Module 14

Using Building Circularity Tools

Circular Economy in Construction

24 partners

12 countries

Date of Event

*Author/ **Institute***

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Using Building Circularity Tools | Summary

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The aim of this module is to provide the basic knowledge to understand importance of the circularity tools and the introduction on how to use the tools for building circularity.

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Using Building Circularity Tools | Objectives

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1. Identify and outline the **standards** for calculating building level Life Cycle Assessment (LCA)
2. Introduction to **the functionality of the circularity tools** (LCA, LCC, Level(s) etc) for building Life Cycle Costs and Assessments.
3. Outline **how to choose material sources**, design out waste and measure circularity, using case studies.
4. Outline how to quantify **and compare the impacts of your different design choices** with the building circularity scores using case studies.
5. Outline how to conduct a **structured cost analysis**, define major expenditure sources, identify priority areas to improve the baseline design and compare impacts of design alternatives.

Using Building Circularity Tools | Content

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Topic 1 – Building Circularity Tools (LCA & LCC)

Topic 2 – Calculation Methodology

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1. Building Circularity Tools

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LCA Data

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- If you need to calculate the environmental impacts of a product, a service, or process in an accurate, reliable way, no methodology is better than LCA.

- This is due to two main factors:
  1. Life Cycle Assessment is **a scientific methodology,** and relies on cold, hard data rather than impressions, predictions, or marketing labels;
  2. Life Cycle Assessment analyses **the impacts over the whole existence** of the product/service/process.

What exactly are we calculating?

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- When we talk about environmental impacts and emissions, we need to clarify what exactly they are.
- **Emissions are substances released into the air, water, or soil, which negatively impact the environment**, and humans as a result. They often enter the environment as waste products.
- The most well known emissions are **greenhouse gases (GHG)**, which contribute to global warming. Greenhouse gases are gases that trap heat into the atmosphere, therefore contributing to warming up the planet and raising the average temperatures across the world.

What exactly are we calculating?

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- In addition to greenhouse gas emissions and their warming impact on the atmosphere, **there are several other ways in which we can evaluate the impact of emissions on the ecosystems.**

- Some of the most commonly used impact categories are introduced in the following slides.

- These categories help us to **measure the effect of some substances and gases on the environment,** and to quantify the impact of human actions on the environment

What impacts are measured?

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Exploitation of fossil resources

acidification

kgSO2 eq

Exploitation of mineral resources

eutrofication

kgPO4-eq

What impacts are measured?

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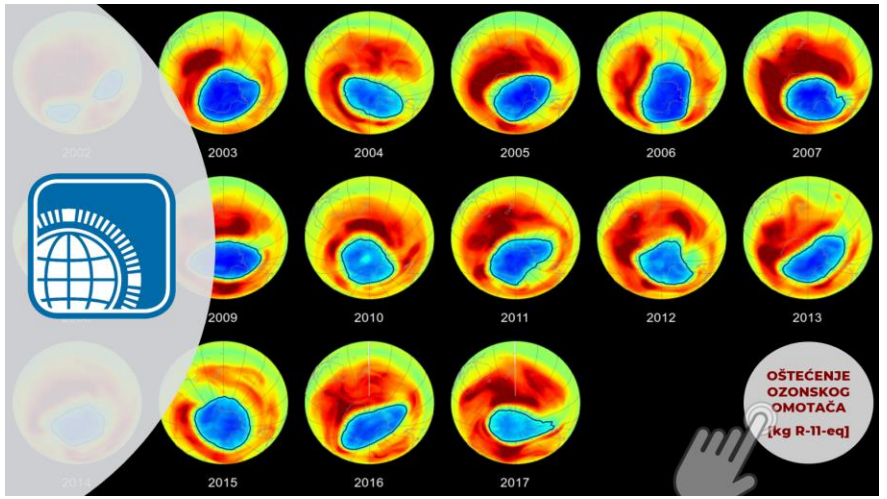
Global warming

kgCO2 eq

formation of photochemical smog

kgC2H4eq



Ozone depletion

kgCFC11eq

Source: BusGoCircular Project

How are they calculated?

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- In addition to the environmental impact categories listed in the previous slides, there are plenty of others that can be analysed.

- For instance, **the EN standards for Building Life Cycle Assessment list a total of 24 environmental impact categories.**

- All the different emissions are translated into **environmental impacts** by multiplying them with the characterization factors that converts their effect into a **common unit.** For example, in the case of climate change all of the emissions are converted into COe equivalents, by comparing the warming potential of different greenhouse gases to that of 1 kg of CO2 in the atmosphere.

LCA standards

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- The rules for the Life Cycle Assessment are defined by standards. The most important standards for building Life Cycle Assessment are listed.
- **The European CEN / TC 350** standards are highlighted.

- **Cornerstone standards:**
  - ISO 14040 and ISO 14044 – fundamentals for LCA; used in all industries and in professional context, almost all the time
- **Construction works specific standards:**
  - **EN 15978 – LCA standard for construction projects (European standard, basis for all EU regulations)**
  - ISO 21929-1 and ISO 21931-1 (hardly used LCA standards)
- **Environmental Product Declaration standards:**
  - ISO 14025 – cornerstone standard for all kinds of EDPs
  - **EN 15804 (EPD data) and EN 15942 (EPD format) (European standard, basis for all EU regulations)**
  - ISO 21930 – (hardly used EPD standard)

LCA- obstacles and opportunities

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- It is important for the construction industry to contribute to the global effort to cut carbon emissions.

- However, there are some **obstacles** in place, preventing a wider adoption of sustainable practices in the building sector: **confusion and lack of knowledge on how to achieve real sustainability, fear of increasing costs, and lack of regulations stating which standards should be followed.**

- Governments and institutions worldwide are introducing sanctions, regulations and incentives, directed at promoting passive/net zero buildings, sustainable infrastructure, and a more transparent approach to manufacturing.

- Performing **Life Cycle Costing calculations along with Life Cycle Assessment represents a powerful opportunity to reduce costs in addition to environmental impacts.**

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2. Calculation Methodology

LCA calculation principles

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https://youtu.be/r0ucT1KRiO4

Tools for LCA

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- For many construction specialists it is important to get access to LCA results in a timely manner. Traditional LCA calculations can take up to a couple of months.

- **Building Life Cycle Assessment calculations can be automated with software tools** that allow you to import your data and get your LCA results in a fraction of the time.

- These tools such as OneClick LCA allow you **to import your BIM/ Revit/gbXML, or Excel file and the software will automatically map your data to a LCA database and automate the calculations**, giving you a detailed report that you can then submit for certification purposes and use to order suitable materials and products.

LCA calculation: OneClick LCA

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LCA calculation using BIM data

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https://youtu.be/UIJryuxFIrY

LCC calculation: methods

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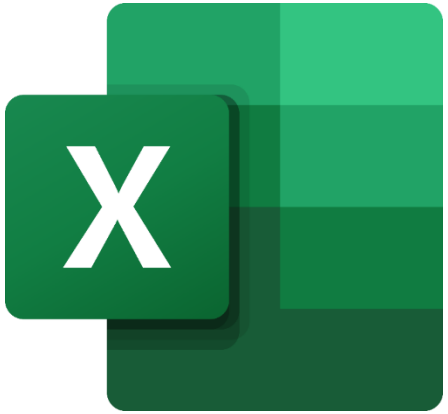
- While manual methods of calculations are still defined in relevant standards they are no longer being used in the production of LCC estimates.
- **Most examples of LCC are now calculated and presented in computer software.**

- There are two categories of computer-based LCC programs, which can be described as glass box or black box systems.
  - A **glass box** computer-based LCC program is characterised by the visibility of the process, such that each step in the LCC process can be seen by the operator. Conversely, a **black box** computer-based LCC program is characterised by the input of data and the output of results with each step in the process being invisible to the operator.
  - The most common glass box systems are based on **spreadsheets** and are developed within an organisation for their specific needs and on specific projects. Black box systems are usually propriety software bought from a software company.



Source: SCSI Guide to LCC

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LCC calculation: spreadsheet

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LCC and BIM

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- A Building Information Modelling/Management (BIM) approach to construction procurement is becoming increasingly popular as a collaborative set of procedures and associated processes that assist design and construction professions in conceiving, designing, constructing and operating the built environment.

- Although **5D BIM (Cost Modelling**) is currently being used by Quantity Surveyors, BIM is not extensively used in the application of LCC and there has been limited research in this area to date.

- 5D automated measurement can still be utilised in 5D application, but currently it is recommended to **export these quantities to MS Excel and then carry out the LCC estimate.**

Source: SCSI Guide to LCC

Learn more!

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The following section provides links to a number of videos, workbooks and solutions to get started on carrying out LCC estimates. They will allow the user to develop the building blocks of proficiency in LCC calculations and start applying them to an LCC estimate.

Life Cycle Costing in Excel 1 – Video

LCC Excel Template - 1

LCC Excel Solution - 1

Life Cycle Costing in Excel 2 – Video

LCC Excel Template - 2

LCC Excel Solution - 2

1 **Life Cycle Costing Exercise 1 - Video**

LCC Excel Template - 1

LCC Excel Solution - 1

2 **Life Cycle Costing Exercise 2 - Video**

LCC Excel Template - 2

LCC Excel Solution - 2

3 **Life Cycle Costing Exercise 3 - Video**

LCC Excel Template - 3

LCC Excel Solution - 3

4 **Life Cycle Costing Exercise 4 - Video**

LCC Excel Template - 4

LCC Excel Solution - 4

The exercises shown in these 4 videos, outline a number of scenarios where the calculations demonstrated in the previous videos (left) are used in some simple LCC models.

Source: SCSI Guide to LCC

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LCA & LCC

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- Building Life Cycle Costing is often calculated alongside a building LCA.

- Similarly, to Building LCA, the earlier in the design process you calculate a building LCC, the more savings you can achieve. In both cases, you can compare design alternatives to find out which is better over the whole life cycle of the building.

- LCC provides metrics on costs and savings over the whole lifetime of the building. When paired with LCA, it can help design buildings that are more sustainable both from an environmental and financial perspective.

LCC calculation: software

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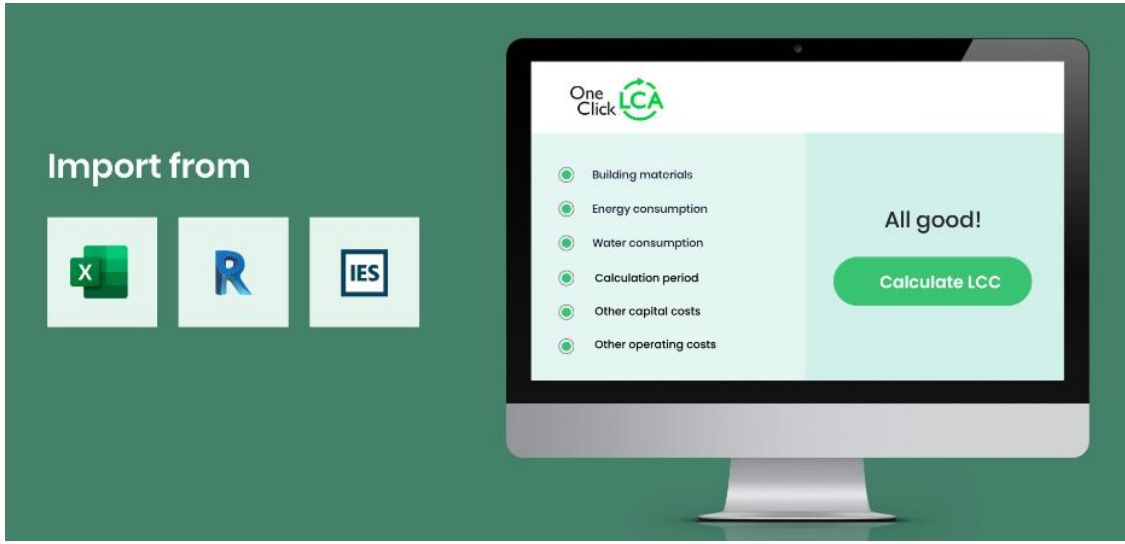
Softwares such as OneClick LCA can also be used to calculate LCC alongside LCA.

- Import all your building materials and quantities from Excel, BIM, or energy models. If you have already calculated your LCA, the materials can be used for LCC calculations.
- Operation and maintenance costs are automatically generated based on your location.
- Replacements are calculated based on the service life of your construction materials.
- All other costs can be added manually. You can edit the figures if you have project specific information.



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LCC calculation using BIM data

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https://youtu.be/cGU3sYi_xeI

Assessment

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Thank You

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