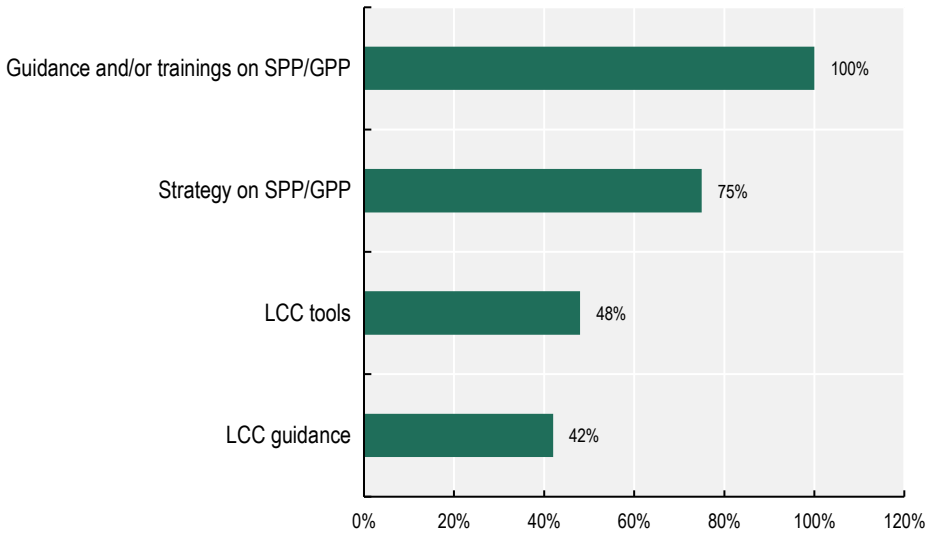
Furthermore, it emerged that all countries (100%) have introduced guidance on SPP/GPP. For the purpose of this exercise, guidance has been defined broadly. Namely, it may include a vast array of support instruments for contracting authorities, such as GPP criteria, competence centre on sustainability and green procurement, guidance documents, etc.

Activities addressing GPP are present in every EU Member States, even when a National Action Plan is not yet adopted. For example, Luxembourg does not have a GPP NAP in place but it does have GPP guidelines for sustainable construction works and use of construction products, as well as procurement trainings including environmental aspects. Indeed, every EU Member States engaging in Green Public Procurement has developed some kind of capacity building activities such as trainings, conferences and seminars dedicated to contracting authorities, decision-makers, representatives of business and suppliers. None of them indicated having nothing in place. These activities can be organised periodically or

permanently depending on the country, and focus on general information about GPP, on how to use GPP criteria, and offer practical guidance on green and sustainable public procurement. Some Member States are very proactive regarding GPP trainings: Malta has set up a permanent training programme for procurers and business entities, Croatia has held 60 specialised training programmes in 2015 attended by 1033 participants, and Latvia organised 29 seminars over five years to train over 1600 procurement professionals. Other Member States (44%) have also set up helpdesks and have specific websites on GPP through which requests can be handled, as well as dedicated webpage to "frequently asked questions", while others focus on developing guidelines and manuals (51%). Special awards on GPP can also be granted for good practice in some countries, such as Germany and Cyprus[3] (European Commission, 2021[1]).

Furthermore, LCC-tools are also relatively wide-spread. In 42% of countries of out the sample (37% of EU Member States) have adopted LCC guidance, and 48% (40% in the EU) have developed general and/or products-specific LCC tools. For example, Denmark has developed LCC tools and guidance for 13 different products groups, which are being updated with a module calculating the end-of-use phase. It seems that indoor and outdoor lighting is the major area where specific LCC tools have been developed across EU Member States. While some Member States have developed LCC guidance and supporting tools, some of them have sometimes developed only LCC guidance without supporting tools, or LCC supporting tools without guidance. Croatia does not have LCC guidance on national level, but their GPP NAP contains an overview of several LCC tools and guides as well as a recommendation for the use of SMART SPP application. France does not have LCC tools but has settled a Joint task force aiming at establishing precise criteria for LCC (European Commission, 2021[6]).

Figure 3.1. Trends in GPP



3.1.2. Approaches to LCC calculations

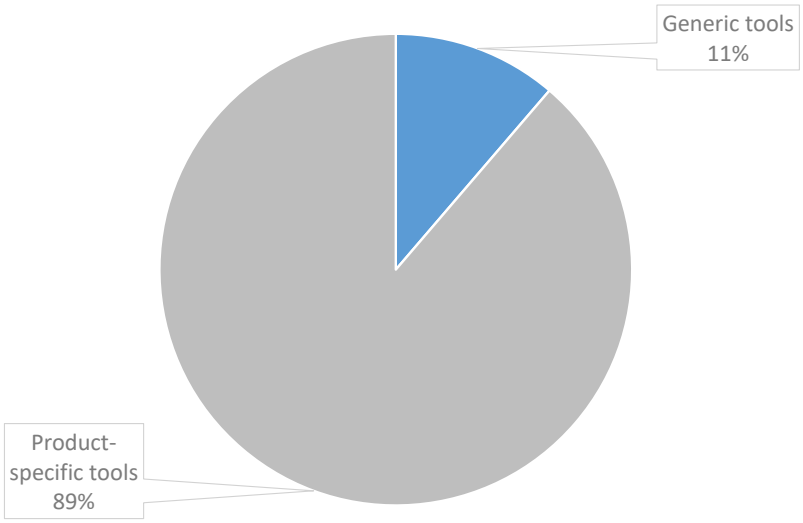
As highlighted by conversations with stakeholders and practitioners, the approach towards the LCC calculations varies notably among countries. A number of underlying assumptions are broadly shared among stakeholders. These include the need to educate public buyers on LCC and its use in public procurement, the relevance of private sector's and research entities' input in the development of ready-to-use tools or other solutions for practitioners, the importance of availability and reliability of data used in the available tools. However, the approaches towards incorporating LCC in public procurement practice diverge. Most countries choose to apply 'ready-to-use' LCC tools, usually in a form of a spreadsheet (Excel

being the most common format), that contain the main costs categories, explanation of the methodology used, reference data, sometimes – the visualisations of the results for an easier comparison of the tenders. Such tools are typically developed either by the body responsible for public procurement or by the environmental protection body, and made available to procurers free of charge.

'Ready-to-use' LCC tools are typically designed to assess the life-cycle costs of a specific purchasing category. This allows to best tailor parameters with relevant cost categories (e.g. need for insurance, particular maintenance, etc.), and simplify the LCC calculation for procurement practitioners. Nevertheless, so-called 'generic' LCC-tools exist, too. These tools can be applied to any purchasing category, and contain the main parameters for LCC calculations, e.g. acquisition price, energy-consumption, installation, maintenance and repair, and disposal costs. When applying these tools, procurers need to adapt the main parameters to the specific purchase at hand. Based on the sample of tools analysed, product-specific tools account for 89% of tools, while generic tools account for 11% of the total (Figure 3.2). This indicates an overall strong preference for product-specific tools.

In some instances, 'ready-to-use' LCC tools may bring a specific environmental focus to the analysis, as it is the case for the tool developed by the Austrian federal railway company ÖBB (see Box 3.1).

Figure 3.2. Generic vs. product-specific tools

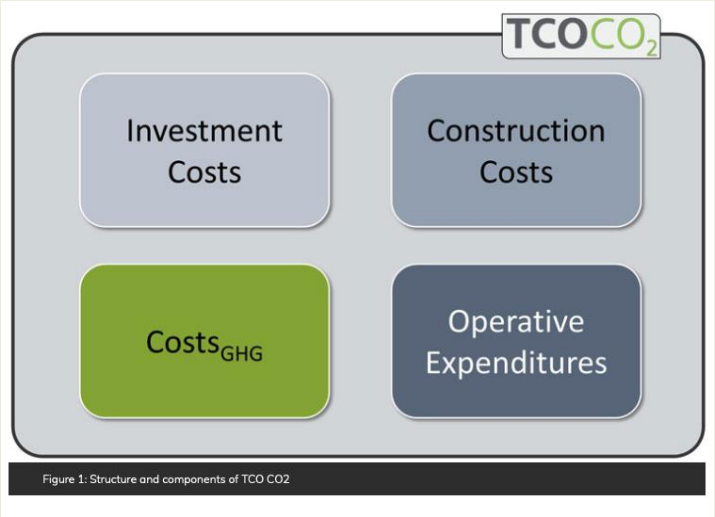


Box 3.1. Austria: ÖBB TCO-LCC tool

The Austrian federal railway company, ÖBB, has recently developed an LCC tool: the TCO CO_2 calculator. ÖBB partnered with the Technical University of Graz to integrate externalities generated by CO2 emissions in its LCC calculation tool.

TCO CO2 calculator is Europe's first well-founded calculation model for the selection of the best bidder by Ecological, Sustainable TCO Evaluation. It is an extension of the Total Costs of Ownership (TCO) calculation already used by the company. It enables a product-specific calculation of the environmental impacts caused by the production, construction and use phase in the context of public procurement. These environmental impacts are monetised and integrated into the Total Costs of Ownership (TCO). This results in a direct inclusion in the tendering process. The aim of the TCO CO_2 project is to develop

a model that calculates the offer-specific environmental impacts in production, construction and operation. The existing TCO methodology is thus extended to include the costs caused by environmental impacts ($Costs_{GHG}$).



Source: Austrian federal railway company, ÖBB

The TCO-CO2 calculator estimates the costs of GHG emissions, and requires the following data:

- Production: The bidder can either use data for energy consumption and GHG- emissions from an EPD or offer data on the energy consumption of production and the weight of the most relevant materials in the product (in terms of weight);
- Transport and construction: The bidder has to offer data on distances, means of transport and weight of the construction material as well as data on the transportation of construction workers;
- Use phase: The bidder has to offer data on energy consumption and maintenance.

The calculator adds the GHG-emissions from the different phases and multiplies them with a monetisation factor, which is currently 20 Euro/t CO2eq monetary value of the sum of GHG-emissions.

Source: (Landgraf and Schirmer, 2021[2])

Other countries opt for more sophisticated approaches, such as software-based solutions combined with underlying databases, and even supporting governance structures. These solutions typically focus on environmental impacts, as opposed to life-cycle costs. As an example, the Netherlands developed the so-called DuboCalc calculation tool that assesses environmental impacts of works in the civil engineering sector. Specifically, it produces an Environmental Cost Indicator (ECI) value based on project data, allowing contracting authorities to select the tender with the lowest environmental impact. The DuboCalc software builds on environmental impact data that is regularly included in the National Environmental Database (*Nationale Milieudatabase*[4]).

In Belgium, a similar approach was taken. In fact, a Life Cycle Impact Assessment (LCIA) enabled with the so-called Totem-building tool[5] is the closest to an LCC-approach used in procurement. This tool is developed, maintained and used by regional governments in Belgium, i.e. the Government of Flanders, Service Public de Wallonie and the Brussels Capital Region. The tool aggregates the environmental impacts of a building design during its entire life cycle. The tool calculates the impact of a building design per environmental indicator, such as climate change, eco-toxicity, depletion of abiotic resources, etc. It

also calculates an aggregated score expressed in 'environmental millipoints per square meter Gross Floor area' of the building.

Beyond traditional LCC/LCA tools, other tools support green procurement more broadly, though strictly speaking they are not considered LCC tools, as they do not monetise environmental impacts. For instance, the CO2 Performance Ladder is a well-established tool in the Netherlands, whereby suppliers commit to reduce their CO2 emissions through an environmental management system. The CO2 Performance Ladder is often used in combination with DuboCalc by Dutch contracting authorities, such as the Department of Public Works of the Ministry of Infrastructure and the Environment (*Rijkswaterstaat*) (Box 3.2).

Box 3.2. Practices in the Netherlands: DuboCalc and the Co2 Performance Ladder

Use of DuboCalc by Rijkswaterstaat (LCA)

In the Netherlands, sustainable public procurement has been a longstanding policy goal, with the decision of the Dutch House of Commons to reach 100% sustainable public procurement by 2015. In response, the Department of Public Works of the Ministry of Infrastructure and the Environment (*Rijkswaterstaat*) introduced several approaches to make its procurements more sustainable, such as the calculation tool DuboCalc and the CO2 Performance Ladder.

To operationalise sustainable procurement, the software DuboCalc calculates the environmental impact of material use of infrastructure projects. The calculation is based on LCA of construction materials. It takes into account the embedded environmental impacts of materials during their lifecycle (e.g. material extraction, production, demolition and recycling). The energy consumed by the infrastructure is calculated, too.

DuboCalc calculates environmental impacts based on a system of shadow prices, which includes 17 different types of environmental impacts (e.g. CO2 emissions, land use, water use). The final result of the calculation is the Environmental Cost Indicator (ECI value). The tool is applied in works tenders that are typically based on the scheme 'Design-Build-Finance and Maintain'. Furthermore, tenders are based on functional requirements, thus giving suppliers the possibility to innovate and determine the most sustainable design. Namely, suppliers use the tool during the tender preparation and are able to test multiple designs to identify the most sustainable version, i.e. with the lowest ECI value.

DuboCalc tool is used in all major projects at *Rijkswaterstaat*, and has been progressively applied by large public entities in the Netherlands, too. Given the complexity of the tool, it is more difficult to apply by smaller entities such as municipalities. However, recently the so-called DuboCalc Light has been in used by smaller municipalities. It consists mainly of a list of materials that have a high negative environmental impacts, and are therefore excluded from the project. This simplified version of DuboCalc can be used for projects of EUR 10,000 or upwards.

An important foundation for the calculations is the underlying database, i.e. the National Environmental Database. This database includes the reference data for the environmental impacts of construction materials. It has a dedicated governance structure (National Environmental Database Foundation - NMD) that is tasked with maintaining and regularly updating the database.

CO2 Performance Ladder (GPP tool)

In the Netherlands, another important tool for including the sustainability dimension in public procurement is the CO2 Performance Ladder. The CO2 Performance Ladder is a certification system with which a tenderer can show the measures taken to limit CO2 emissions both within the company and in projects, as well as elsewhere in the supply chain. *Rijkswaterstaat* and other contracting

authorities have used it in their procurements for more than a decade. Specifically, one in ten above threshold tenders in the Netherlands make use of the CO2 Performance Ladder.

Companies are certified by the CO2 Performance Ladder by an independent Certifying Institution on a scale of 1 to 5. When implementing a CO2 management system, certified companies are required to continuously measure and reduce the CO2 emissions of their operations. Level 4 and 5 certification also requires companies to take into account CO2 emissions throughout their supply chains.

The CO2 Performance Ladder can be used in the procurement process as an award criterion. That is, suppliers certified with the CO2 Performance Ladder receive a fictional discount on their tender price, giving them an advantage in the tendering process. The higher the level of certification, the greater advantage the supplier would receive. When applying for the tender, organisations do not need to be in possession of a CO2 Performance Ladder significant, but they make the commitment to obtain one at the indicated level within one year. Alternatively tenderers can choose to apply with an ambition level for the specific project. While it originated in the rail sector and is most widely used in the infrastructure sector, it can be implemented in any other sector, too. To date, over 1,200 certificates have been issued in the Netherlands and Belgium in the procurement context.

Research demonstrates that certified organisations reduce their CO2 emissions much faster compared to uncertified organisations. Furthermore, all investigated companies certified by the Ladder have implemented a fully-fledged energy management system, which highlights the reduction of CO2 as a key business strategy.

The CO2 Performance Ladder is managed by the independent Foundation for Climate Friendly Procurement and Business (SKAO) bringing together relevant stakeholders to promote the use of the instrument.

Source: (SKAO, n.d.[3]) (SKAO, n.d.[4]) (OECD, 2015[5])

In addition to LCC/LCA practices based on tools, there are also practices of applying the LCC approach without any type of individual tools used for the task. This is the case for instance in Italy, where the central purchasing body Consip developed its own approach to introducing LCC in certain tenders, such as ICT and vehicles. The detail of the practice is described below in Box 3.3.

Box 3.3. Consip's integration of LCC in framework agreements

Italy's central-level CPB Consip developed a simplified methodology to consider LCC in some of its framework agreements, such as ICT, vehicles, printing and public lighting. The methodology consists in taking into account energy consumption of the product category combined with green criteria. The methodology is adjusted on a case-by-case basis depending on the product group.

For instance, when procuring public lighting, Consip applied criteria, which allow for the reduction of cost during the duration of service. First, the Italian GPP criteria (criteria ambientali minimi - CAM) define the threshold consumption for lamps[6]. The efficiency of the lamps is also incentivised by the better lumen to watt (LM/W) result. Second qualitative criteria were applied. Namely, the design of the lighting systems has been awarded, which provides extra points for the decomposition of each component to facilitate repair or single component replacement instead of replacing the whole system. This approach favours the lengthening of the life cycle and a significant reduction in maintenance costs by applying strategic choice of ecodesign. In this approach, the quality of the tender is determined by technology that is easy to repair. In the health sector, the cost of service, maintenance and disposal was included for the purchase of radiation appliance and medical ultrasound machines.

Furthermore, a simplified, yet effective, LCC approach was chosen for the procurement of desktop computers and monitors. The award was based solely on the lowest cost, taking into account minimum environmental and social requirements, as well as energy consumption during the duration of the contract (3 years). Suppliers were requested to provide data on the energy performance based on specific ETEC (Calculated Typical Energy Consumption) parameters defined by IEC Standard (IEC 62301:2011). An independent entity certified the ETEC energy performance. The energy performance is multiplied by the reference price of electricity, as defined by the Authority for Energy Regulation and Environment. The full cost calculation formula is included in the tender documents to ensure transparency and clarity on the rules applied during the procedure.

Source: Consip

Each option has their strengths and shortcomings, as summarised in the Table 3.1.

Table 3.1. Overview of approaches to LCC/LCA

Approach to LCC	Strengths	Weaknesses	Countries
Application of LCC methodology without specific tools	• Consideration of acquisition cost and use cost (energy consumption) • Possibility to combine the LCC requirements with environmental [minimum] performance requirements • Data used for the LCC calculations is validated by a third party	• Does not provide ready-to-use solutions for the (average) procurement official • Requires significant investment in identifying and replicating good practices	Italy
"Ready to use" LCC tools	• Model that simplifies the calculation for the buyers. It is generally easily understandable by the (average) procurement official • Presented in a widely used Excel spreadsheet format • Do not require significant investment in technical solutions, hence fairly easy to maintain	• Tool application is limited in the cases of complex projects • Oftentimes the tools do not include the externalities	European Commission, Sweden, Germany, Denmark, Belgium, Austria, Germany, Norway, New Zealand, Australia, Poland, Lithuania, Latvia, US
LCC tool with specific environmental focus	• Combines the LCC data with environmental [CO2 emissions] data for the purchased goods, services or works • Data used for the LCC calculations is provided by	• Requires environmental data requires to be publicly available • Does not provide ready-to-use solutions for specific purchases in the beginning; these have to be added over time	ÖBB (Austria)

	verified third parties (e.g. environmental agencies) • Tool is widely flexible for future demands like evaluation environmental impact of water usage, particle emissions, NOx emissions, etc • Tool requires no investment other than the training of own personnel • Tool can easily be adapted for any kind of purchase		
Tools with an environmental focus (e.g. Dubocalc, Totem)	• Strong uptake of the tools due to inclusive approach to their development and maintenance • Mostly used in sectors that have a high impact on the environment (e.g. construction of buildings, roads)	• Higher level of sophistication in terms of technical implementation of the tools in comparison to the ready-to-use spreadsheets (e.g. software-based tools, creation of relevant databases) • Higher costs for the set up and maintenance of the tools (e.g. regular updates are required in order to maintain their relevance, inter-sectoral cooperation is required in order to create relevant databases, governance structures might be needed to ensure the tool's relevance)	Netherlands, Belgium

3.1.3. Economic methodology for LCC calculations

Despite the different approaches and practical implementations of LCC tools, the economic methodology at the core of LCC calculations, namely Present value (PV) calculation, is consistent in the LCC tools analysed in detail in the following sections. The dynamic approach of future costs is a fundamental concept in all areas of economic calculations, not just in LCC. By methodological definition, **life-cycle cost is the present value of all the costs throughout the whole life-cycle**. It can be calculated with the general formula for present value calculation:

$$LCC = PV = \sum_{n} \frac{C_n}{(1+i)^n}$$

Where:

- LCC = life-cycle cost
- PV = present value of the series of costs throughout n years
- C_n = value of costs in year n
- i = discount rate
- n = number of years analysed

All of the LCC tools analysed in the following section utilize Microsoft Excel, they apply a variety of mathematically equivalent, correct formulas provided by the software for present value calculation.

Most of the analysed LCC tools consider future prices in real terms, meaning on the fixed price level of a given year, to which the "present value" applies. Though nominal approach to future costs can be valid if applied correctly (i.e. with a nominal discount rate), **in LCC calculations the real approach is preferred** over nominal approach in order to avoid distortions and decrease uncertainty of future costs due to inflation. Certainly real price changes (which exceed general inflation) are considered in calculations applying real approach, in practice, most commonly real price increase of energy and personal costs are considered. In addition, the proper application of real approach to future costs requires a real discount rate (excluding inflation).

Determination of the appropriate level of the discount rate is a complex economic exercise, which is usually out of the scope of a single LCC calculation. Accordingly, the **LCC tools typically include the discount rate** or an official reference to its suggested value. However, a few tools (e.g. SE, BG) offer more flexibility in this regard, and allow the buyer to determine its own discount rate. This practice also can be methodologically correct, but it assumes a high level of economic background knowledge and sufficient capacities of the buyer. The application of a zero discount rate also can be justifiable in practical applications as a few of the tools allow this option, especially in case of products with shorter life span. This is simply due to the mathematics of present value calculation; on a short time period, it simply has no significant effect on the outcomes. As the formula above suggests, the smaller the discount rate and the shorter the time period considered, the less significance discounting has. In a generalised sense, discounting prefers the present over the future, which time preference is expressed by the discount rate. The impact of the discount rate on the outcomes can be explored in a sensitivity analysis, as included by the Austrian tool for computers, however in most cases this is not necessary due to the official recommendations for the value of the discount rate.

Best approaches to the methodological issues above are fundamentally dependent on the characteristics of the specific purchasing category and on the purchasing situation. Certainly, LCC calculations are also embedded in the relevant legal environment of public procurements, so methodological choices on handling inflation or on the level of discount rate should comply with these. Furthermore, special regulations applying for the buyer as a public organisation or specific requirements of public funding schemes can also influence these methodological choices in practical LCC tools.

3.1.4. Purchasing categories relevant for LCC

In addition to diverging approaches on the types of tools used for LCC assessment, not all purchasing categories are equally relevant for the consideration of LCC, and related tool development. In fact, a total of 29 different product groups have been identified, for which spread-sheet based LCC tools exist (Figure 3.3). These product groups cover several purchasing areas, ranging from ICT goods, consumer goods, building and construction as well as health-related goods.

Despite the breadth of available tools, several trends emerge regarding recurring purchasing categories, across the countries analysed. In fact, similar considerations are often shared by countries when selecting purchasing categories for the development of LCC tools. This includes purchasing categories that require

high levels of energy consumption during the use time, goods/services that are quite easy to standardise and that are purchased frequently.

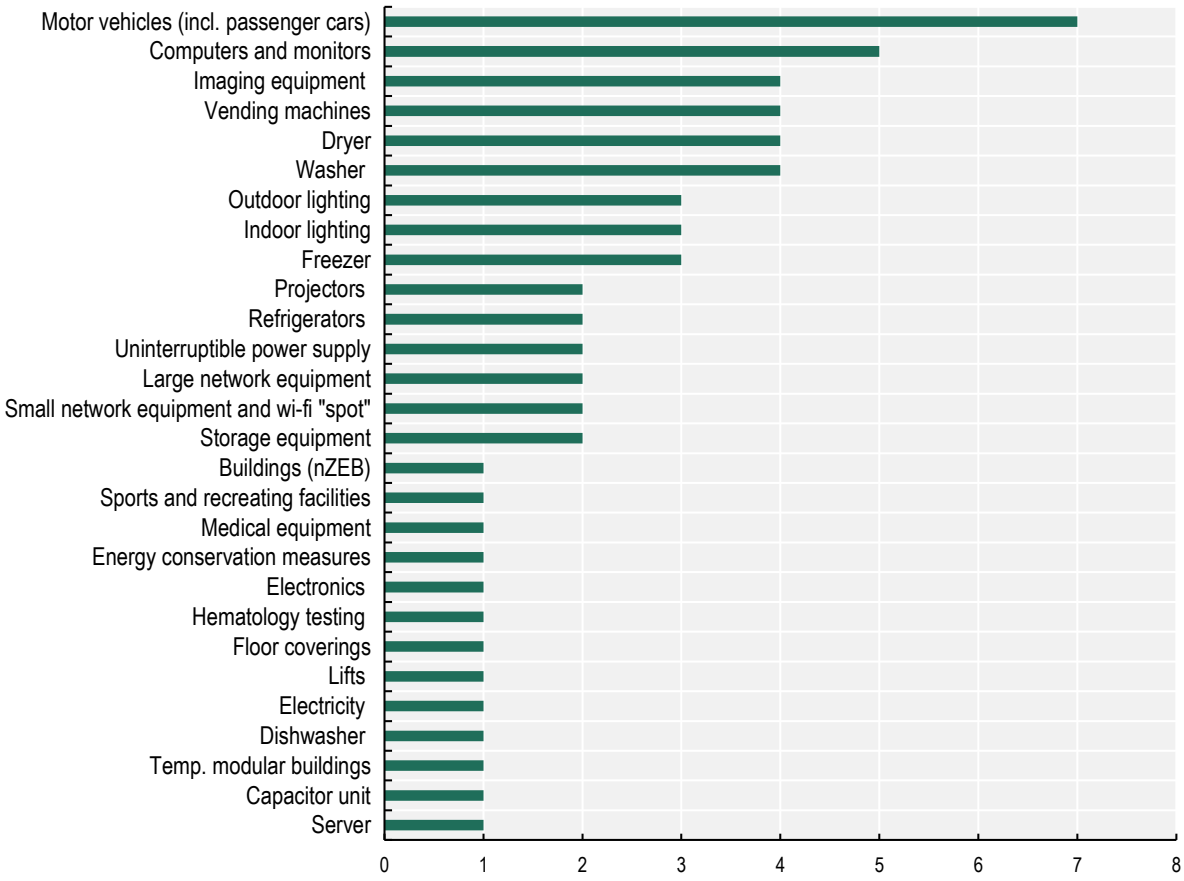
For instance, in Germany the focus for the choice of purchasing categories has been energy efficiency, as this reflected policy priorities at the time. As a starting point for LCC tool development, the German Federal Environment Agency (*Umweltbundesamt*) selected 10 products with the highest energy consumption during the use phase. A further selection was based on the frequency of purchase of these goods, as well as the purchasing volume. The final choice for LCC tool development includes computers, multi-functional machines, monitors, data centres, floor coverings, fridges, and dishwashers.

The European Commission focused its own LCC tool development on purchasing categories, for which green criteria already existed. The selection therefore includes vending machines, imaging equipment, computers and monitors, indoor lighting and outdoor lighting. The government of Flanders based its decision to develop an LCC-tool for indoor lighting on the fact that available tools did not take into account LED technologies. Finally, Denmark approaches the selection of LCC purchasing categories by consulting first with the central purchasing body SKI (*Statens og Kommunernes Indkøbsservice A/S*). This allows getting a first assessment about the level of demand for purchasing categories, and as well as getting technical product information necessary for later tool development.

Overall, the most frequent purchasing categories consist of the following:

- Office and ICT equipment;
- Outdoor lighting;
- Indoor lighting;
- Electric appliances;
- Computers and monitors;
- Imaging equipment;
- Vehicles.

Figure 3.3. Purchasing categories for LCC tools based on tool mapping



3.1.5. Mapping the climate dimension of LCC tools

The introduction of the Directive 2014/24/EU paved the way for the consideration of external environmental costs in procurement awards. As such, LCC calculations may be used as an instrument to monetise climate impacts, and thus promote goods and services with lower CO2 emissions. A series of requirements needs to apply for the calculation to comply with the EU Directives. Specifically:

- The calculation must be based on objectively verifiable and non-discriminatory criteria;
- The cost model must be accessible and free of charge for the bidder;
- Bidders must be able to provide the required data with reasonable effort (e.g. manufacturing data, data available to the bidders or subcontractors themselves);
- External data on which the bidder does not have any influence may also be used if it meets the above-listed criteria.

While several LCC tools take into account externalities related to CO2 emissions, the majority of tools focus on Total-Cost-of-Ownership, as opposed to full LCC (including externalities). As such, CO2 emissions are either not factored in the LCC tool, or they are not monetised. However, it should be noted that the TCO-CO2 developed by the ÖBB presents an exception in this regard (it does both). As reported by stakeholders, the greatest barrier to including CO2 emissions in the calculation is the lack of a consensus on an accurate CO2 price. However, once again, there is no unified approach, and countries have each taken several different approaches on whether to use LCC tools as an instrument for taking into account the climate dimension. For instance, in Italy, Consip opted for not considering CO2 emissions

(except for vehicles, in which case the EU price was used) in their LCC calculations given the broad range of different estimates available, and the lack of a nationally accepted CO2 price.

In contrast, some countries have defined a price for CO2 emissions, and are making use of it in their LCC tools. This is the case for tools developed in Denmark, in Flanders (Belgium) and by the European Commission. In the Netherlands, a commonly agreed-on price for CO2 emissions applies in DuboCalc's calculation. The CO2 prices are, however, commonly considered low, or too low to actually have an impact in the calculation.

Taking into account the difficulties in determining a price for CO2, the National Agency for Public Procurement in Sweden opted for only including the quantification of CO2 emission in kg in its LCC tools, without assigning a specific price. An overly low CO2 emission price is considered potentially counterproductive, while transparency about the quantity of emission related to a procurement may be informative for buyers. Climate goals are achieved through other policy instruments, such as GPP criteria. In Austria, similar considerations applied in developing overall GPP policy (*naBe Aktionsplan*). Namely, Austrian policymakers considered that the maturity of methodologies for monetising CO2 is not advanced enough to be used on a broad scale. As such, TCO calculations are recommended for several product groups (with dedicated tools).

Conversely, Germany has introduced a new regulation ("AVV Klima") to reduce the climate impact of public procurement. Among other aspects of the regulation, federal buyers are mandated to consider a CO2-shadow price that takes into account the emissions embedded in the various lifecycle of the product learnt (e.g. production, transportation etc.). The Federal Environment Agency (*Umweltbundesamt*) is tasked with developing new LCC tools that address such embedded emissions.

The challenges of applying LCC including externalities have important repercussion in the calculations and ultimately the choice of climate-friendly procurements. In fact, the preparatory study to support the revision of the Clean Vehicles Directive highlighted that the proposed LCC calculation of Directive 2009/33/EC ('old' Clean Vehicles Directive) with the externalities did not achieve the expected result to drive cleaner vehicles in the market[7]. Hence, the approach taken in the new Clean Vehicles Directive was revised, and no longer mandates an LCC calculation. A similar experience was shared by the city of Niort in France. It used the LCC approach and cost factors for pollution when purchasing vehicles, but cleaner ones did not have a lower overall LCC, showing that the approach of including the externalities did not help to buy a cleaner vehicle.

3.1.6. Lessons learnt from the tool development process

The tool development process is important to ensure that the final product is aligned with the needs and expectations of users. As such, potential users should be involved from the beginning, and be given many opportunities to review and test the tools before their launch. Suppliers or industry representatives also need to be given opportunities to express their views during the development process, as their input is required during the use phase of the tool.

Broadly, the tool development process follows a similar pattern throughout the countries analysed. Typically, once the decision about which specific tools has been taken, a dedicated team (either internal or outsourced) develops a first version of the tool taking into account the relevant parameters. This is draft version of the tool is shared with a wider group of stakeholders for review and testing. An updated version is finalised and made available for use. The review process generally also includes industry stakeholders. Tools that are 'non-traditional' may have a more complex set-up process, as they may require the definition of a governance structure to maintain and operate the tools (e.g. DuboCalc and the CO2 Performance Ladder). In specific instances, such as the CO2 Performance Ladder that is managed by an independent foundation, the processes of setting up such structures is supported by civil society organisations, thereby facilitating the task for government.

Several common trends and good practices emerge from discussing the tool development process with stakeholders. Some countries and institutions have formed a permanent or semi-permanent stakeholder group that informs the policy process around sustainability in public procurement, including on LCC topics. These group help in guiding the overall sustainable procurement approach, and generating buy-in for policies related to GPP and LCC. In Austria, for instance, stakeholder management is considered an important aspect of GPP policy. Namely, since 2018 a stakeholder management process was initiated as part of the revision of Austria's GPP Action Plan (*naBe Aktionsplan*). This included the relevant federal ministries, the central purchasing body, experts, and representatives of *Länder*, among others. The goal was to generate wide buy-in of the goals of GPP policy across the country (Bundesministerium für Klimaschutz Umwelt Energie Mobilität Innovation und Technologie, 2021[11]). The European Commission also consults regularly the stakeholders on GPP with a dedicated Advisory Group, which represents all member states.

While forms of stakeholder representation are often focused on GPP policy at large, they can also be leveraged for discussing the implementation of LCC and specific LCC tools. In some instances, stakeholders have expressed specific needs, such as the creation of a dedicated LCC tool for indoor lighting in Flanders that would take into account the complexity of their projects. Similarly, the EC's Advisory Group on GPP has provided feedback on LCC tools and expressed demand for the development of tools in this area.

Testing of tools is another key step of the tool development process. In Flanders, a small working group of fifteen experienced users, which included public buyers and suppliers, was gathered to test the tool. This allowed ensuring the robustness of the tool. Importantly, engaging the right stakeholders requires their identification and targeted reach out early on in the process. In Denmark, a similar approach is taken to test LCC tools. Namely, a group composed of buyers and suppliers are tasked with reviewing the first approach of the tool, to ensure that there is a broad agreement on the parameters used and the tools offer a fair comparison between products. An iterative approach is taken to reach a satisfactory result for the stakeholders involved. LCC tools developed by the European Commission underwent similar testing. Namely, an external group was set up to test the first tool (for the structure, explanations, etc.), and the feedback was used to develop the additional tools. Internal testing was conducted, too.

Regarding the working methods of tool development, it is important to consider an agile approach, i.e. proceeding in iterations, and allowing for stakeholder feedback throughout the process. This is the approach taken in Norway by the DFØ (Norwegian Government Agency for Financial Management). However, DFØ also warns of 'engagement fatigue' if stakeholders are solicited too often. Another consideration applied in Norway is the engagement of users that are generally unfamiliar with the topic to ensure that the tools are understandable for a broad population.

An important consideration to make is the choice of interface and technical support on which LCC tools run. Spreadsheet-based tools based on Excel is the most commonly used format and presents several advantages, as reported by stakeholders. Namely, the Excel software is well known and commonly used by virtually any type of users, thus limiting the requirements for training on the software itself. Furthermore, Excel allows for transparency and potential adaptation of the calculation. This is an important factor to increase trust in the tool, as well as providing flexibility to users. While Excel is the format of choice of most LCC tool developers, it may not be the most suitable instrument in case the complexity of the calculation is very high (e.g. types calculations performed by DuboCalc).

Finally, stakeholders stressed that a consistent visual identity of LCC tools matters for recognition and ease of use.

3.2. Comparative analysis of selected spreadsheet-based LCC tools

The second part of the mapping of existing LCC tools consisted in a deep-dive comparative analysis on a selected number of product-specific LCC tools. The aim of this assessment is to extract essential user-friendly features of common LCC tools to support the development process of LCC tools in Hungary. As such, the analysis focused on two key elements:

1. first, elements pertinent to the LCC calculation as such (e.g. basic parameters, cost categories identified, reference data within the tools);
2. second, consideration of other features related to the "look and feel" of the tools (e.g. availability of guidance, user-friendliness, visualisation features).

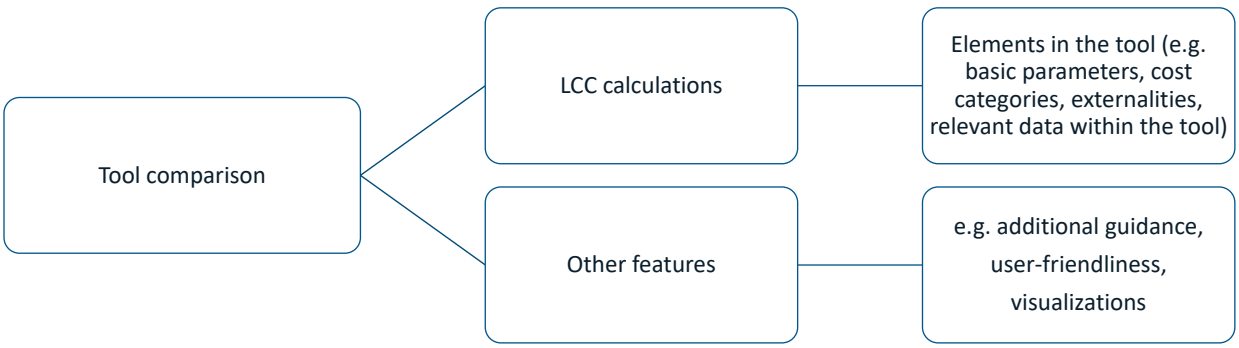
To extract comparable results, the analysis focused on a selected number of common purchasing categories, i.e. computers and monitors, indoor lighting, outdoor lighting, imaging equipment, vending machines and vehicles. This allowed to compare several tools for each of these categories, and analysing a variety of spreadsheet-based tools.

Table 3.2. Tools analysed

	European Commission	Denmark	Germany	Austria	Flanders	Sweden
Computers and monitors	√	√		√		
Indoor lighting	√				√	√
Outdoor lighting	√					√
Imaging equipment	√	√	√			
Vending machines	√	√				√
Vehicles	√	√				√

Note: Austria's tool for the TCO-calculation for computers and monitors was available on the old website of the naBe Aktionsplan (until the beginning of 2021). Since June 2021, there is a new website (www.nabe.gv.at) where tools are offered for those product groups where the naBe-Aktionsplan recommends the TCO-calculation. TCO-tools are made available from the SPP Smart project (https://www.smart-spp.eu/index.php?id=6988). The European Commission tool for vehicles is the Clean Fleets LCC Tool, https://clean-fleets.eu/home/

Figure 3.4. Elements of the analysis



3.2.1. Findings

Overall, findings suggest that there is a lack of homogeneity among tools, despite the fact that tools related to the same purchasing categories were compared. Namely, cost parameters that are taken into account may vary across different tool. The calculation of consumption patterns may also vary. For instance, maintenance for imaging equipment tools is calculated on the basis of estimated cost of spare parts in one tool, while it is estimated as the time and hourly wage for maintenance in a different tool.

Finding the balance between simplicity and accuracy

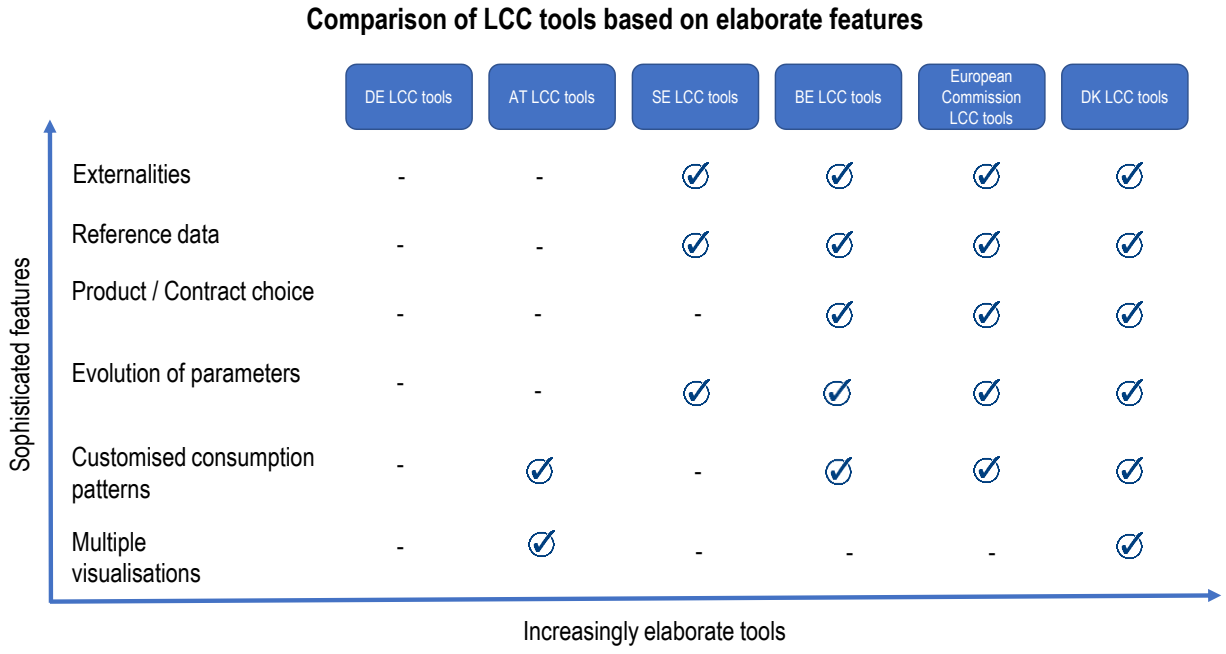
As an overarching observation, it is possible to distinguish amongst tools based on the level of sophistication. Some tools have a very simple interface and include only basic parameters for calculation, while other tools can be considered more elaborate. For instance, elaborate tools may include calculation parameters related to externalities (e.g. CO2 emissions) or allow for a more granular definition of operational costs, which may take into account customised consumption patterns. The possibility to customise consumption patterns could consist for instance in defining how long a computer is used in several types of modes (on, off, sleep) instead of using standardised assumptions.

Some of the tools analysed also provide users with reference data for some of the calculation parameters, such as e.g. a recommended discount rate. Not all tools include such reference data, and the type of available reference data also differs from tool to tool, as further detailed below. A number of tools also account for the evolution of parameters, such as the increase of electricity prices or similar. Typically, the user is able to select the estimated increase in percentage. In some cases, this is part of reference data.

In some instances, elaborate tools allow to choose the contract type (choice of acquisition of a product or a service) or further distinguish between the product categories within one tool. As an example, in the category of computers, some tools allow a more specific product choice, such as laptop or desktop. Modalities for visualisation of results can be more extensive in some tools compared to others.

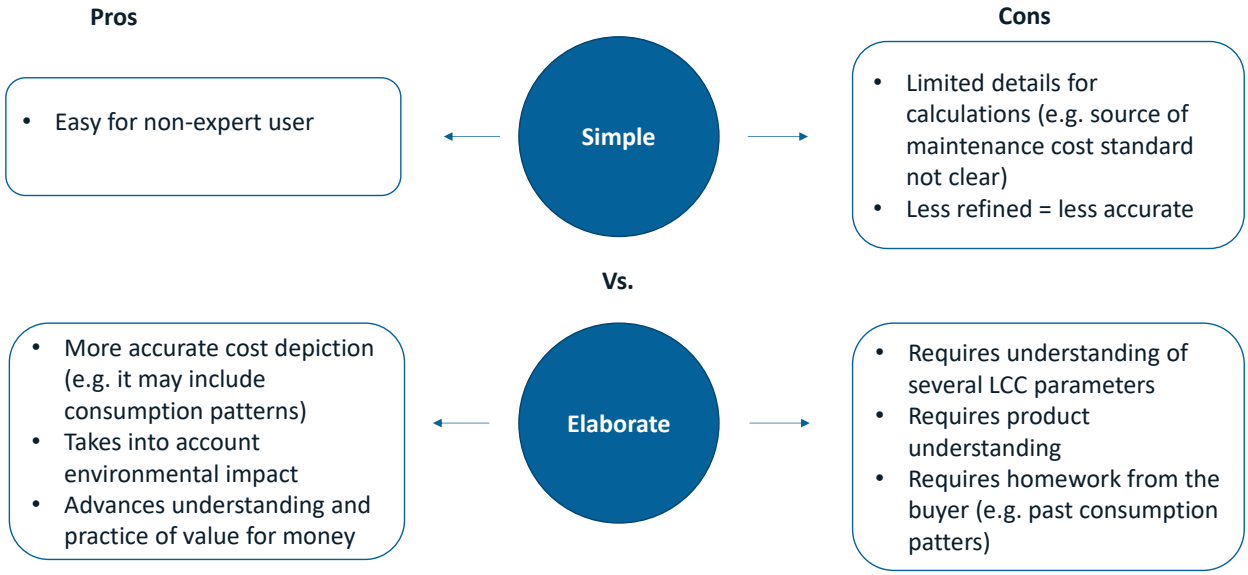
The Figure 3.5 below provides an overview of features that are considered more sophisticated.

Figure 3.5. Increasing sophistication and complexity of LCC



While elaborate tools are considered more accurate in depicting LCC tools, there are advantages in keeping tools as simple as possible, notably to allow for use by non-expert users. In discussions with stakeholders, it generally emerges that LCC tools are sufficiently easy to be understood by procurement practitioners, albeit with some training requirements. However, the ease of use is often not the only obstacle to applying an LCC calculation tool. The barriers to LCC use are further discussed in the section on 'Key takeaways'.

Figure 3.6. Pros and cons of simple vs. elaborate tools



Externalities

The inclusion of externalities remains one of the most challenging elements in developing LCC tools. Whenever tools take into account externalities, these are for the most part indirect emissions generated by the electricity consumption of a certain product or service. Even when such costs are included, discussions with stakeholders underscored the difficulty in pricing relevant aspects. For instance, depending on studies, the monetisation of CO2 emission equivalents may range from EUR 20-30 to EUR 650.

Beyond indirect CO2 emissions related to electricity, only very few tools take into account other types of externalities such as embedded emissions or direct emissions from product use. Currently, such types of emissions are taken into account for the LCC tool dedicated to indoor lighting developed in Flanders. The table below summarises what types of externalities are taken into account in the tools analysed.

Table 3.3. Externalities considered in LCC tools

Product group	Externalities considered
Computers and monitors	Indirect CO2 emissions (electricity)
Indoor lighting	Embedded emissions from production stage, construction process, end-of-life stage Indirect CO2 emissions (electricity)
Outdoor lighting	Indirect CO2 emissions (electricity)
Imaging equipment	Indirect CO2 emissions (electricity)
Vending machines	Indirect CO2 emissions (electricity)
Vehicles	Direct emissions CO2 (fuel consumption) Direct pollutant emissions (NO_x, Particular Matter, NMHC)

Consumption patterns (operational costs)

Tools also differentiate themselves regarding how the contracting authority's consumption of resources is taken into account during the use phase of the product, i.e. the estimate of operational costs. The resources taken into account in the consumption patterns vary depending on the product group. While energy consumption is relevant for all product groups, other specific resources apply depending on the product categories, such as water consumptions in the case of vending machines, or toner for imaging equipment.

Estimating consumption typically requires the contracting authority to specify its needs, though the input required to define the needs (i.e. operational costs) may vary from tool to tool. For instance, in one of the LCC calculators for imaging equipment, the contracting authority is requested to specify the number of pages to be printed in black and in colour. In a similar tool for a printing machine, the calculation of operational costs is based on the average number of hours in 'ready', 'sleep' or 'off' mode and corresponding energy consumption per mode.

Similarly, to calculate the energy consumption of PCs and monitors, contracting authorities may be required to detail the number of hours in each power consumption mode (e.g. on, off, sleep). Alternatively, labels or standards provide pre-defined data for such consumption patterns. For computers, for instance, the Energy Star defines standard times in different power modes.

Table 3.4. Definition of consumption (operational costs)

	Tool 1	Tool 2	Tool 3
Computers and monitors	Energy consumption in: - 4 modes for computers (off, sleep, long-idle, short-idle) - 2 modes for monitors (on, off)	Power consumption in 3 modes (on, off, standby)	Power consumption in 3 modes (on, off, standby)
Indoor lighting	Energy consumption Area to be illuminated (sq/m) Operating hours (in different modes)	Operating hours (all attributed to calculation conditions) Area to be illuminated (sq/m)(attributed in basic description in the original tool) Power per lum (attributed to info from tenderer) Type of control Reduction (of operating time) factor	Building information (floor, room name, surface, number of lighting points, occupancy, function) Control system (Daylight entry detection, size area, presence detection, uniformity, maintenance factor, unified glare rating, level working surface, level lighting unit, reduction factor) Energy use: - Daily use (operating hours) - Number of days per year in use - Annual use (operating hours)
Outdoor lighting	Energy consumption: Area to be illuminated Operating hours (in different modes) Energy consumption in 2 modes (full/reduced power)	Operating time (h/year) Operating time in 2 modes (full effect, reduced (2 levels)) Power per lum Reduced power level (2 levels)	N/A
Imaging equipment	Estimated number of prints Estimated cost of toner	Consumption of units Length of service contract period (if applicable) Length of leasing period (if applicable)	Average number of hours in 'ready' mode Average number of hours in 'sleep' mode Average number of hours in 'off' mode Power consumption in operational state Power consumption in sleep state Power consumption in off state
Vending machines	Water price Water annual price increase Estimated use of products (that are sold, also cups) Estimated litres of drinks	Machine capacity (litres) Length of service contract period (if applicable) Length of leasing period (if applicable)	Annual use Annual energy price change (optional)

Vehicles	Annual fuel consumption (depending on fuel type, fuel price, possibility for dual fuel)	Annual mileage per motor vehicle For electric vehicles: Charging subscription	Annual mileage per vehicle

Reference data

The calculations of LCC may be simplified by the availability of so-called reference data. In most cases, reference data is suggested to procurers to simplify the task of applying LCC tools. Other reference data can be embedded in the calculations of the tool. The buyer is given the option to select the reference data available or pick a different parameter.

Table 3.5. Types of reference data available

	Tool 1 (EC)	Tool 2 (DK)	Tool 3 (SE)	Tool 4 (BE)
Computers and monitors	• Currency • LCC evaluation period (suggested) • Discount rate (suggested) • Electricity grid mix CO2eq emissions for EU countries • Cost of CO2 (suggested) • Time use profile in operation modes as defined by the Energy Star	• Evaluation period • Discount rate • Standard electricity price • Standard increase in electricity prices • Standard CO2 emission factor for electricity consumption	N/A	N/A
Indoor lighting	• Currency • Electricity grid mix CO2eq emissions for EU countries • Discount rate (suggested) • LCC evaluation period (suggested)	N/A	• Discount rate • Reference data for calculating the climate impact from electricity use - Swedish electricity mix - Nordic electricity mix - Electricity of unknown origin • EU (25) electricity	• LCC evaluation period (suggested) • Discount rate (suggested) • Table materials: - Rated wattage of lighting system - Rated lumen of lighting system - Useful lifetime - Useful lifetimeLx - Useful lifetimeBy - Driver type - Separate replacement of driver possible - Driver failure rate - Embedded emissions from production Stage (A1-A3) - Embedded emissions from construction process stage (A4-A5) - Embedded emissions from end-of-life stage (C1-C4) - User
Outdoor lighting	• Currency • Electricity grid mix CO2eq emissions	N/A	• Discount rate • Reference data for calculating the	N/A

	• CO2 externality cost • Provided AECI of the installation • Discount rate (suggested) • LCC evaluation period (suggested)		climate impact from electricity use - Swedish electricity mix - Nordic electricity mix - Electricity of unknown origin - EU (25) electricity	
Imaging equipment	• Currency • Electricity grid mix CO2-eq emissions • CO2 externality cost	• Evaluation period • Standard electricity price • Standard electricity price increase • Discount rate • Standard CO2 emissions factor • Standard cost of CO2 externality	N/A	N/A
Vending machines	• Currency • Electricity grid mix CO2-eq emissions • CO2 externality cost	• Standard CO2 emission factor for electricity consumption • CO2 externality cost • Evaluation period (suggested) • Standard electricity price • Standard increase in electricity prices (annually, in addition to inflation) • Discount rate	• Discount rate • Reference data for calculating the climate impact from electricity use - Swedish electricity mix - Nordic electricity mix - Electricity of unknown origin - EU (25) electricity	N/A
Vehicles	• Cost of emissions (NOx, PM, NMHC, CO2) • Fuel price increase (Default OECD FAO values)	• Evaluation period (suggested) • Discount rate (suggested) • Standard price increase rate for fuel • Standard price for fuel (Tax Council Rate) For hybrid plug-in: • Evaluation period (same as the service agreement period, cf. the requirements specification) • Electricity price • Electricity price increase (annually, in addition to inflation) • Discount rate • Life expectancy for charging stations (possibly charging boxes)	No reference data available	N/A

User-friendly features

The user-friendliness of tools is an essential aspect for their uptake and practical use. As discussed earlier in this chapter, user-friendliness often consists in finding a balance between a simple approach to the calculations, while maintaining sufficient accuracy. Beyond these elements, the structured comparison of LCC tools and conversations with stakeholders allowed identifying several features that contribute to user-friendliness of tools:

- **Clear distinction on the input to be provided by the buyer and the supplier**: If LCC tools are meant to be used in a procurement procedure, it should be very clear to the contracting authority, which data and input it needs to request from suppliers, and which input it has to provide itself. Some tools, such as LCC tools in Sweden, have been revised to take into account this aspect.
- **Transparency in the calculation**: It is essential that procurers trust the LCC calculation. This implies introducing transparency about the formulas used, and providing explanations about the methodology in the tool, including a definition of all parameters used.
- **Guidance on using the tool embedded in the tool itself**: A number of tools (e.g. Denmark, European Commission) have embedded guidance to simplify the use of LCC tools. This can take the form of comments that appear when hovering over a cell. Such feature is very practical, as it gives an immediate explanation of the parameter at hand. Reference data may also be embedded in this manner.
- **Availability of reference data:** As discussed in this chapter, reference data is a key element to simplify the use of LCC tools for public buyers, as it diminishes the work for contracting authorities.
- **Visualisation of results**: The visual representation of results provides a simple and effective modality of transmitting key information.
- **Appropriate support tools**: Spreadsheet-tools such as Excel provide several advantages as the format for LCC tools, such as transparency and adaptability. In case calculations are too heavy for an Excel-file, however, other software formats should be adopted to avoid overly slow processing times.
- **Basic explanations of investment calculations**: It is important to provide key explanation of the concepts that lie behind LCC calculations and related methodologies (e.g. LCA). A simple webpage with such explanations on economical calculation has proven to be very popular with users in Sweden.
- **Means of proof of input data**: When applicable, appropriate measurement methods of input data should be defined to prevent the risk of litigation and determine an unequivocal evaluation of the best offer.

3.3. Key takeaways

This section draws on the analysis of LCC tools, fact-finding discussions with stakeholders as well as the survey of Hungarian contracting authorities to draw conclusions about the current use of LCC, challenges and recommendations for a way forward to improve the uptake of this practice.

3.3.1. LCC adoption remains low across many countries, even when there is commitment to GPP

Overall, based on the evidence gathered, broad LCC uptake during the procurement process appears to be limited, in particular for goods and services. Importantly, the adoption of LCC remains low even when there is an overall policy commitment to GPP and sustainability at country level. In fact, most countries in

the EU have adopted a national strategy or action plan to advance GPP practices and take several actions to move forward on this agenda.

Nordic countries traditionally have placed GPP high on their agendas, and made substantive commitments to the introduction of LCC in public procurement. In Denmark for instance, LCC (or TCO) is an explicit part of the GPP agenda. Namely, the Danish strategy *Green Procurement for a Green Future* launched in 2020 foresees the mandatory use of existing calculation tools for several purchasing categories, as well as the creation of a digital version of the currently available spreadsheet-based LCC tools (Finansministeriet, 2020[12]). Sweden has had longstanding work in the LCC area as well, with first LCC tools created in the 1990s and becoming an integral part of the current sustainability-oriented public procurement practices. Originally concerned with energy efficiency, after the adoption of the new public procurement directives in 2014, LCC tools have become a relevant means to promote the use of other criteria than price and cater to the goal of efficient and environmentally responsible public procurement (Government Offices of Sweden and Ministry of Finance, n.d.[13]).

Other countries have placed the focus explicitly on the application of TCO instead of LCC, given that the maturity of methodologies to monetise environmental impacts is not considered sufficient for broad adoption. This is the case in Austria, where the new strategy for GPP, the so-called *naBe-Aktionsplan*, places emphasis on applying TCO when procuring selected purchasing categories (i.e. lighting, electrical appliances, IT equipment, and vehicles) (Bundesministerium für Klimaschutz Umwelt Energie Mobilität Innovation und Technologie, 2021[11]).

Germany is another example where policy ambitions are high with regards to implementing LCC. Namely, since January 2021, federal contracting authorities must take into account monetised costs of GHG emissions over the lifecycle of a product (see Box 3.5). The German Federal Environment Agency is tasked with developing LCC tools that will support this exercise. Furthermore, in principle the German procurement law requires the use of LCC. In practices, however, most contracting authorities find exemptions to this rule.

Despite public procurement being susceptible to the use of the LCC, many policy initiatives and ambitions targeted at GPP or LCC (including the European Commission efforts to support the uptake of the practice), stakeholders overall consider that the use of LCC is relatively low, with the exception of the construction industry, where a higher level of advancement with LCC appears more common.

3.3.2. Limited availability of tools for specific product groups

The tool mapping exercise has demonstrated that the purchasing categories for which the LCC tools are available tend to recur, such as computers and monitors, imaging equipment, vending machines, kitchen equipment, vehicles. This might be explained by a relative ease in creating tools for standardised products which are also widely used, making it simpler to introduce a calculation that would be well understood by procurement officials and therefore easier to incorporate in procurement practices.

In some cases, availability of specific categories of LCC tools also depends on the background of the organisation that was appointed with the task to develop them. For example, in Germany LCC tools have been developed by the German Federal Environment Agency, meaning that the primary criterion for identifying relevant purchasing categories was based on the purchases that have an impact on energy efficiency. Considerations regarding procurement volume and frequency were secondary. Specific considerations apply whenever LCC tools have developed by agencies responsible for GPP. Such actors, too, typically focus on purchasing categories that consume energy, as taking these parameters into account is considered to lead to greener choices. However, this is not always the case in practice. As reported by practitioners, LCC use leads to environmental choices when purchasing categories have a long lifespan (e.g. indoor and outdoor lighting), while it is less effective for ‘green’ purposes for short-lived products, such as IT goods.

At the same time, it means a vast spectrum of products remains non-covered, so even if there is inclination from the procurement practitioners to expand the application of the LCC in their daily work, they simply have no tools to make it happen. Each purchase also requires a tailored approach, meaning the procurement officials choosing a product for which LCC tool is not available, would have to create a tool on their own or apply the LCC methodology. That consequently implies the need for specialised knowledge and the investment of time and human resources.

3.3.3. Development of LCC tools is a labour-intensive process

The creation of any LCC tool is also highly labour intensive. Even a relatively simple product requires extensive research on which specificities are the most relevant for the LCC calculations, the ability to select an appropriate and reliable methodology, and finding reliable sources for the reference data to be used in the tool. All the interviewed authorities confirmed the relevance of these elements.

Since all the relevant competencies are rarely found within one organisation, creation of LCC tools also requires to involve and manage a wide net of stakeholders (such as other public bodies, private sector (e.g. individual companies or associations of companies working in the relevant field), research bodies (e.g. universities), capable and willing to provide their knowledge and expertise in the process.

For example, the Danish Environment Protection Agency is working in cooperation with one of their central purchasing bodies – Statens og Kommunernes Indkøbsservice (SKI) – in order to define the needs of the public buyers and ascertain whether the chosen purchasing categories for which the tools are created, correspond to these needs. They also regularly engage not just with the company that is responsible for the physical development of the tools, but also with other stakeholders such as other public bodies, research bodies and infrastructure companies, and retain a pool of economic operators and public buyers and their associations willing to provide their input during the development process. What is more, the work is continuous since the relevant developments in other areas, for example, standards, requires modification of already existing tools that contain related elements.

The German Federal Environment Agency takes a similar approach, considering the volume of purchasing and public buyers' needs, collaborating with the experts from different fields, utilising reviewed papers and conducting their own research on the relevant aspects and drawing lessons from their previous experiences in developing the tools and methodologies.

3.3.4. Difficulty in ensuring the methodological soundness of the tools

The final result of the LCC development process requires scrutiny of the potentially affected entities (i.e. contracting authorities, suppliers, academia) to ensure methodological soundness. The interviews have indicated that agreeing on specific aspects of the LCC calculations, such as, for example, monetisation of the CO2 emissions, can be a complicated process due to the need to ensure a wide acceptance of the relevant stakeholders and consider potential sensitivities.

Failure to address methodological soundness and acceptance of the tool may not only result in lack of trust in existing tools but also may mean legal implications for the public buyer if they decide to use them. For example, if the LCC tool was used in the contract award process and it becomes apparent that the metrics of the tool are scientifically incorrect, not only it may raise questions regarding the tool's compliance with the existing standards and regulations, but also regarding the potential consequences to the procurement procedure it was used in.

The articles of the Directive also do not provide enough assurance of avoiding legal issues. For example, as one of the conditions for the method used for the assessment of costs imputed to environmental externalities, the Directive states that "the data required can be provided with reasonable effort by normally diligent economic operators", leaving to the discretion of the creator of the methodology to define the standard of "reasonable effort" and "normally diligent economic operator" in a particular case.

Stakeholders also list the reservations regarding the acceptance of the LCC on the auditors side as one of the reasons for the reluctance to embrace LCC more often. Reaching consensus on the soundness of the tool may assist in ensuring a greater certainty for the procurement practitioners that they will not be penalised by the supervising institutions in case they would choose to adopt LCC practices.

3.3.5. LCC and TCO practices and approaches are more advanced in the infrastructure/ construction sector

While LCC approaches are not widely adopted for many purchasing categories, the infrastructure and construction sectors stand out as areas, in which LCC practices are more developed. This applies for most countries interviewed during the fact-finding, e.g. Germany, Finland, Norway, the Netherlands and Belgium. In part, this is linked to the fact that LCC in the infrastructure and construction sectors are partially mandatory in some countries. In Austria, for instance, the *naBe-Aktionsplan*, which is mandatory at federal level, outlines that for constructions of new buildings, life cycle costs have to be calculated. Furthermore, the Austrian Standards Institute developed a specific standard, which defines lifecycle costs in buildings, i.e. the ÖNORM B 1801-4:2014. The standard defines the accepted principles for lifecycle cost calculations and provides recommendations on calculation methods and assumptions for calculation parameters.

Denmark, in addition to the aim of making available LCC tools mandatory in spring 2022, is also taking steps to go beyond the LCC frame and introduce the specific requirements in relation to the building and construction sector's climate footprint in a form of a voluntary sustainability standard. The purpose is to test a life-cycle assessment (LCA) requirement with an intention to make it a part of the building code as a requirement for all buildings by 2023 (Denmark, 2021[14]).

In other instances, countries have invested significantly to apply LCC calculations to the infrastructure sector, particularly given its impact both on the environment and on CO2 emissions. Well-established practices in the infrastructure and construction sector can go beyond the classic quantification of LCC but focus on environmental impacts of infrastructure projects. A clear example of this are practices developed in the Netherlands around introducing LCA/LCC calculations based on a national environmental database, and using the CO2 Performance Ladder tool (see Box 3.2)

Pilot initiatives also appear to be more common in the infrastructure sector, and are typically led by large public companies responsible for such public works investment. An example is the Austrian federal railway company, ÖBB, which has recently developed and applied an LCC tool suitable for any kind of purchase, including for large projects. To conduct the LCC calculation, ÖBB partnered with the Technical University of Graz to integrate externalities generated by CO2 emissions in the LCC calculation (see Box 3.1). While requiring an important effort, the application of LCC proved successful, and is registering increasing interest (including by companies in the USA).

Other contracting authorities that conduct big investment projects are well placed in taking the lead regarding LCC in their procurement operations. Given the significant budgets and environmental impacts at stake, these contracting authorities are often more invested in making use of LCC in their projects. For instance, the Swedish Road Authority realised the value of using LCC for a lighting installation, as LCC considerations allowed to halve electricity usage for a lifespan of the product of 25 years, compared to a design that did not consider such operational costs. In Norway, the Norwegian Public Roads Administration is also advanced when it comes to LCC, as it also monetises CO2 emissions as part of the LCC calculations (see Box 3.4). In addition, Norway has developed a tool for buildings aimed at facilitating a simple LCC analysis of various alternative buildings (not replacing a complete LCC analysis of the entire building). To support the uptake of LCC, authorities have been focusing on providing guidance of the public project owners purchasers with different tools like an online guide with advice how to integrate a LCC analysis in the different phases of a building project, as well as e-learning courses, films, and proposal of LCC criteria and requirements in the tender documents.

Box 3.4. Norway: Reducing CO2 emissions in asphalt contracts

In 2017, the Norwegian Public Road Administration set the goal of reducing CO2 by 50% in asphalt contracts by 2030. In 2021, the Administration used CO2 emissions as an award criteria in 7 out of 27 asphalt contracts. To document emissions, it uses Environmental Product Declarations, which must include all emissions from the production of asphalt until it is laid out. The price defined for CO2 emissions has been set at 1 kg CO2 for 5 Norwegian kroner.

This price is added to the difference between the tender and the tender with the lowest amount of CO2 emissions. All the tenders, except the one with the lowest amount of CO2 emissions, thus have a new total cost. The tender with the lowest total costs is awarded the contract. The supplier awarded the contract must provide a climate budget prior to the contract start and an account when the contract is finished. The difference between the climate budget and accounting triggers a bonus if CO2 emissions are lower, or a deduction if CO2 emissions are higher.

Source: Information provided by Norwegian stakeholders

3.3.6. Evidence and data on LCC use is scarcely available

The use of LCC is scarcely documented, with very limited availability of data on concrete uptake and use of LCC tools. In part, this is linked to the broader trend of limited monitoring of strategic public procurement policies, including GPP. Countries typically do not have monitoring systems that are built into their e-procurement system, thus allowing to simplify and automate the data collection process. Instead, measuring the uptake of LCC relies on dedicated data collection exercise, such as surveys, self-reporting or similar. Furthermore, visibility over the use of LCC in the pre-tendering phase is limited. Organisations may use LCC to support their decision-making about which solutions to purchase, but this is difficult to track as it is conducted prior to tendering.

Finland and Norway are two examples of countries that have recently estimated the uptake of LCC. Specifically, a procurement survey in 2018 conducted by Norwegian Agency for Public and Financial Management (DFØ) revealed that approximately one third of respondents make use of LCC in the construction and ICT sectors (Rambøll Management Consulting/Difi, 2018[15]). In Finland, KEINO, the Competence Centre for Sustainable and Innovative public procurement, used data analytics methodologies to analyse open tenders and their documentation. Based on a keyword search, it emerged that 5% of public tenders include LCC.

Information about LCC uptake relies otherwise on anecdotal evidence, or proxies. For instance, the number of downloads of LCC tools could give an indication of their use. However, since the introduction of General Data Protection Regulation (GDPR), some countries chose not to collect such statistical data.

Monitoring activities by the European Commission also cover LCC only to a limited extent. For instance, the Commission regularly gathers information about the member states' implementation of their GPP national action plans (European Commission, 2021[6]). While it collects also information about the availability of LCC tools in EU countries, data on uptake of LCC is not available. Nevertheless, the European Commission has published a study that analyses the implementation of LCA in the procurement context across the EU (European Commission, 2021[16]).

3.3.7. Standardisation gaps/lack of consensus on how to incorporate environmental costs

The mapping of LCC and conversations with stakeholders pointed to gaps and lack of consensus on how to address certain aspects of LCC calculations, notably using LCC tool to take into account environmental impacts. As discussed in this chapter, monetisation of CO2 remains one of the main challenges. As per EU Directives, costs related to external environmental effects (e.g. pollution, emissions, etc.) can only be taken into account to the extent the monetised value can be verified. Currently, this represents one of the key barriers to include environmental costs in LCC calculations (Schreiber et al., 2021[17]). As a result, approaches diverge among countries. Some do not pursue climate policies through LCC (e.g. Sweden, Austria), while others are working towards improving LCC tools to address environmental dimensions, and notably embedded emissions (e.g. Germany, Flanders).

Beyond the challenges related to the monetisation of CO2, the lack of specific sustainability standard also poses a barrier to the development coherent LCC tools, as reported by stakeholders. For instance, standards that would tackle maintenance, reparability or circularity are currently not available. These would provide a strong basis for suppliers to compete on, and would simplify the development of LCC tools. Countries also consider that the creation of such standards needs to be an international effort. A small economy may not be in a position to invest in a lengthy process of standard creation if it is not able to subsequently ensure its diffusion and adoption at international scale.

Similarly, stakeholders also pointed to limitations in the availability of information on environmental impacts, such as embedded emissions throughout the lifecycle of a product (including the production stage). Currently, information about environmental impacts can be gathered through Environmental Product Declarations (EPD), but these are not consistently available for all products. In case no EPD information is available, a significantly higher effort is needed to assess the environmental impacts, such as embedded emissions. From the perspective of the European Commission, the ongoing Sustainable Products Initiative represents an important step. This initiative foresees a revision of the Ecodesign Directive including an expansion of regulatory measures to increase the sustainability of products on the EU market. In fact, as of March 2022, the European Commission adopted a proposal for regulation on eco-design of sustainable products (European Commission, n.d.[18]).

In this context, collaboration between various entities that have competencies related to technical/environmental performance and the public procurement community is essential. As discussed in earlier in this chapter, collaborative efforts have been part of the tool development process, and are necessary to ensure robust tools. Beyond the tool development, it is important to ensure the knowledge transfer between public procurement and expertise related to sustainability and environmental impacts. In some countries, the development of LCC tools or GPP policy at large falls under the purview of environment ministry or agency. This is the case in Germany and in Denmark, where the Federal Environment Agency and the Ministry of the Environment have responsibility for LCC tools. Incidentally, these countries are advancing their thinking about LCC by pioneering new types of tools (see Box 3.5). In other cases, the development of LCC tools is led by the public procurement authority.

Collaboration is important to set some of the foundations that are needed for the advancement of LCC tools. This may include the development of a structured and regularly updated database compiling the information on the relevant aspects for the existing LCC methodologies. Once data is available, accessible and regularly maintained, the development of a calculation software becomes more of a technical task rather than a methodological challenge.

Box 3.5. New trends in LCC tools

DE – Developing LCC tools that capture GHG during full life-cycle

With the introduction of the "AVV Klima", German lawmakers have identified public procurement as a key policy instrument to address climate change. Among several measures addressed by the regulation, federal buyers are mandated to take into account the monetised costs of GHG emissions over the lifecycle of goods and services. This approach goes beyond the current consideration of LCC tools developed by the German Federal Environment Agency, which focus on energy consumption during the life-cycle of various products. In fact, the AVV Klima requires that all embedded GHG shall be monetised and taken into account into the procurement decision, beyond emissions produced during the operations phase (i.e. GHG emissions from the production, transport of the products, or other emissions prior to use by the contracting authorities). The German Federal Environment Agency is tasked with developing tools that facilitate the calculation of such embedded GHG. The regulation went into effect as of January 2022.

DK – Developing LCC tools for products with low energy consumption during the life-cycle (textile)

The Danish Ministry of Environment has developed over 20 spread-sheet based LCC for several purchasing categories. Currently available LCC tools focus on products that generate significant energy consumption over their lifetime, e.g. computers, multifunctional machines, vehicles, etc. Thus, energy efficiency of is typically the main factor to determine the least costly option, when comparing several products. The next frontier in expanding LCC considerations lies in developing tools for products that have low energy consumption during their lifetime, such as textile. With such product categories, the main cost drivers will be longevity of the product, and considerations related to one-time use versus products that can be washed and re-used.

Source: Umweltbundesamt, Danish Ministry of Environment

3.3.8. Time pressure and capacity gaps pose key barriers to wider adoption

A common view held by stakeholders is that practitioners are short on time to introduce practices that require some learning and investment, such as LCC. In fact, LCC practices require having a more extensive knowledge on the matter which may not be easily attainable for an average public procurement official, especially if the practice is not widely used and examples of existing practices are not easily accessible. Furthermore, LCC use requires more time and investment than the usual methods applied in the daily work of public procurement practitioners. Among other activities, public buyers need to verify the accuracy of LCC calculations and input data from suppliers, which is considered a challenging and time-consuming task.

While many stakeholders during the fact-finding missions agreed that LCC methodologies are generally accessible to the average public buyers, there is a need to be trained in understanding the key concepts behind the tools, and applying them in practice. Despite being broadly familiar with methodologies related to LCC, only few buyers have used them in the past and are therefore at ease making use of them. Institutional knowledge of LCC practices is also often lacking.

Resistance may also come from the fact that procurers lack specific expertise related to some aspects of LCC/GPP strategies. In the case of the CO2 Performance Ladder for instance, buyers are not familiar with supply chain risks. Hence, they welcome tools or support that minimise or eliminate specific risks in their practice. Similarly, in the case of smaller infrastructure projects, public buyers are faced with the high effort

of learning how to use specific tools, such as DuboCalc. As such, there is greater resistance to make use of such tools, and simplified versions are more accepted.

The organisational culture and approach may play a role, too. As reported by stakeholders, procurement officials often do not have many resources to invest in developing new approaches, and rather rely on tested strategies. The lack of a more comprehensive, organisational approach, however, hinders the uptake of LCC, as the application of LCC calculation often relies on the cooperation of various departments and entities within an organisation. For instance, buyers may need to interact with the controllers department to define and agree on some of the parameters of the LCC calculation (e.g. interest rate or discount rate).

3.3.9. Tools are necessary but not sufficient condition for success

Conversations with stakeholders confirmed the need for tools to simplify and make LCC accessible in every day operations of public buyers. However, it emerged that beyond the availability of user-friendly tools, an enabling environment that supports the uptake of LCC tools is necessary to ensure widespread use. This entails support and commitment both at the political and strategic level, but also within an organisation. Countries that have made GPP a priority are more likely to invest in awareness-raising activities, or mandate some of the actions linked to LCC uptake, such as mandatory use of tools (e.g. Denmark). Commitment at organisational level is also considered a key factor for the successful integration of LCC into daily practices. As discussed above, collaboration within an organisation is a pre-condition for the uptake of LCC tools, bringing together the necessary skills and knowledge. Beyond that, a mind-set change is also required from the organisational leadership. As reported by stakeholders, proactive project managers may want to include LCC considerations in the tenders, but they need the support from the leadership to move ahead.

It is also important to consider the incentive structure, in which public buyers operate. Namely, in some instances the budgetary process does not favour the use of LCC. This is the case when there is a separation between the budget for the procurement and the one for operation costs. In such arrangements, the procurement department may not have incentives to generate savings for different parts of the organisation, and therefore not invest in LCC practices. Stakeholders also emphasise the need to rethink how the public buyers budget is formed switching from annual to longer period planning that would enable them to make decisions based on long-term aims rather than the immediate benefits such as savings generated by the procurement. Governments need to ensure that the right incentive structure is place, so that public buyers procure long-term sustainable solutions.

Collaboration among institutions to develop and mainstream tools is another key factor to creating an enabling environment, in which LCC is widely used. This entails the cooperation between procurement agencies and stakeholders with knowledge and expertise in environmental matters. Such collaboration is necessary to tackle some of the gaps related to standardisation in the LCC calculations, and removing related barriers to LCC adoption. Not least, enhancing capacity at individual level is necessary to meet pre-conditions for tool use. This requires training users in developing basic understanding of relevant parameters, as well as sufficient knowledge of consumption patterns, or the ability to retrieve such information, in order to fill all aspects related to operational use in the LCC calculation.

In addition to an enabling environment that supports LCC, policymakers need to develop the right kinds of tools supporting LCC. In Norway for instance, public procurement authorities have moved away from traditional LCC calculation spread-sheets, and now focus on tools that illustrate certain environmental impacts from public procurement (e.g. purchasing electric vehicles versus fuel-powered vehicles). These include tools developed for cars, vans and construction machines that calculate the effect on Co2 emissions and costs related to fuel and electricity consumption. An additional Norwegian tool helps to calculate, plan, and follow up on the climate footprint from food. Danish authorities would like to upgrade their TCO tools to web-based tools to facilitate their use.

Others, for example, the Swedish Public Procurement Authority and Austrian Federal Railways (ÖBB) continue the use of the traditional Excel spread-sheets, emphasising the transparency provided by this type of calculation, since the methodology, reference data and other relevant aspects are openly shown on the tool, which may not always be the case with the software solutions (albeit the latter might look less complex and more appealing to the users). As per EU procurement Directives, the lack of transparent calculations may result in litigation and the ensuing delay of the procedure.

It is also important to keep in mind that the creation of the tool is just the first step of the journey and LCC tools require a certain level of maintenance to ensure that reference data and other parameters are up-to-date. As the relevant markets and approaches to the LCC evolve, the existing tools need a regular review in order to ensure that the calculation models and data used are still relevant and reflect the realities. Depending on the chosen product and the form of the LCC tool, the level of effort needed to sustain the relevance of the tool will differ. For example, Excel spreadsheets require less investment for subsequent updates. In contrast, software-based approaches mean higher initial financial investment and the need to ensure the funds for the further development and upgrade of the tool, and may even mean the need to establish governance structures to keep the tools up and running. On the other hand, the updates for software-based solutions are automatically shared with users, while an Excel update requires the user to re-download the tool. Thus, the pros and cons need to be carefully weighed.

Last but not least, the stakeholders emphasise that LCC tools are not a substitute for quality criteria and proper technical specifications, which reminds that LCC tools are not the goal *per se* but rather a means in achieving the benefits resulting from the application of LCC.

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Notes

1 The sample of countries analysed consists of 27 EU countries and 5 OECD countries (Australia, Norway, New Zealand, United Kingdom, USA, Switzerland)

2 European Commission, National GPP Actions Plans (policies and guidelines), December 2021

3 Note by the Republic of Türkiye

The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Türkiye recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Türkiye shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union

The Republic of Cyprus is recognised by all members of the United Nations with the exception of Türkiye. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

4 https://milieudatabase.nl/an-introduction-to-the-nmd/

5 Tool to Optimise the Total Environmental impact of Materials

6 CAM, decree issued by the Ministry of Ecological Transition and mandatory for Italian public Authorities referring to art 34 of the Code of Contracts

7 European Commission, Commission Staff Working Document, Impact Assessment Proposal for A Directive of the European Parliament and of the Council amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles, https://eur-lex.europa.eu/resource.html?uri=cellar:fd4de3bc-c55d-11e7-9b01-01aa75ed71a1.0001.02/DOC_2&format=PDF

4. Recommendations

This chapter provides evidence-based strategic policy recommendations for the Hungarian Government on how to move towards a more structured and co-ordinated approach in the use of green public procurement criteria and especially the use of life-cycle costing (LCC).

4.1. Political leadership is a key element for commitment to sustainability

Sustainable public procurement is largely being driven by policy and top-down leadership. The existence of national strategic and regulatory framework on sustainable public procurement, a strong political and organisational leadership and policy commitments are the strongest drivers. Signalling commitment to GPP and LCC as a political priority is necessary to firmly introduce LCC calculations in the day-to-day operations of contracting authorities. Political leadership is a decisive factor in creating a supportive environment for less common practices, such as LCC, by engaging the relevant actors of the public sector.

The creation of a supportive environment can entail several aspects. Strategic soundness is the basis for further action, meaning, that the relevant strategies and policies, recognising the significance of the desired practices and incorporating them into the long-term aims have to be in place. Effective implementation of long-term goals consequently calls for institutional ownership of relevant processes and involvement of different levels of the public procurement community.

Introducing LCC in the procurement process is unlikely to happen if procurement officials are expected to do so on their own. Institutional leaders (starting with the policy implementing institutions and including the management at the contracting authorities) should expect LCC to be incorporated in the procurement process, and should make available resources for the necessary upskilling of procurement practitioners. In such context, inter-institutional co-operation among the policy makers, policy implementing institutions, supervisory and audit bodies emerges as a particularly relevant measure to trigger systemic change of existing practices. Such co-operation would not only serve as a means to address the potential misalignment in the views towards a specific practice (by providing the possibility to review and harmonise existing positions, procedures, checklists, etc.), but would also work as a channel for capacity building. Last but not least, a step-by-step approach should be applied in promotion and expansion of the desired practices. A stricter approach towards the implementation of sustainability-oriented practices consists in introducing obligations to use LCC–either in each or in certain types of purchasing categories, or by certain types of contracting authorities—might seem a viable policy option intended to quickly increase the uptake of LCC and build experience.

However, each step of the journey towards sustainability should be made by taking into account the maturity level of each element in the system (e.g. contracting authorities, market, supervising institutions).

Another important factor is ensuring the existence of the enabling factors for the successful implementation of the LCC (e.g. relevant policies, support mechanisms, tools) as opposed to adopting elements of existing approaches, taken out of a country-specific context.

Against this background, Hungary could consider:

- accelerating the adoption of its planned Green Public Procurement Strategy.
- assigning a clear ownership for relevant functions related to the development and promotion of GPP and LCC (LCC tools development, maintenance and promotion, training, and support for procurement practitioners).
- establishing a formal or informal inter-institutional co-operation mechanism which would enable policy makers, policy implementing institutions, as well as supervisory and audit bodies such as but not exclusively the PMO, PPA, State Audit Office) to discuss the progress and challenges in adopting and promoting GPP and LCC, and align the relevant positions and practices.
- applying a stricter approach towards implementation of the desired practices (such as the review of the regulatory framework by introducing obligations) only in the case of sufficient maturity of the practice. To achieve mature LCC practices some key steps need to be taken that address both available support structures and day-to-day practices. In terms of support structures, dedicated guidance, and tools (calculators), established frameworks to support practitioners, and relevant

cooperative relationships need to be set up. Regarding practices, it is key to develop experience in applying LCC (e.g. conducting pilots in different purchasing categories, drawing lessons, sharing, and replicating successful practices between contracting authorities), while also adopting a phase-based approach to LCC-related obligations.

4.2. Target strategically the efforts in the adoption of LCC

The wide spectrum of the existing LCC tools might create an assumption that any sector or purchasing category is susceptible to the use of LCC. However, considering that adopting LCC practices requires consistent effort and investment in order to maximise the gains, public buyers should consider the following:

- **Targeting the efforts on sectors or purchasing categories with the most impact.** It is important to take into account the impacts of a sector or a specific purchasing category when developing tools, either from an environmental/energy consumption perspective, or in terms of procurement volume. For this reason, some countries choose to maximise the impact of the practice by investing in tools meant for more complex purchasing categories, such as buildings or infrastructure projects.
- **Focusing efforts on the conditions when LCC application leads to different procurement results.** The use of LCC is not adapted to all purchasing categories, and should thus be focused on those where there is a high difference in cost, i.e. when the application of LCC supports the choice of goods, services or works that generate savings over the long-term (despite a potentially higher acquisition price). Typically this entails the choice of energy efficient, or more durable products and services. This means that savings generated through the use phase outweigh the initial higher cost of acquisition.

The end-goal of a wider adoption of LCC practices should be designed and the consecutive targeted effort should be made by taking into account the existence of the enabling environment and the maturity level of the practice in a particular country.

Hungary could consider:

- setting up the ultimate objectives of the adoption and promotion of LCC in the context of the planned Green Public Procurement Strategy.
- defining the criteria for identifying the high-impact/most sensible areas that could benefit from the application of the LCC in the future.

4.3. Ensuring the collection of evidence and data on LCC use

The tool mapping exercise has demonstrated that currently both policymakers and public bodies responsible for the implementation of LCC policies and for LCC tool development in different EU and OECD countries have very limited visibility on its uptake, and hence on the impact of using LCC tools in procurement processes. The review of the effectiveness of the established policies in the field is either conducted sporadically or not conducted at all, making it difficult to establish the most appropriate ways forward. Thus, the design of policies for a wider uptake of LCC must consider the **creation of monitoring mechanism**, as a means to collect evidence on the effectiveness of the policy intervention and guide the corrective action. For example, a simple mechanism for monitoring LCC use could be integrated in the e-procurement system via self-reporting or automated collection of relevant data. As an alternative, countries could invest in regularly performing policy evaluations to understand the impact of LCC policies. Another relevant aspect to take into account is the **limitations on evidence collection** stemming from other

regulations. Some countries state that other applicable laws, namely, the ones implementing the GDPR, are preventing them from collecting proper statistical data on the matter. Hence the assessment of potentially limiting regulations and (or) their application practices must also be considered when establishing the means for the collection of evidence and data.

Hungary could consider:

- the creation of a monitoring mechanism, preferably integrated in the e-procurement system, in order to enable the collection of evidence and data on the use of LCC.
- the assessment of other existing regulations that might prevent the efforts to collect the relevant evidence and data.

4.4. Enhancing cooperation for standardisation of parameters and integration of expert knowledge

The success of the LCC tools largely depends on their perceived reliability. In this sense, a consensus among a wide spectrum of stakeholders regarding the methodologies and the data used is a must-have. Cooperative approaches in the tool development process support such consensus-building. Stakeholders highlight the lack of homogeneity among the existing calculations in addressing some of the relevant aspects, leading to significant differences depending on the tool used. Elaborate LCC tools require sophisticated product, technical and environmental knowledge, particularly in the case when policymakers aim at integrating the environmental components of LCC (for example, emissions) into the calculation. This type of specialised knowledge can hardly be found in one organisation, thus it requires the collaboration between institutions responsible for the procurement process, and those with technical expertise on environmental aspects. A productive collaboration of these entities ensures that LCC tools are sound from both a procurement and sustainability perspective. Consequently, the LCC tool development process calls for **building on collaborations between procurement and specialised agencies to integrate expert know-how.**

Moreover, to advance the knowledge base that lies at heart of LCC calculation tools, particularly in the area of environmental impacts, there is a need to further develop and harmonise standards, in particular for the monetisation of externalities, and for the inclusion of circularity considerations. The development and harmonisation of standards necessitates **enhanced cooperation with competent bodies for standardisation of LCC parameters** at national, European and (or) international level, such as universities or research institutions, standardisation bodies, private sector representatives, procurement representatives, etc. Once important methodological questions are standardised and harmonised, the uptake of LCC will be facilitated, as the arising key practical and legal concerns will be addressed.

Hungary could consider

- the creation of structures that would enable the cooperation for standardisation of parameters and enable the transfer of expert knowledge (networks, working groups, partnerships).

4.5. Ensuring the maintenance of the existing tools and the supporting frameworks

Ready-to-use tools are just one element in the integral system of the conditions paving the way to the success in adopting LCC in public procurement practices. The most user-friendly, easy-to-understand LCC tools will not work if capacity gaps of end-users remain unaddressed. Even with a variety of methodologies for LCC calculations being relatively accessible, buyers need some level of training and help in understanding the basic investment calculation (net present value method), as well as training on how to

use the existing LCC tools. Hence investing in **educating buyers** is inevitable when taking a systematic approach to the issue. While typical forms of education (e.g. seminars, workshops) never lose their relevance, some non-traditional approaches seem to work particularly well when it comes to the transfer of scarcely used practices. **Creating practitioners networks** is a rather simple but effective way of allowing buyers to share their good practices and learn from one another. This can take the form of so-called 'change agents', i.e. experienced buyers that help other buyers in modifying their typical practices. Typically, tool owners are in charge of dedicated training, outreach and promotion activities related to the tools themselves. However, some countries have taken a step further and adopted an institutionalised approach in **ensuring the availability of assistance** on matters related to LCC and GPP to public buyers by establishing dedicated competence centres that are often tasked with assistance in sustainability-related topics, including LCC. In addition to that, the most advanced countries in the field consider LCC tools as "living documents", requiring **maintenance and regular updates** in order to ensure that parameters and reference data correspond to the latest developments. In some cases, even the governance structures for the upkeep of the tools are established. Timely update and improvement of the existing calculations is achieved by **engaging with different stakeholders**, at the same time keeping them informed about ongoing developments, and ensuring their buy-in regarding efforts to promote LCC tools.

Hungary could consider:

- mobilising a practitioner's platform (network, forum) for sharing practices and experiences in conducting sustainable public procurement.
- establishing a dedicated competence centre on sustainable public procurement that could act as a main agent in ensuring assistance to public buyers.
- the creation of structures that would enable the regular review of existing tools to tackle GPP and LCC related issues (working groups, partnerships, etc.).

Annex A. Identified LCC tools

Country/organisation	Available LCC tools	Link
Australia	Passenger cars, medical equipment, sports and recreation facilities (conditioning)	Vehicles; sport and recreation facilities; Victoria state government; Central government
Austria	TCO-Tool for PCs und Notebooks	
Austria / ÖBB	„TCO CO2" tool: generic tool which incorporates environmental costs into the TCO/LCC calculation making it useable for any GPP	Contact: sven.schirmer@oebb.at
Belgium (Government of Flanders)	Indoor lighting	
Denmark	Appliances: washers, freezers, dryers, ovens, Projectors, Storage equipment, Servers, Small network equipment and wi-fi "spot", Large network equipment, Uninterruptible power supply, capacitor units, multifunctional machines (copy and print), computers and monitors, vending machines (inlc. Coffee), motor vehicles	https://csr-indkob.dk/tco-vaerktoejer/
EU-wide	Life-Cycle Cost for clean vehicles directive	https://clean-fleets.eu/publications/
	Smart-SPP generic tool	
	Indoor and outdoor lighting, vending machines, imaging equipment, computers and monitors	https://ec.europa.eu/environment/gpp/lcc.htm
Germany (Umweltbundesamt)	Generic Tool	https://www.umweltbundesamt.de/themen/wirtschaft-konsum/umweltfreundliche-beschaffung/berechnung-der-lebenszykluskosten
Germany (Umweltbundesamt)	Product specific tool	https://www.umweltbundesamt.de/dokument/berechnungswerkzeug-fuer-lebenszykluskosten
Germany (Police Berlin)	LCC Tool and Guidance for vehicles	
Germany (Berlin Energy Agency)	- Generic tool - Printer - Ablufttrockner - Electric oven - Dishwasher - Fridge - Washing machine - Dryer	https://www.berliner-e-agentur.de/ueber-uns/service
Germany	Tool for green electricity (Ökostrom)	
	Tool for lifts	
Germany (Umweltamt)	Tool for floor coverings	
Germany (ZVEI - Central association for electrical engineering and the electrical industry)	Tool for comparison of Investment Projects	
Latvia	Road vehicles/ methodology and calculator	Methodology of the lifetime of road transport costs | Procurement Monitoring Bureau (iub.gov.lv)
Lithuania	Appliances: washers, freezers, dryers (DK), Computers, monitors (EC), Hematology testing (LT), Projectors (DK),	

	Storage equipment (DK), Servers (DK), Small network equipment and wi-fi "spot" (DK), Large network equipment (DK), Uninterruptible power supply (DK)	
Netherlands (Rijkswaterstaat)	Dubocalc (Sustainable Construction Calculator)	https://www.dubocalc.nl/en/what-is-dubocalc/
Netherlands (SKAO – Foundation for Climate Friendly Procurement and Business)	CO2 Performance Ladder	https://www.co2-prestatieladder.nl/en/what-is-the-ladder
New Zealand	TCO Calculator	https://www.procurement.govt.nz/assets/procurement-property/documents/tool-total-cost-ownership-calculator.xlsx
Norway	Vehicles cars, vans and construction machines (CO2, fuel and electricity consumption)	https://www.anskaffelser.no/verktoy/analyseverktoy/effektkalkulator-personbiler
	Management tool for public owned vehicles	Søk | Anskaffelser.no
	Tool for calculating the reference level for Co2 emissions from material use in buildings.	Bilparkdata | Anskaffelser.no
	Climate calculator for procurement of food	Klimagassutslipp for bygg | Anskaffelser.no
		Klimakalkulator for matanskaffelser | Anskaffelser.no
Poland	Computers and monitors, indoor/outdoor lighting, imaging equipment	https://www.uzp.gov.pl/baza-wiedzy/zrownowazone-zamowienia-publiczne/zielone-zamowienia/przydatne-informacje/rachunek-kosztow-cyklu-zycia
Sweden	Indoor lighting; outdoor lighting; commercial kitchen; passenger cars; temporary modular buildings; vending machines; appliances	https://www.upphandlingsmyndigheten.se/om-hallbar-upphandling/ekonomiskt-hallbar-upphandling/lcc-for-langsiktigt-hallbara-inkop/lcc-verktyg/
USA (EPA)	TCO calculator for Electronics	https://www.epa.gov/sites/production/files/fec/resources/tco_tool.xlsx
USA	Harvard - Tool for Energy Conservation Measures (ECM)	
	National Corrugated Steel Pipe Association - LCC calculator	

OECD Public Governance Reviews

Life-Cycle Costing in Public Procurement in Hungary

STOCKTAKING OF GOOD PRACTICES

This report provides Hungary with key recommendations and policy options to establish comprehensive and user-friendly methodologies and tools for the greater uptake of life-cycle costing (LCC) methodology in public procurement. The report introduces the concept of LCC and its links to the wider sustainable public procurement agenda, and maps the current practices in Hungary and existing LCC tools in other EU and OECD countries, with a view of drawing insights to promote the development and uptake of LCC tools.

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