BUS GoCircular

Shaping a Circular Sustainable Future

Module 8

Material Impact in Relation to the Circular Economy

Circular Economy in the Construction Industry

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Summery

The trainee will cover several topics associated with material impact reduction in the construction industry. They will gain knowledge of Green Public Procurement, Life Cycle Analysis, Life Cycle Costing and Level(s) to a level fitting the trainees profession. These should all be illustrated practically where possible to allow the trainees to gain an understanding of how to apply these practices to their own work and future Multi-functional Green Roofs Facades and Interior Elements within their industry.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Objectives/Learning Outcomes

- 2 – Enact measures that optimise material use to strive for material efficacy
- 3 – Design with non-critical raw materials as defined by EU
- 4 – Design with non-toxic materials as defined by EU
- 25 – Evaluate and assess life cycle impacts of buildings, construction products and materials on the environment (emissions, soils, water, biodiversity, etc.)
- 36 – Make choice of materials between different tender options for multifunctional green roofs, façades, and interior elements
- 74 - Source local and lightweight materials for multifunctional green roofs, façades, and interior elements if possible

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Content

- Material Impact Reduction
- Green Public Procurement
- Life Cycle Analysis
- Life Cycle Costing
- Level(s)
- Application for Multi-functional Green Roofs Facades and Interior Elements

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Impact Reduction -

Embodied Carbon

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Impact on Indoor Climate

Materials have impact on the indoor climate,
and should mainly be oriented towards comfort.
They can be:

- Temperature Regulation
- Air Regulation
- Moisture Regulating
- Noise Regulating

Source: https://www.sciencedirect.com/science/article/pii/S1876610217355376

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Impact on Energy Use

Temperature Regulation

Include thermal insulation materials built into the outer walls and roof, and materials that reflect heat radiation or stabilize room temperature through high thermal capacity. They increase thermal comfort and reduce energy use for space acclimatization (heating and/or cooling). The technical demands of an insulating material usually are:

- High thermal insulation properties
- Stability and long lifespan
- Fire resistance
- Lack of odour
- Low chemical activities
- Ability to cope with moisture

Air Regulation

Usually composed of thin barriers covering the complete building envelope to resist air flows through the construction. The three major motives are to increase the thermal comfort for the inhabitants, reduce the risk of moisture problems and reduce the energy needed for space acclimatization. Air barriers are also used in internal walls between cold and warm rooms, where there is a chance of a draught being caused in the warm room.

Source: https://www.sciencedirect.com/science/article/pii/S1876610217355376

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Impact on Energy Use

Noise Regulating

Necessary to reduce transfer of sound of different types both in and between rooms, as well as between inside and outside, and to provide a good acoustic climate.

Moisture Regulating

Using for waterproofing, and to prevent vapour produced from people and processes inside the building from penetrating walls and roof and creating moisture problems, especially through condensation. They also include materials that can regulate and stabilizing moisture both within the construction and in the indoor air.

Source: https://www.sciencedirect.com/science/article/pii/S1876610217355376

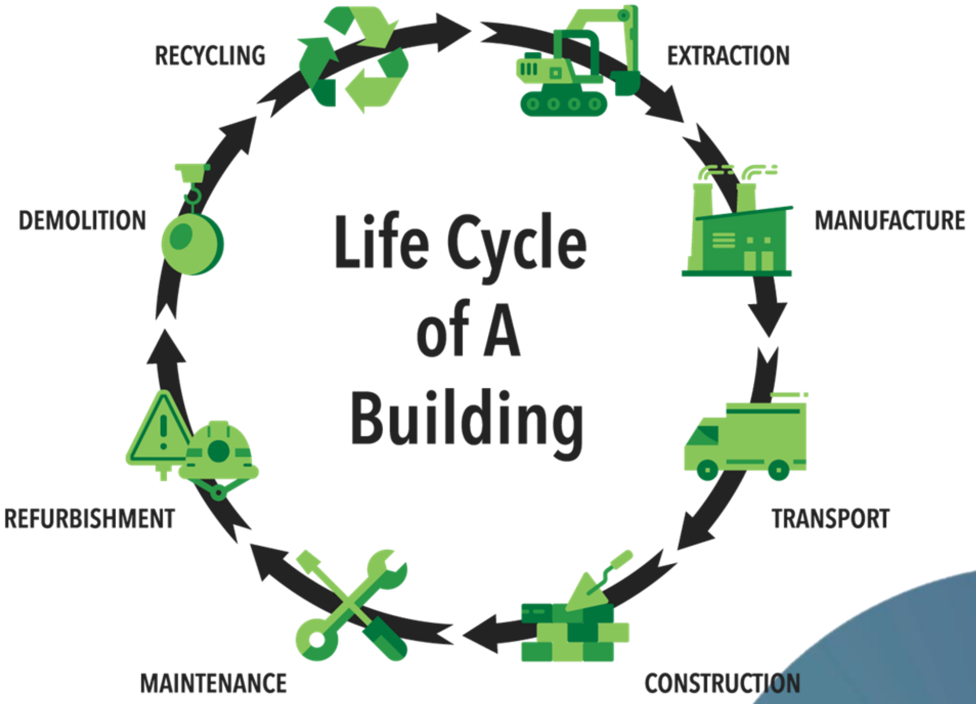
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Material Impact Reduction

“What cannot be *measured, cannot be improved*”

Therefore, a series of tools have been designed to measure and compare in a verifiable way the environmental performance buildings and materials, and to monitor the circular economy in the construction sector.

Life Cycle Assessment (LCA) is a methodology that calculates the potential environmental impacts of any type of product or building throughout its entire life cycle, or parts of it.



Source: Green Growth Project

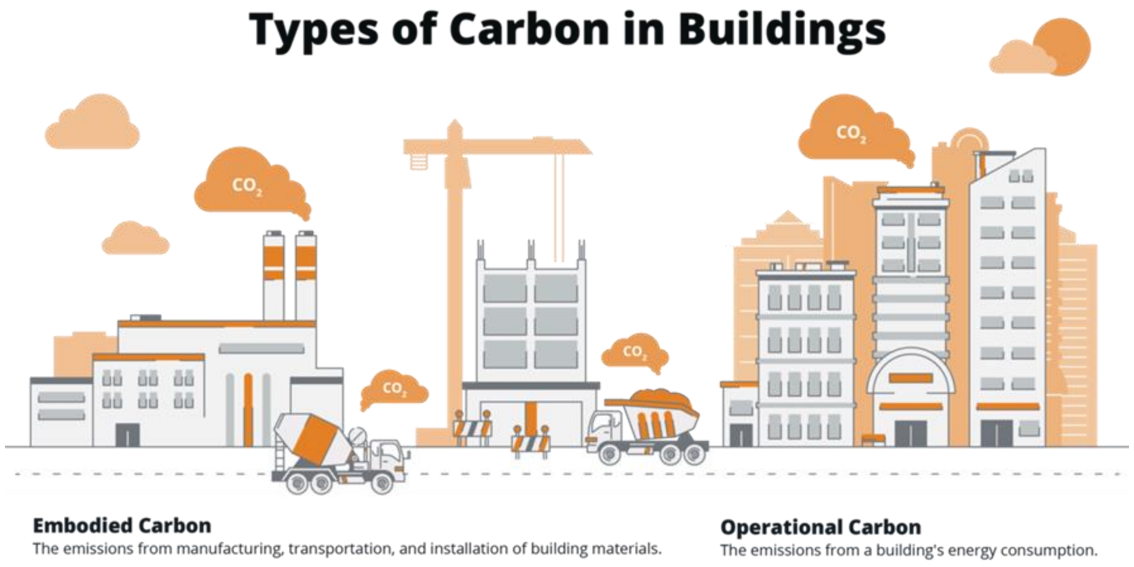
Source: https://gupp-class.eu/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

What is Embodied Carbon?

Upfront embodied carbon refers to the emissions associated with all the activities of:

- procuring, mining, harvesting raw materials,
- transforming these materials into construction products,
- transporting them to site and incorporating them into a building, and
- maintaining, replacing and removing and disposing at the end of their life.

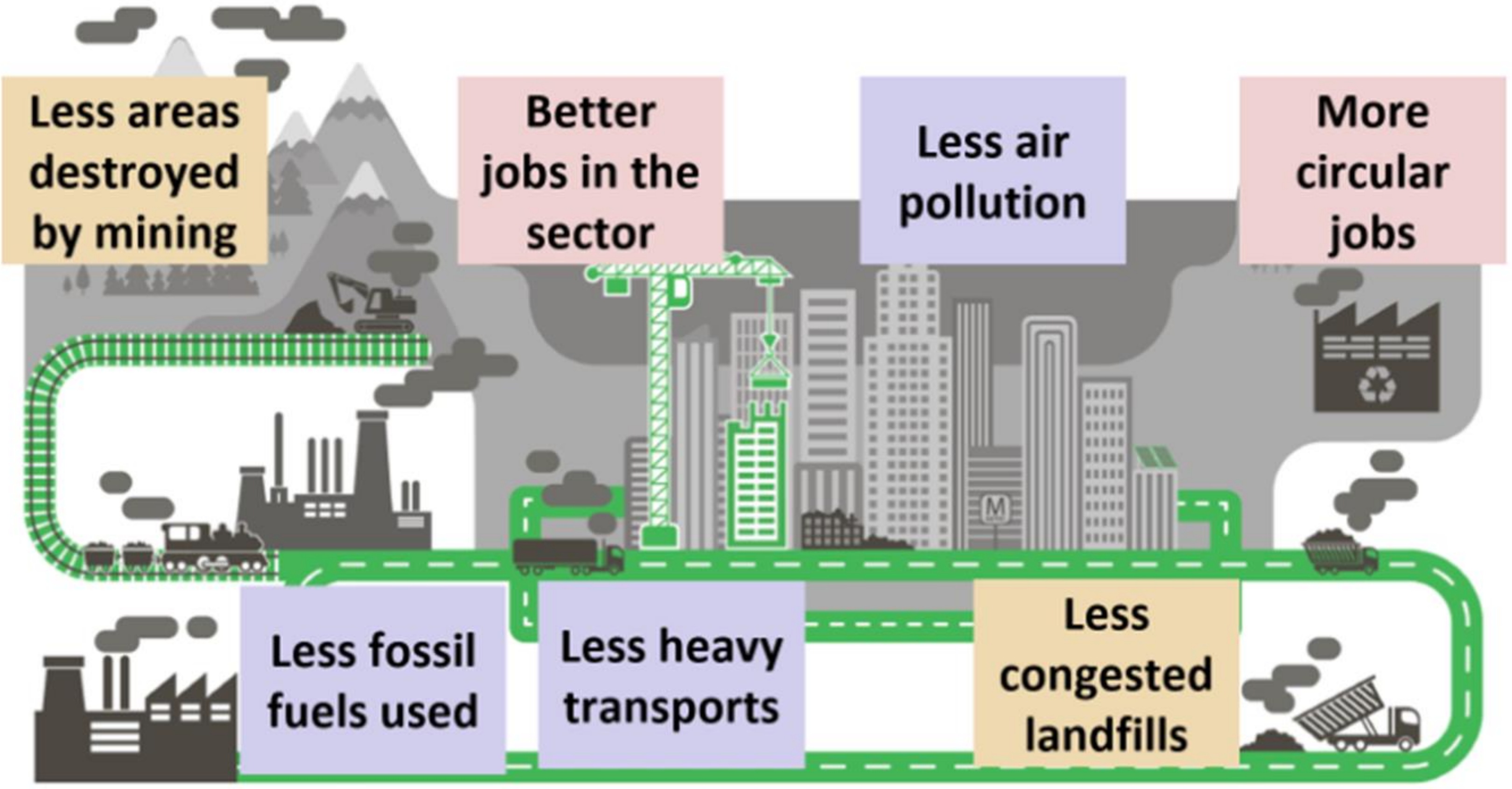


Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Embodied Carbon Reductions Benefits

Embodied carbon reductions benefit the broader society in many ways.



Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Reducing our building's embodied carbon

Reducing embodied carbon in buildings is critical to achieving net zero and carbon neutral construction targets. Yet there is much uncertainty about how to reduce embodied carbon. We will discuss some of the most effective approaches in these 10 easy-to-follow design rules or commandments.

Source: https://www.oneclicklca.com/embodied-carbon-reduction-in-construction/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Reducing Our Building's Embodied Carbon

- When reusing a product or a building, you are also saving on embodied carbon.
- This is the carbon dioxide emitted during the manufacture, transport and construction of new building materials, together with end of life emissions.
- Our carbon footprint has a negative impact on the environment in multiple ways: It is the main cause of human-induced climate change, it contributes to urban air pollution, it leads to toxic acid rain, it adds to coastal and ocean acidification, and it worsens the melting of glaciers and polar ice.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Baseline building

With a focus on practical solutions, a **baseline building design** helps to quantify the potential impact of adopting these practices.

Baseline building design

- **7000** m2 (75,350 ft2) office building
- **7** above-ground floors of each 1000 m2 (10,760 ft2)
- **2** underground parking levels
- **Precast concrete frame**
- **60**-year assessment period, assuming that the building would be kept in a condition for leasing to third parties.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

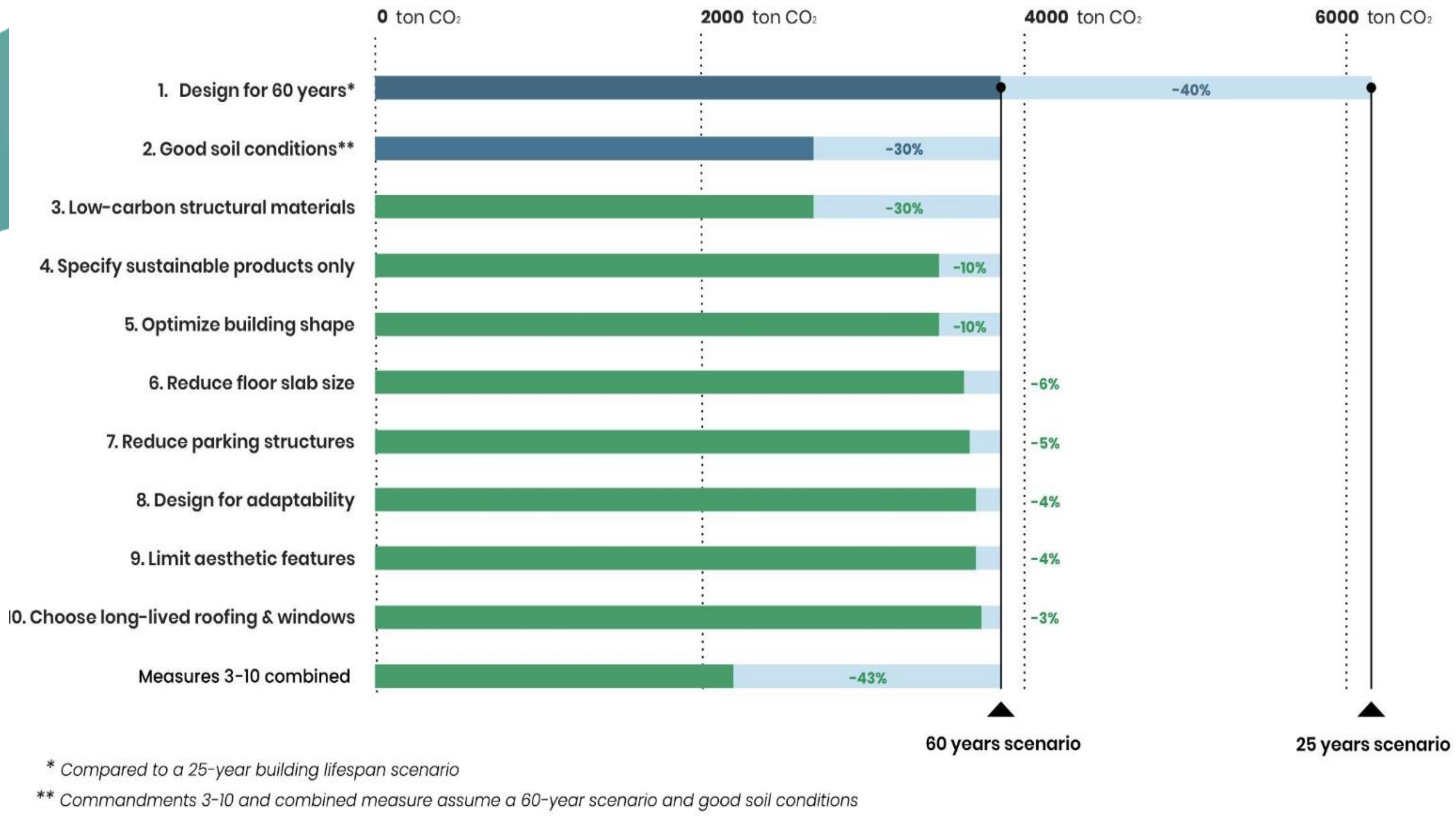
Reducing embodied carbon: Before we start.....

When you begin working on embodied carbon, make sure that your building has a decent energy performance and whatever low carbon energy supply options your locality can offer.

Avoid sites where transport relies on private cars or with long transport distances for users. These provide a solid basis for further decarbonization.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740



Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 1 - Do not build for short term

Ensure demands support a permanent building. **Optimizing the life-cycle impacts for anything less than a 60-year span is not worthwhile.** If the need for the building is not sustainable, for example, due to ongoing demographic change or zoning changes elsewhere. This may be addressed by designing either a building that's highly adaptable or with a modular transportable building that satisfies the demand for a shorter period of time.

Potential carbon savings in the baseline building

40-50%

If the service life is limited to 25 years, the annualized materials-driven carbon impacts are 120% higher. If the building can be converted to another use, the impact is reduced even further.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Longer lasting materials

Materials and transport | Maintenance and material replacement | Demolition

Example 1: Material that will last over 60 years building life time

Manufacturing | A4 | C3-C4

Example 2: Material that will last 40 year
Replacement after 40 years

Manufacturing | A4 | Manufacturing | A4

Source: https://gupp-class.eu/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 2 - Avoid sites requiring soil stabilization

Deep foundations can mean high emissions

Soil conditions greatly impact the stabilization and foundations your project will require. If your site requires massive foundations to support the building, reconsider the site. If you are committed to the site, see if you can place the building mass on the site to optimize the distance to bedrock as it likely varies within the site, and also consider opting for a less heavy structural solution, for example, timber or steel. Finally, avoid cast-in-place concrete, which tends to result in the heaviest of all structural solutions.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Avoid sites requiring soil stabilization

Potential carbon savings in the baseline building

30%	The foundations share of embodied carbon impacts is 40% when also considering replacements during life-cycle (not needed for foundations).

NOTE: for commandments 2-10, we have used a 60-year building lifespan scenario to more accurately depict the impact of each measure.

Source: https://gupp-class.eu/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 3 - Consider structural options

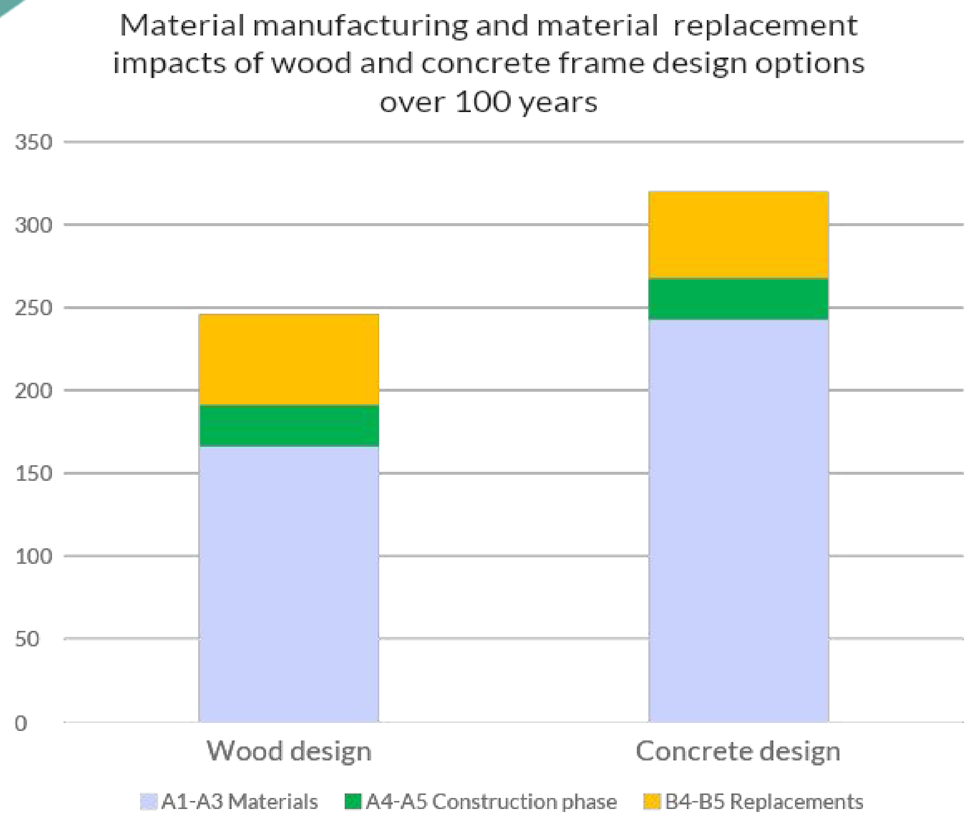
Could a lighter or timber framework?

Choosing wood structures, when the requirements allow for it, can reduce embodied impacts substantially in most projects. In our example building, this embodied carbon reduction – when measured over the whole life-cycle – would lead to a reduction of around 30%.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Wood versus Concrete structure



Also notify smaller scale changes such as:

- Wood based insulation vs. mineral or plastic based option
- Wood cladding (interior or exterior)
- Wooden doors and windows

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Consider structural options

Potential carbon savings in the baseline building

30%

The share of embodied carbon impacts for structural materials is always substantial, and in our example building, nearly three quarters.

NOTE: for commandments 3 - 10, we have assumed good soil conditions and used a 60-year building lifespan scenario to more accurately depict the impact of each measure.
One Click LCA’s Carbon Designer tool allows users to quickly evaluate the impacts of common structural materials using building geometry.

Source: https://gupp-class.eu/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Set clear requirements and select the right suppliers

- Setting environmental performance requirements for materials and products is an effective way of reducing impact while achieving exactly the same design and performance.
- The requirements could specify minimum carbon performance targets or other measures such as stipulating the use of recycled binders for concrete, for example.
- This strategy works effectively for all materials where supply is competitive and some suppliers are willing to supply products with improved environmental performance.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Greener Manufacturers (Maing Manufacturing Greener)

Some manufacturers may have improved their process efficiency

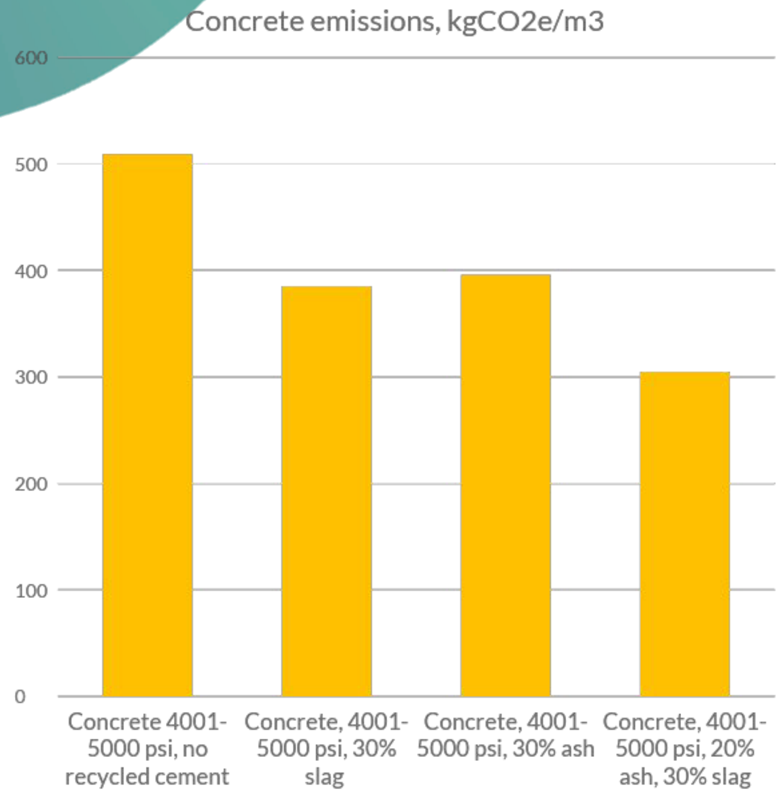
- Better efficiency of processes, less energy, waste and water
- Choosing renewable energy options

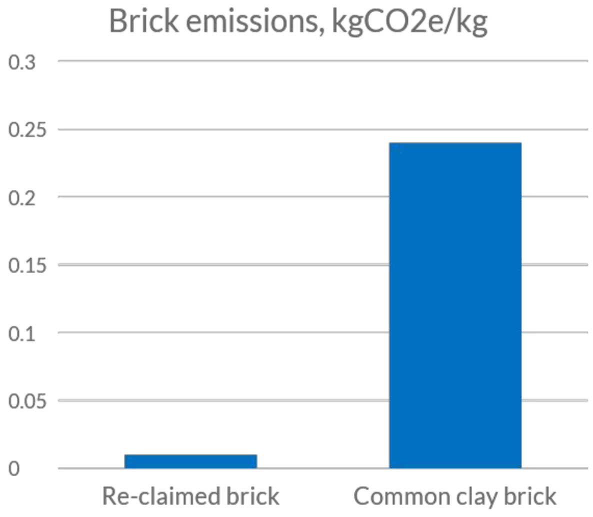
Rebar steel emissions, One Click LCA comparison of European and Asian manufacturers based on EPD's, secondary route (over 90% recycled content, kg CO2/kg of steel.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Recycled materials





Source:IMPACT database

Source:EPD Norge, World steel

Source:EPDs from National concrete association, US https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 4 - Choose low-carbon products

Potential carbon savings in the baseline building

10%	In the example building, when structural concretes and steels were changed to lower impact products, the whole building materials life-cycle impacts were reduced by 10%. Looking carefully at what you source can make substantially greater reductions.

One Click LCA's materials database contains over 100,000 different construction materials environmental impact profiles for different products, technologies, suppliers and products.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 5 - Optimize the building shape

Achieve a mass reduction with a compact shape

- As a general rule, a simple shape is more materials- and energy-efficient.
- Building in a square shape is not always possible due to daylighting, zoning, functional, or space distribution requirements.
- A more complex building shape drives external walls demands, and also requires additional access corridors.
- If the building requires additional staircase and elevator shafts in different locations, this also creates demand without additional corresponding available room area.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Optimize the building shape

Potential carbon savings in the baseline building

10% If the example building were built as a three-storey elongated building, the embodied carbon impacts would be approximately 10% higher. Also, this increases the envelope area, and, as a result, the energy loss via the building envelope.

One Click LCA's Carbon Designer allows users to consider the impacts of the number of floors, building shape, floor height and additional parameters for the materials demand as well as resulting embodied carbon impacts.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 6 - Design thinner floor slabs

Reduce both slab and envelope use

- Slabs are a major contributor to the embodied carbon of a building. Unlike the envelope area, the amount of slabs scales linearly with the internal area required.
- Slabs provide structural, acoustic and fire resistance capabilities for the building, among others, and may embed piping or other installations.
- Reducing the net thickness of slabs by 10 cm reduces the building envelope height correspondingly, thus saving materials from slabs and walls, and energy via reduced conductive loss.
- Some good practices include using innovative technologies, including Deltabeam, Bubbledeck, and hollow core slabs in concrete construction. This kind of change can reduce building life-cycle embodied impacts by approximately 6%.

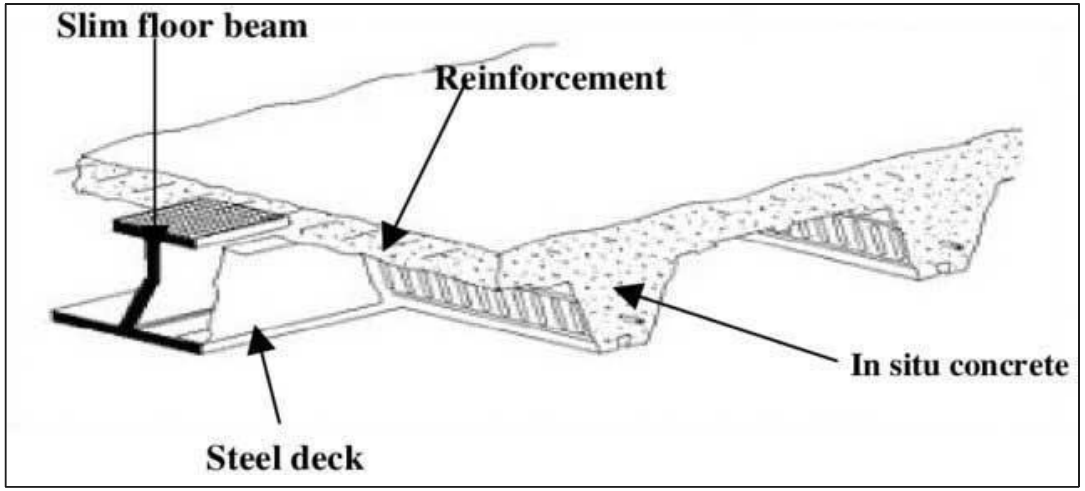
Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Design thinner floor slabs

It is also worth noting that having shorter grid spans for columns makes it possible to use **lighter and less steel- and cement-intensive slabs**.

This will have to be balanced against the impact it has on the materials used in the columns and the potential impact on the future adaptability of the spaces. Some types of slab systems also have higher impacts, and care should be paid to the overall design and choice of the floor slabs used.



Source: Eyad Sayhood, Mohammed Mahmood. "Non-Linear Behavior of Composite Slim Floor Beams with Partial Interaction", European Journal of Scientific Research, 56(3):311-325, July 2011.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Design thinner floor slabs

BUS GoCircular

Potential carbon savings in the baseline building

6%	In the example building the share of embodied carbon impacts for all slabs is around 45%. Reducing the net thickness of slabs leads to potential carbon savings of around 6%.

One Click LCA's database includes 50+ pre-built slabs as well as ready-to-use solutions for most innovative beam and deck technologies. A module for creating and calculating your own constructions / groups is also available.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 7 - Do not built separate parking structures

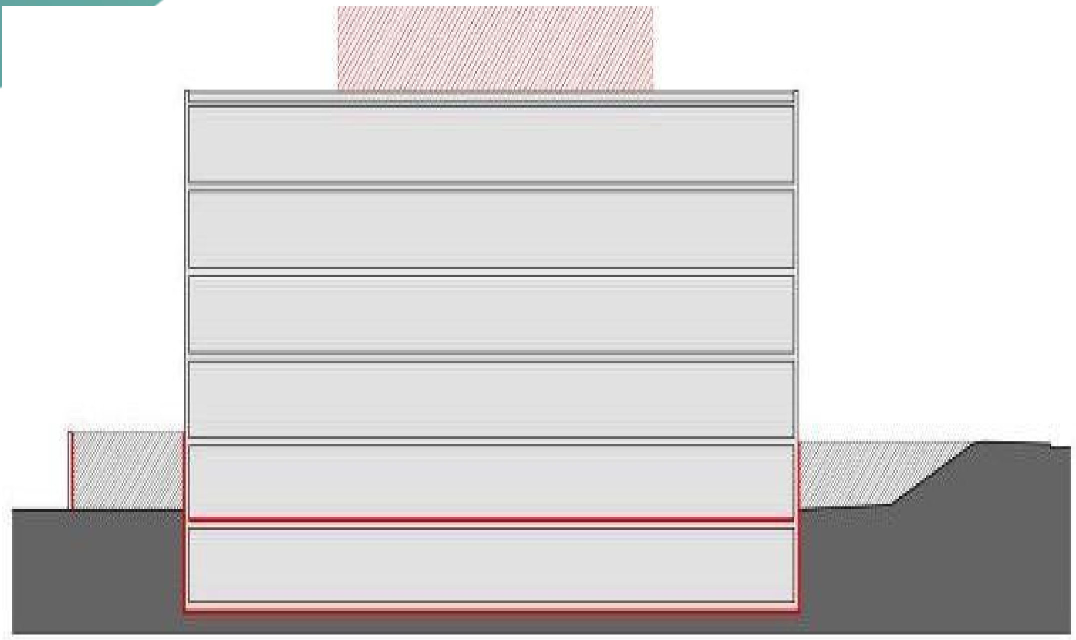
Apply parking policies to shift demand

- If your zoning laws allow it, try to reduce the number of parking spots, in particular, underground parking spots and places in parking towers.
- If you have to have parking spaces below the building, consider raising the building so that the building stands on pillars with an open area for parking below the building.
- **This will save a substantial amount of materials in needless walls around the parking spaces.**

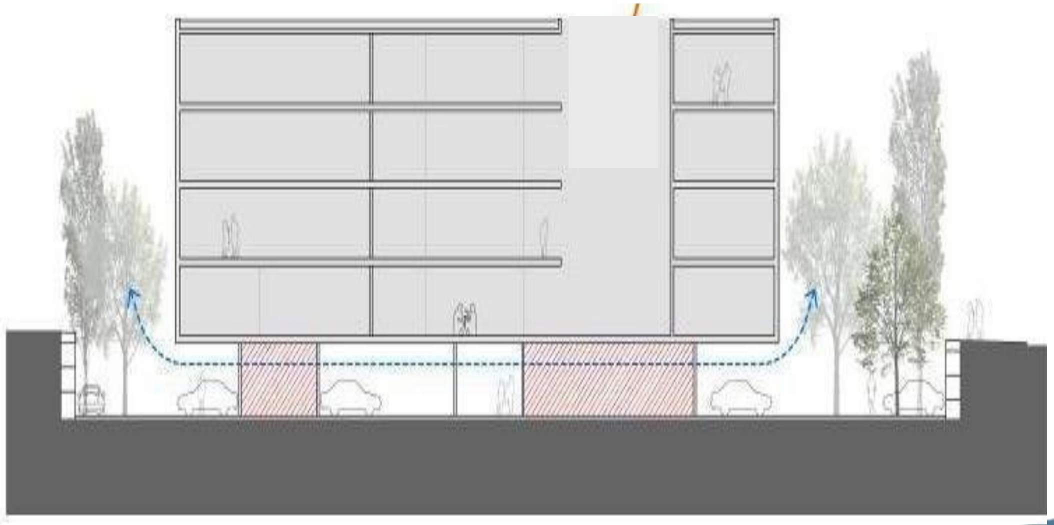
Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Do not built separate parking structures



Conventional: retaining walls and floor slab in contact with the ground



Demand reduction: no retaining walls or floor slabs in contact with the ground

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Do not built separate parking structures

BUS GoCircular

Potential carbon savings in the baseline building

4.8%

The share of embodied carbon impacts for parking structures is 7% (in the initial case with the parking mix heavily dependent on private cars). If the initial mix of underground and above-ground parking could be shifted to only above-ground parking places, these impacts would be approximately 69% lower, so an overall potential carbon saving of 4.8%.

One Click LCA's Carbon Designer module includes an optional calculation for underground parking floors. Further, operational transport carbon impacts can be accounted for using One Click LCA's Site Designer.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 8 - Use movable or refurbish-able wall elements

To solve space redistribution issues

- As floorplan configurations may often change, it is good practice to use reusable and possibly movable internal walls to the extent that they work for the building function.
- Similarly, electrification that tracks seating arrangements in office buildings.
- If this practice is not applicable to your project, consider applying construction methods that make it possible to remove the boards intact. (Design for Disassembly)

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Use movable or refurbish-able wall elements

Potential carbon savings in the baseline building

4%	We have assumed that half of the internal walls in our example building are load-bearing, but that the rest would require rebuilding every decade to fit changing floorplan demands. In this case, the material life-cycle impacts would be around 4% higher, compared to a scenario where wall configuration could remain in place until the material reaches the end of its service life.

One Click LCA allows you to set the service life for each material to reflect their actually foreseen replacement frequency as well as eventual reuse.

Source: https://gupp-class.eu/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 9 - Avoid elements with limited value

E.g. flooring, ceiling or facades

- If your cladding or façade material provides mainly an aesthetic function, consider omitting the layer.
- If your internal ceilings are not providing e.g. acoustic or fire protection, the entire element could be removed.
- This will also allow better maintenance access to installations and cabling.
- The same considerations apply to flooring: a simple polished concrete floor could be a good option for some types of spaces (while not all).

Potential carbon savings in the baseline building

4%	The share of embodied carbon impacts for internal ceilings is circa 1%. Furthermore, the building is cladded with an aesthetic steel facing, which has life cycle impacts of around 2%. Avoiding the flooring altogether would achieve impact reductions of around 4%.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Early stage LCA

LCA performed early in the design process results in the highest carbon reductions and lowest costs. As the project progresses, the ability to reduce carbon decreases drastically

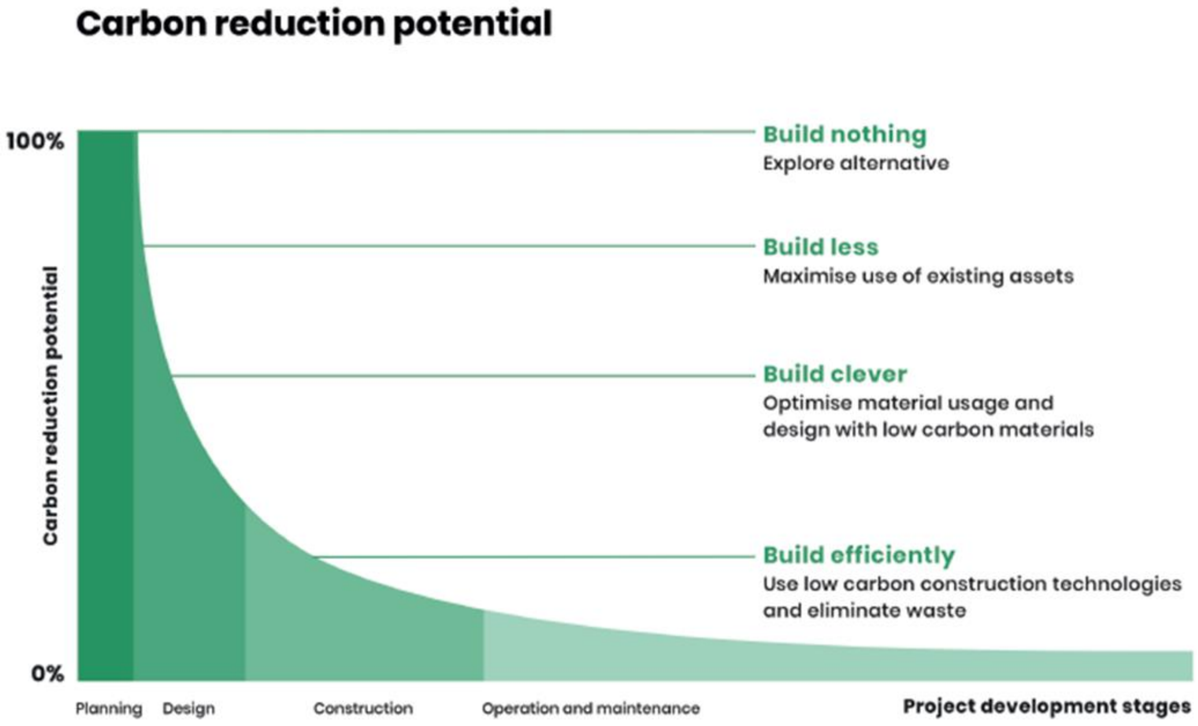


Fig 6. Opportunities to reduce embodied carbon reduces as the project progresses (Decarbonizing construction, 2021, WBCSD)

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Commandment 10 - Choose long lived solutions for windows & roofing

- Investing in durable materials means fewer replacements over time, which means fewer carbon emissions, less waste generated, lower life-cycle costs and less tenant disruption.
- What is a durable and suitable material for your market varies depending on the conditions, however, the principle remains the same.

Potential carbon savings in the baseline building

3%	*Depending on your project conditions, specifying longer-lived systems can save both carbon and money. This will be dependent on conditions but can achieve several percentage points of life-cycle embodied carbon reductions – in our example project between extreme cases the difference would be in the order of 3%.*

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

10 Commandments

These are our top **10 Commandments**, but there are many more. Including many innovative designs and products or applying some of the following practices:

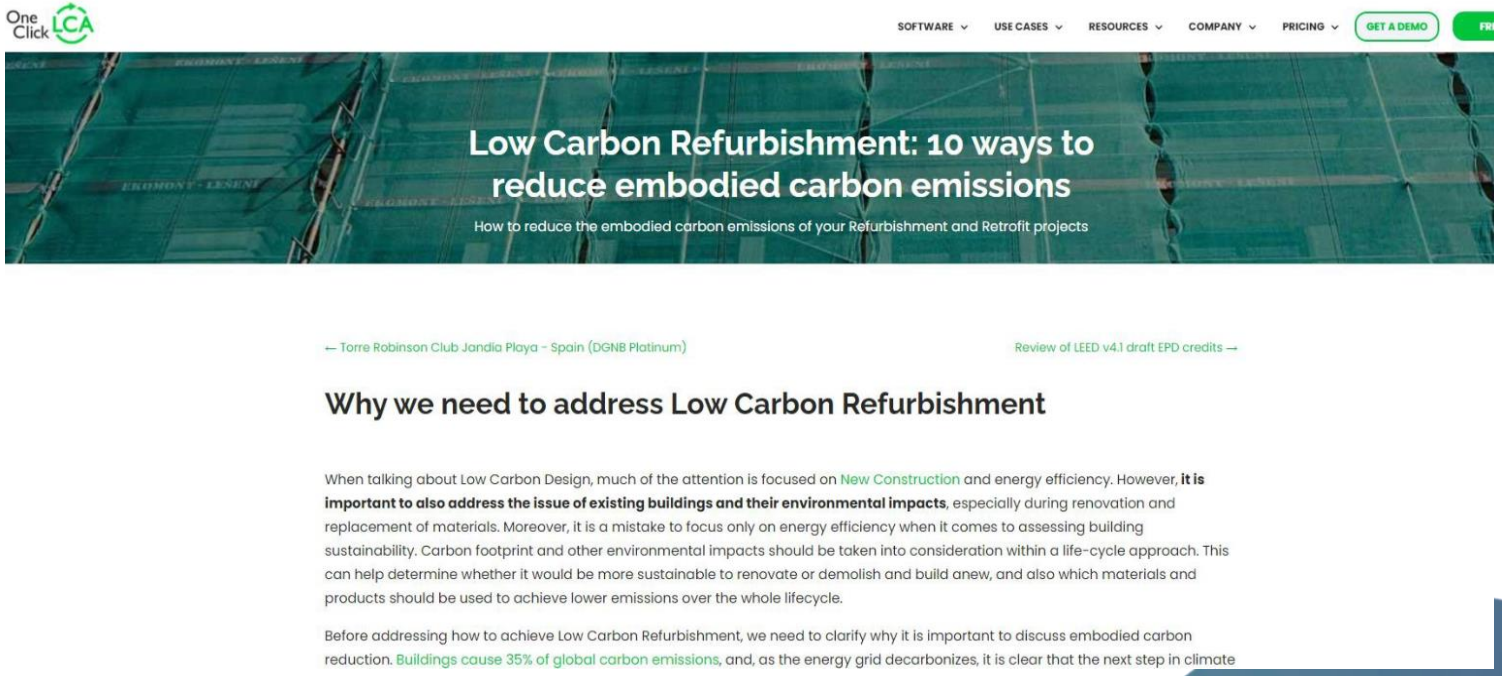
- Incorporate design for disassembly and other circular economy principles into your design.
- Buy local materials wherever possible to reduce transport impacts.
- Ensure structural material strengths are not generalized but optimized for different uses.
- Reduce waste through careful specification and buying with takeback agreements.
- Consider the longevity of the materials that you use – if it needs to be replaced frequently its impact will be greater.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Further Information

If you are interested in refurbishment, you can look at 10 ways to reduce embodied carbon emissions in refurbishment: https://www.oneclicklca.com/low-carbon-refurbishment/



Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Green Public Procurement

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Green Purchasing

Green Public Procurement
(GPP) or Green Purchasing.
€1.8 trillion
is spent by EU public authorities each year
(14% of EU GDP)
GPP aims to use this power to drive the market for more sustainable goods and services choosing environmentally friendly goods, services and works, they can make an important contribution to sustainable consumption and production

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Key choices about building design to reduce impacts

- Construction products (recycled materials such as aggregates from construction and demolition waste)
- Transportation of aggregates to production sites by rail or shipping
- Environmental management of construction and demolition waste

Construction and use of buildings in the EU:

- Uses approx. half of all materials extracted
- Consumes 40% of energy
- Consumes 1/3 of water
- Generates 1/3 of all waste

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

GPP Impact

GPP can affect environmental impact:

- **Directly** – through improved environmental performance of goods, services and works bought
- **Indirectly –** through using this market leverage to encourage companies to invest in cleaner products and services

How can GPP help?

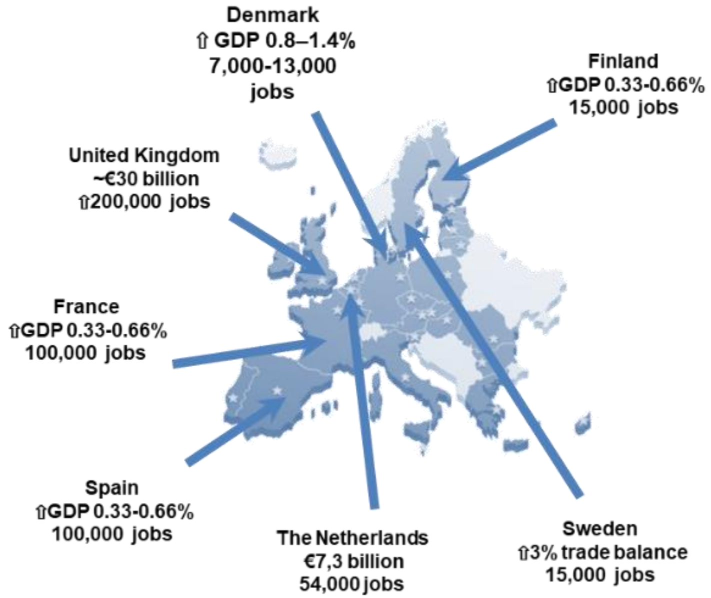
- Require extended product lifetimes, and guarantee of spare parts
- Demand reduced or reusable packaging
- Encourage the use of recycled materials in construction

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

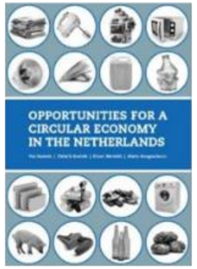
Circular Benefits

Studies show the Circular Economy pays:



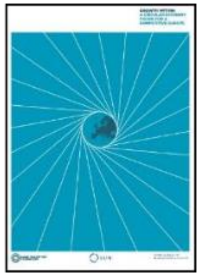
Source: EU GPP training toolkit

$630 BILLION (EU)
THROUGH MATERIAL SAVINGS
(ELLEN MCARTHUR FOUNDATION, 2013)



€7.3 BILLION (NED)
BY 54.000 NEW JOBS
(TNO, 2013)

AVAILABLE IN ENGLISH, FRENCH, UKRAINIAN AND POLISH
(CLUB OF ROME, 2015)



+$1200 BILLION (EU)
THROUGH ADDITIONAL BENEFITS
(ELLEN MACARTHUR FOUNDATION, 2016)

Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

What is Circular Procurement?

Circular procurement definition:

Circular procurement can be defined as the process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains, whilst minimising, and in the best case avoiding, negative environmental impacts and waste creation across their whole life-cycle.

Public procurement for a circular economy.

European Commission, 2017 (p.5)

Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Construction

Opportunities:

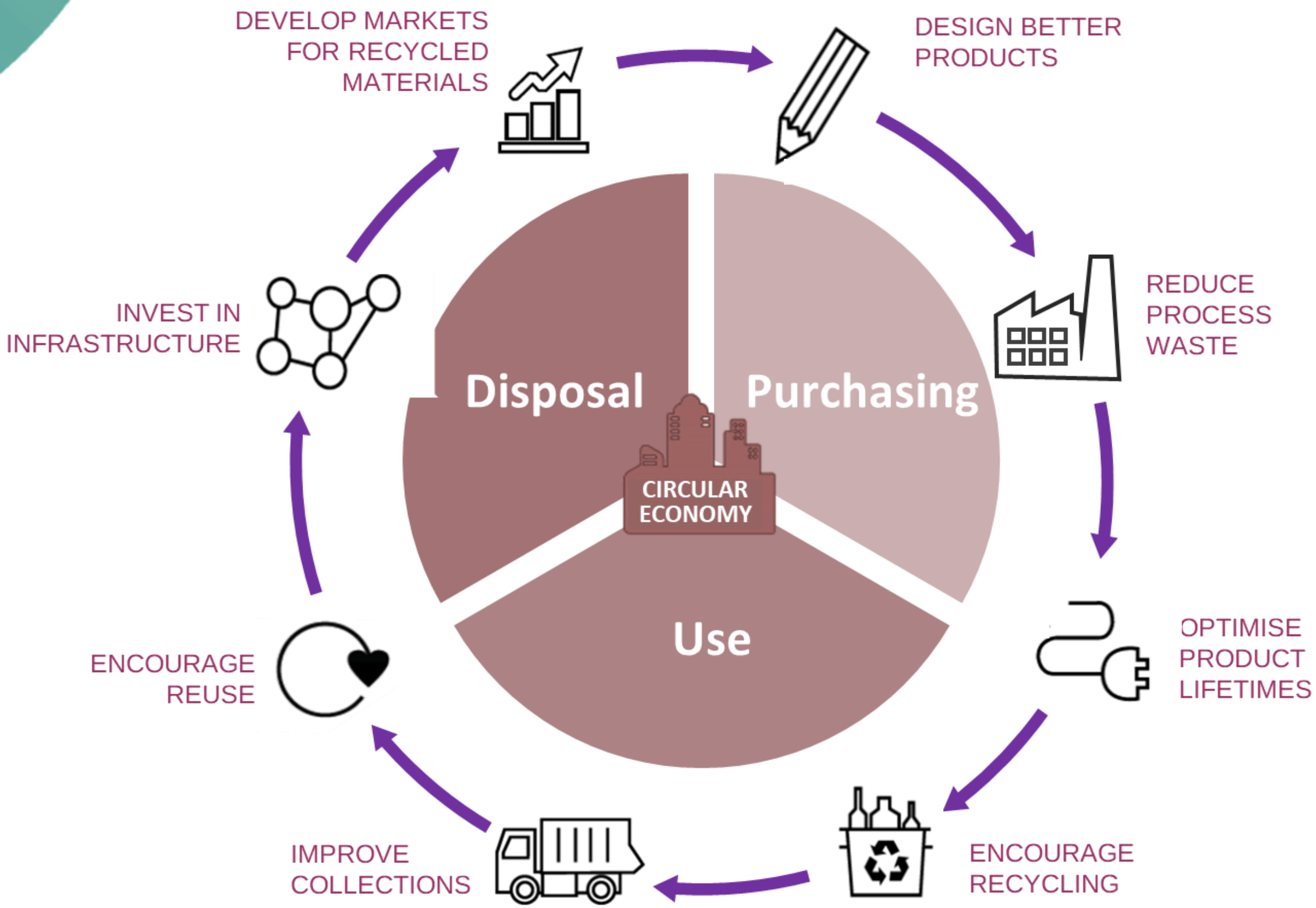
- Design for deconstruction
- Recycled content
- Multiple REBMs
- CO_2 reduction
- End of Life - closing material loops
- Refurb & maintenance
- Cost savings

- Brummen, Netherlands - circular Town Hall
- Netherlands – DBFM, Rapid circular contracting
- BAR HQ, Portsmouth, UK – Whole Life Costing & BIM
- Viaduc de Millau, France- build, fund & operate (BFOT)

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Procurement Cycle

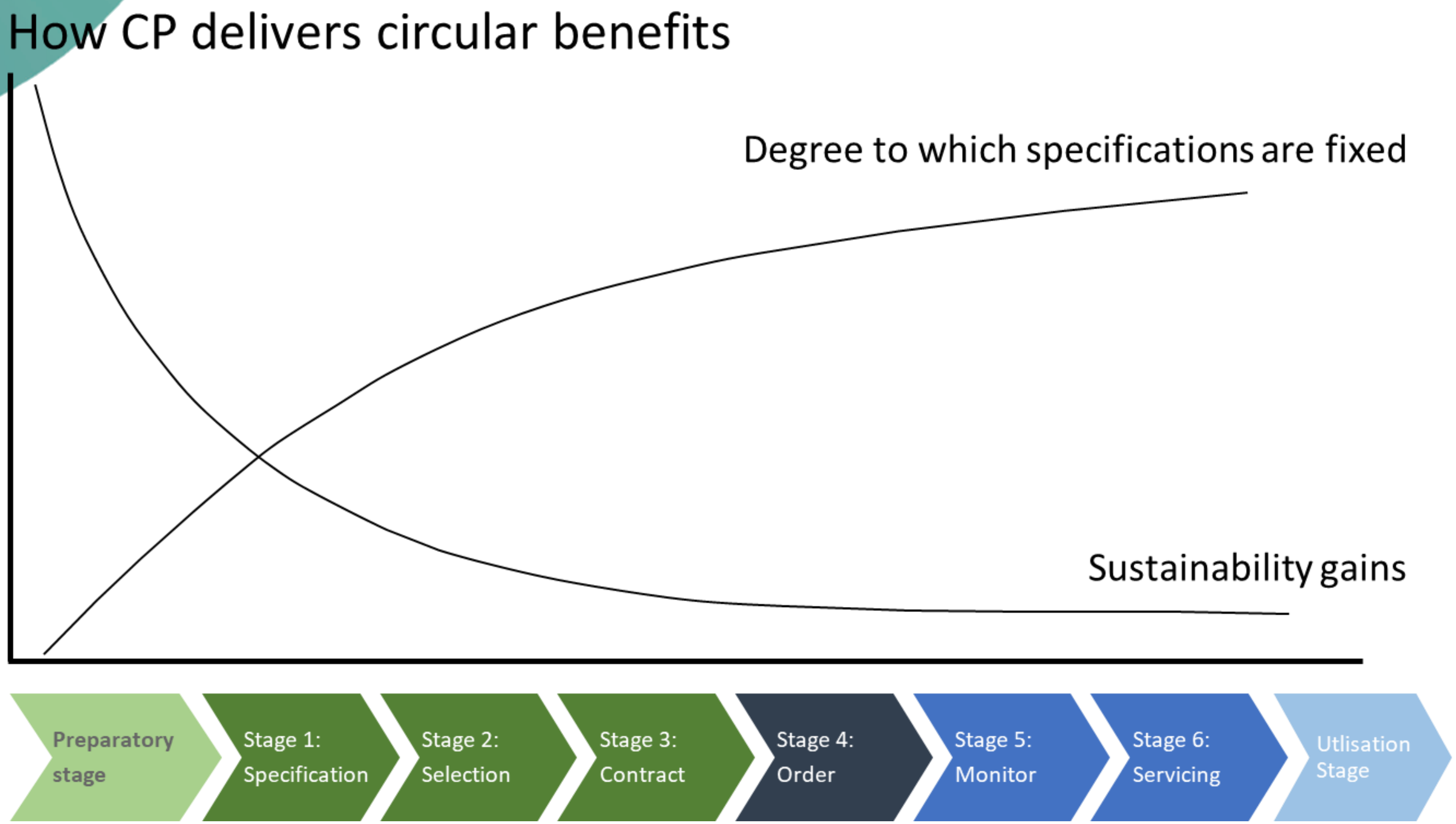


Circular procurement opportunities

Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Procurement Cycle Impact

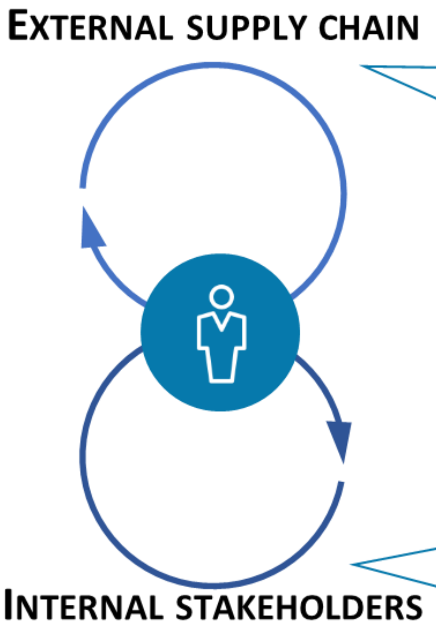


Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Stakeholder Engagement

The importance of collaboration



- Who are relevant external stakeholders?
- What are their Circular ambitions and Interests?
- make optimal use of external knowledge, innovative ideas, out-of-the-box solutions etc during the whole project
- Build a collaborative (trust) relationship

- Use CP to support the interests of internal stakeholders
- make sure circularity is part of the project aims as early as possible
- ‘connect ‘all relevant stakeholders
- What are the implications of CP for the use and end of life phases of the product?

1. Identifying stakeholders
2. Mapping stakeholder interests
3. Involving stakeholders in preparation
4. Involving stakeholders in procedure

Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

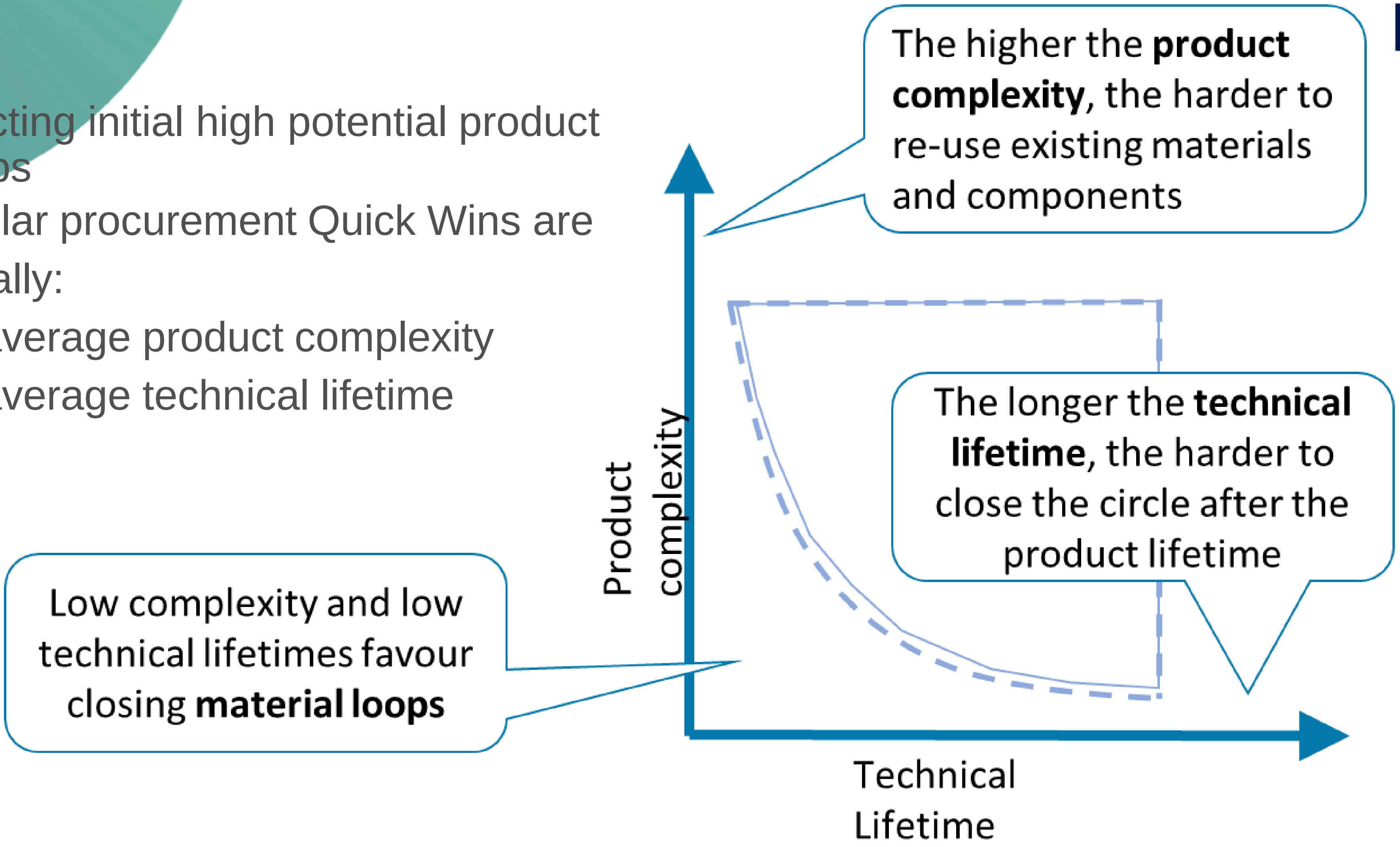
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Product Categories

Selecting initial high potential product groups

Circular procurement Quick Wins are typically:

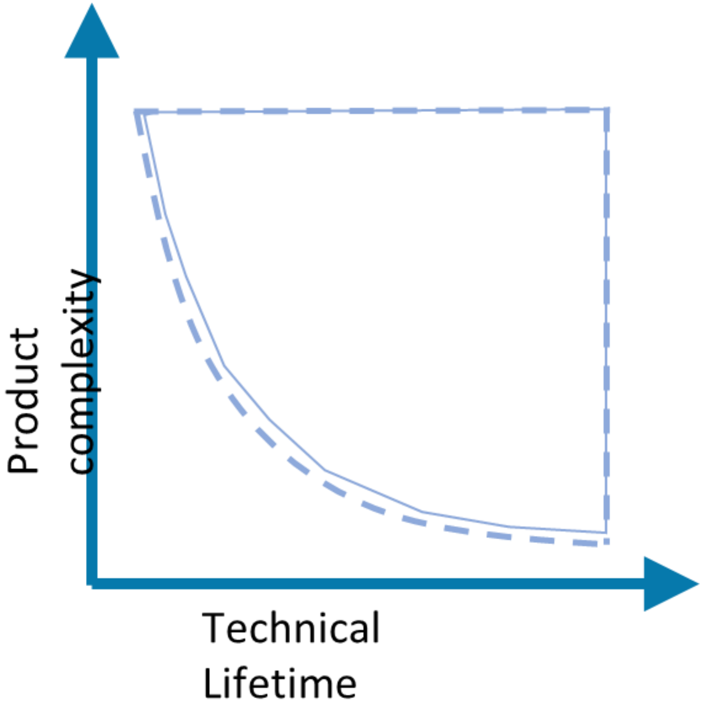
- average product complexity
- average technical lifetime



Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Exercise



Use the knowledge you have to assess your own high potential product groups on the chart above

What are your organisations high-potential product groups?

Spend

- How big is the category spend?

Risk

- What level of risk does this category pose?

Scope

- What scope have you to improve sustainability?

Influence

- What influence have over this market and supply chain?

Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Common examples

Product complexity vs technical lifetime

Construction projects (infrastructure and buildings) are highly complex with multiple products but also create the opportunities for large scale impact through circular procurement.

Construction procurement can also help create markets for recycled materials by specifying requirements for recycled content.

Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Conclusions

Three key points:

- **Process** – challenge the need, consider circularity early and collaborate
- **Technical** – market engagement to understand what is possible as well as what is available
- **Finance** – circular business models help facilitate circular procurement

GPP Helpdesk

For further support on GPP, contact the EU's free

Helpdesk

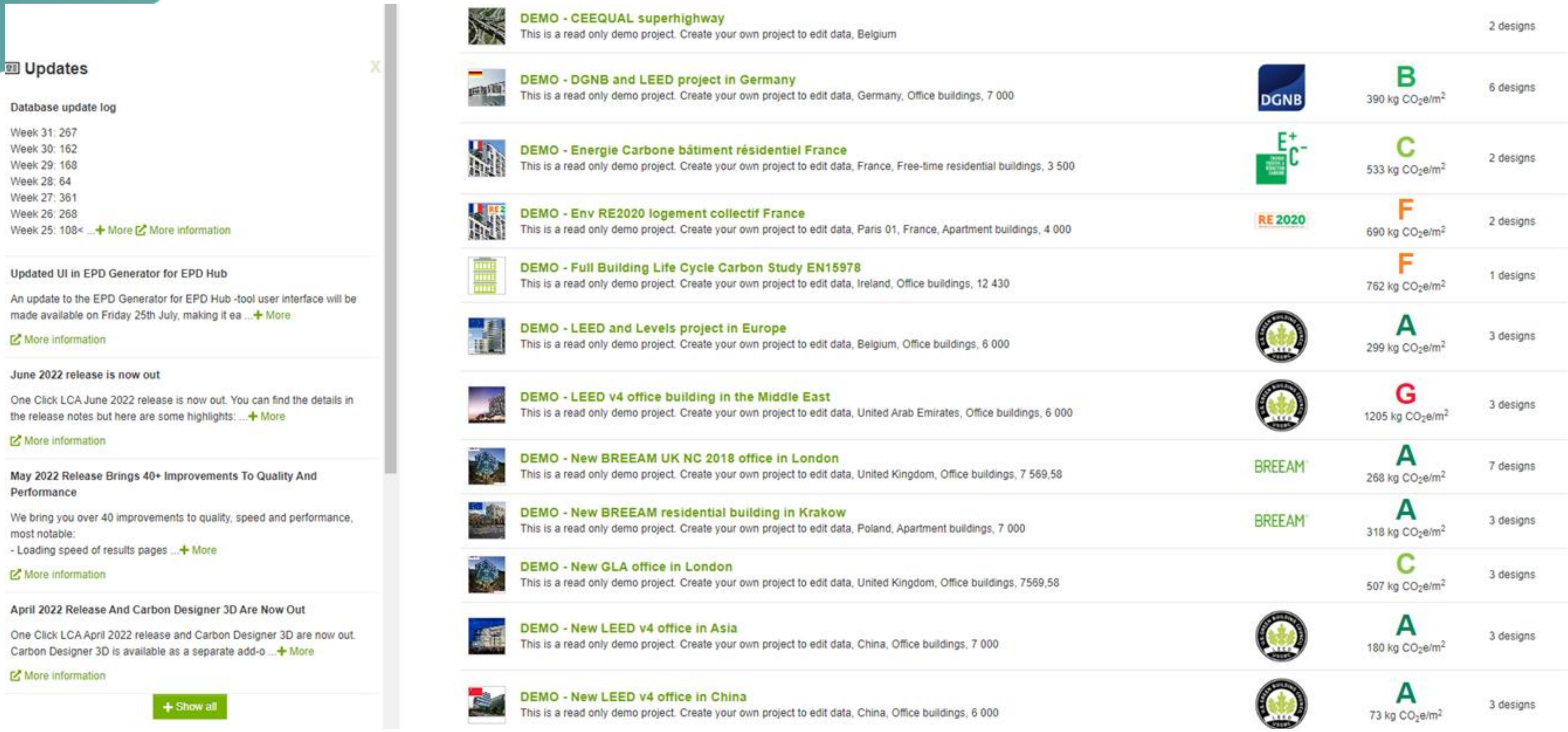
Source: https://gupp-class.eu/ https://ec.europa.eu/environment/gpp/toolkit_en.htm

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Life Cycle Analysis

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Workshop



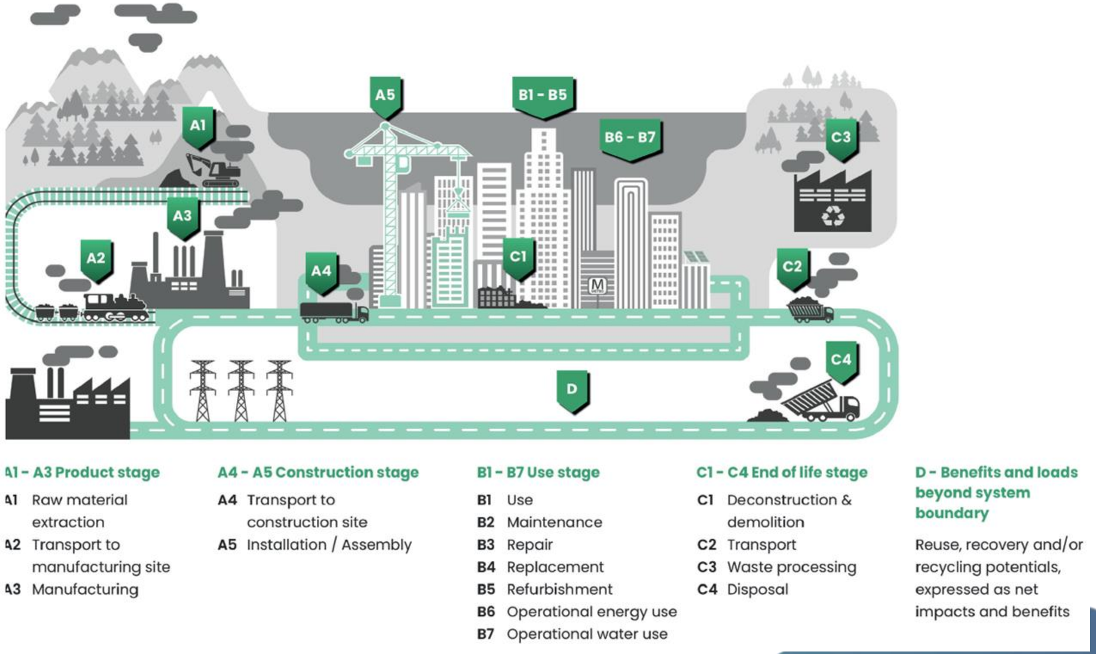
https://www.youtube.com/watch?v=rBmfNYjJpzY&t=2s&ab_channel=OneClickLCA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Introduction to LCA

The different periods of a building’s life are known as its **life-cycle stages**. They are referred to as **product, construction, use, end-of-life and benefits beyond the system boundary.**

The processes involved in the life-cycle stages of a building releasing gaseous, solid, and liquid emissions into the air, water, or soil can negatively impact the environment and humans.



Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFslOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

What cannot be measured cannot be improved

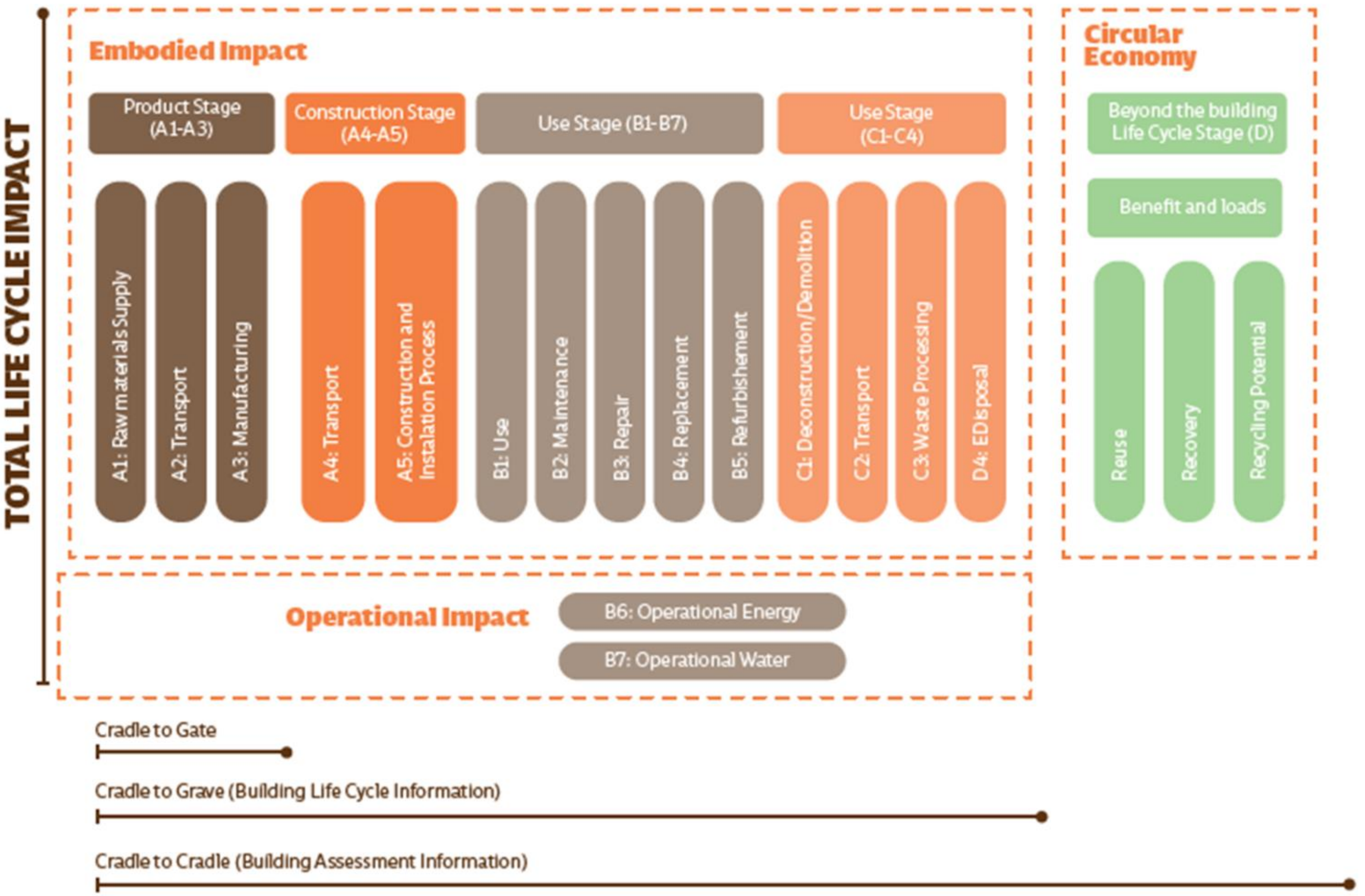
Life Cycle Assessment (LCA) is a methodology that quantitatively analyses and evaluates the potential environmental impacts of any type of product, process or service throughout its entire life cycle, or parts of it.

The environmental impacts of a building, system or construction product can be measured in certain sections of its life cycle, these sections are:

- **"From the cradle to the door".** This is the "product stage", comprising the extraction and processing of raw materials, transport to the factory and manufacturing.
- **"From cradle to site":** Comprises the "product stage" plus the "construction stage".
- **"From the cradle to the grave".** It covers the complete life cycle, including demolition and valuation as waste.
- **"From cradle to cradle"** is the life cycle of the complete product taking into account its reinsertion in the production chain if it is reused or recycled.

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740



Source:https://growgreenproject.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

LCA in Construction

In the field of construction, the LCA is applicable to a **material, a construction system, a building or an infrastructure.**
The reference documents for the development of an LCA are the international standards ISO 14040:2016:2006 (LCA: principles and framework for LCA)
and
ISO 14044:2006 (LCA: requirements and guidelines).

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

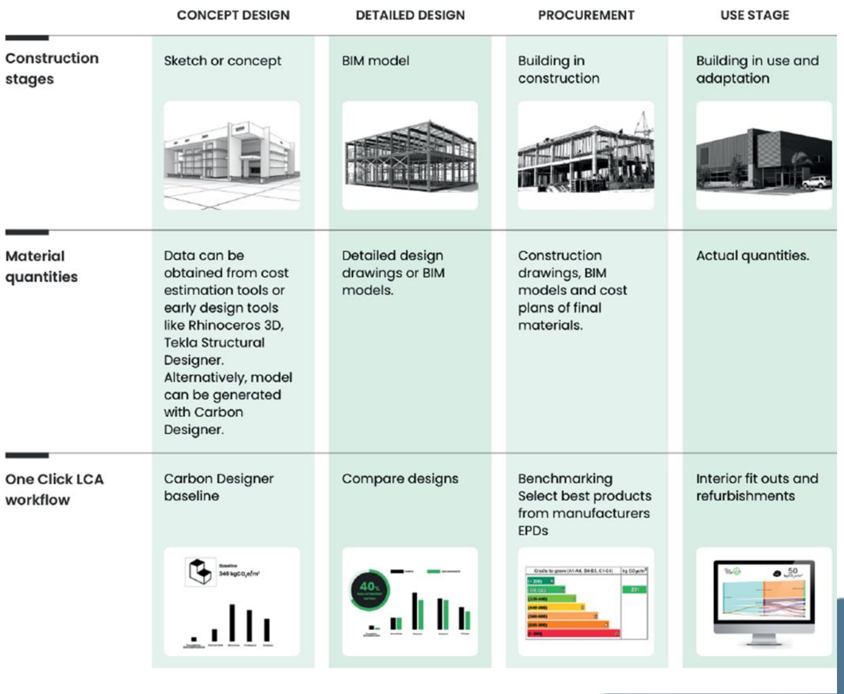
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

LCA at different Design Phases

A building goes through several design phases: **concept design, detailed design, construction and procurement, and use phase**. The level of detail required for carrying out LCA depends on the data available at each stage.

A **screening LCA** is usually performed in the concept design phase to identify material and building element hotspots, using available data.

A **comparative LCA** can be performed at the detailed design stage and uses more accurate and relevant data to choose the best design alternatives. The most accurate LCA is performed after the construction and procurement stage using the actual material quantities and information about the exact materials.



	CONCEPT DESIGN	DETAILED DESIGN	PROCUREMENT	USE STAGE
Construction stages	Sketch or concept	BIM model	Building in construction	Building in use and adaptation
Material quantities	Data can be obtained from cost estimation tools or early design tools like Rhinoceros 3D, Tekla Structural Designer. Alternatively, model can be generated with Carbon Designer.	Detailed design drawings or BIM models.	Construction drawings, BIM models and cost plans of final materials.	Actual quantities.
One Click LCA workflow	Carbon Designer baseline	Compare designs	Benchmarking Select best products from manufacturers EPDs	Interior fit outs and refurbishments

One Click LCA solutions for each project stage

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Business case for LCA

By far, the most common goal for the use of building LCA is **decarbonizing the construction sector and ensuring competitiveness in an increasingly carbon-aware market**.

With the growing focus on sustainability, investors, end-users, and tenants are increasingly looking for ways to assess and reduce the lifetime environmental impact of their projects. **Conducting a building LCA demonstrates a commitment to measuring and reducing the environmental impact of construction projects.** It also provides sound market advantages for actors across the supply chain.

Depending on your role within the construction supply chain –

- investor,
- designer,
- engineer or consultant

the business drivers for performing LCAs may vary.

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Business case for LCA

Decarbonise construction projects

Incorporating a life-cycle perspective in projects can help project owners attain **carbon reductions and transparency, regulatory compliance and certifications**. Moreover, it is needed to meet the net-zero and low carbon targets which end-users, investors and tenants value. Various stakeholders across the construction supply chain are working towards decarbonizing their projects.

Regulatory compliance

Governments are increasingly recognizing the need to legislate and reduce whole-life carbon in construction. As a result, building **LCAs are now a mandatory part** of several existing and future regulations in various countries. To read more, refer to this article.

Jurisdiction	Regulations	Status	Timeline
Belgium	National LCA requirement for state government buildings	Mandatory	In force
Denmark	National life-cycle carbon limits on new buildings	Mandatory	2023
Finland	National life-cycle carbon limits on new buildings	Mandatory	2025
France (RE2020)	National life-cycle carbon limits on new buildings	Mandatory	2022
Netherlands	National life-cycle impact limits on new buildings	Mandatory	In force
Sweden (Klimatdeklaration)	National carbon reporting for new buildings, limits by 2027	Mandatory	2022
London, UK	Greater London Authority requirement for new projects	Mandatory	In force
Germany	National LCA requirement for federal government buildings	Voluntary	In force
European Union	Sustainable finance taxonomy criteria for large buildings	Voluntary	In force
Canada	National LCA requirement for federal buildings, limit by 2025	Mandatory	2022
New Zealand	National life-cycle carbon limits on new buildings	Undefined	Open
United States	National materials LCA requirement for federal buildings	Undefined	Open
Toronto, Canada	Whole building LCA demonstrating 20% embodied carbon reduction from baseline required for all city-owned developments	Mandatory	2022
Colorado, U. S	Requires policies to be created that set GWP/emissions limits for key construction materials in federal construction and infra projects.	Mandatory	2024

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Business case for LCA

List of green building certifications

Certifications	Requirements
BREEAM International (Similar to BREEAM Sweden, Norway and Spain) BREEAM®	Perform a high-quality whole building LCA analysis.
LEED	Complete a whole building LCA. Additional credits are awarded based on the demonstrated impact reductions and by incorporating building reuse and/or salvage materials into the project's scope of work.
DGNB DE, DGNB International and DK	Perform a whole building LCA and demonstrate impact reductions.
Energie Carbone	Undertake a whole life-cycle assessment for the building permit and post construction. The assessment accounts for materials, construction site, energy, and water impacts. The results are then benchmarked against carbon level thresholds.
Level(s)	Measure GHG across a building's life cycle, demonstrate resource-efficient and circular material life-cycles, optimize life-cycle cost and value.

Achieve certification

For a building LCA to contribute toward achieving BREEAM, LEED, HQE, E+C- or other green building certifications, its results must be tailored to the relevant scheme, including life-cycle stages, impact indicators, benchmarking, and more.

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Summary of Business benefits of building LCA

1. Quantifying All Carbon-emitting And Carbon-reducing Options
2. Achieving Green Building Certifications
3. Complying With Regulations
4. Supporting Carbon-informed Decision Making
5. Reducing Project Costs Through Increased Material Efficiency And Waste Reduction
6. Quantifying Corporate Level Emissions With A Science-based Approach

Read more about the business case for building LCA here

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

How to perform a building LCA

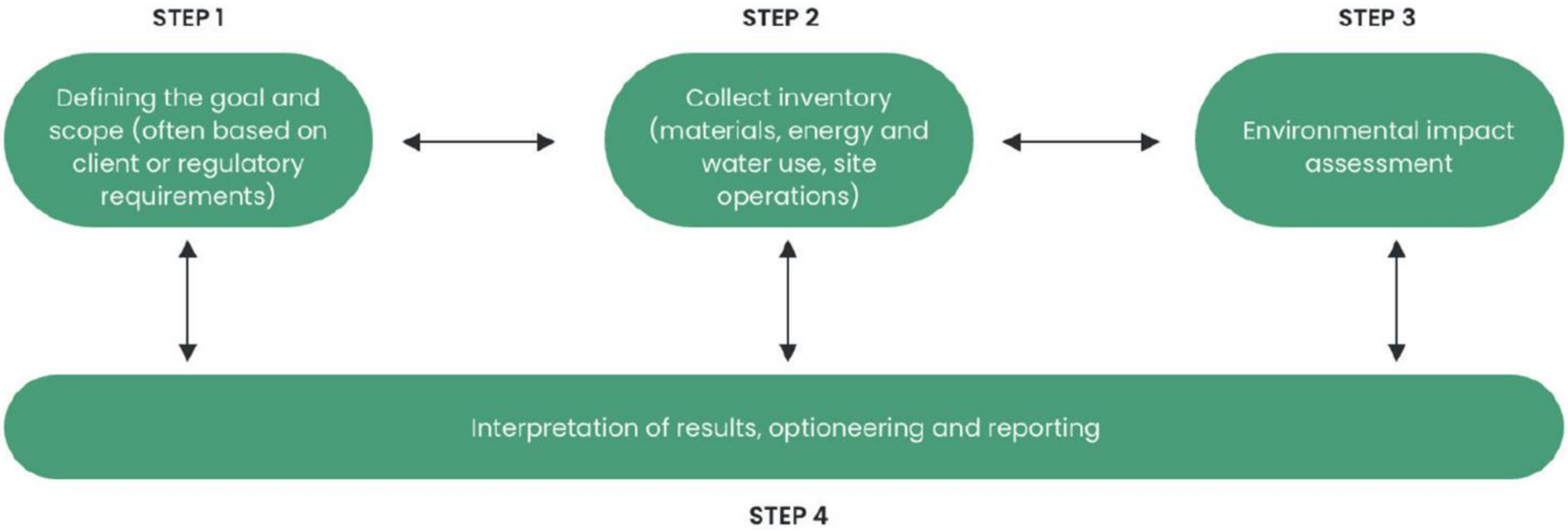


Fig. 7. Steps involved in conducting a building LCA

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Step 1: Define goal and scope

Several reasons for conducting a building LCA include quantifying emissions, achieving certifications, and complying with regulations.
They often define the goal and scope of the analysis as described below:

Defining goal
The general goal is to measure and reduce a building's environmental impact, but specific goals can be identified based on your requirements (mentioned previously in the business case section).

Defining scope
The LCA scope defines the areas to be included or excluded from the LCA analysis and is usually defined by the overall goal. For example, if the goal does not require the evaluation of whole-life carbon, you can limit the extent of your analysis.

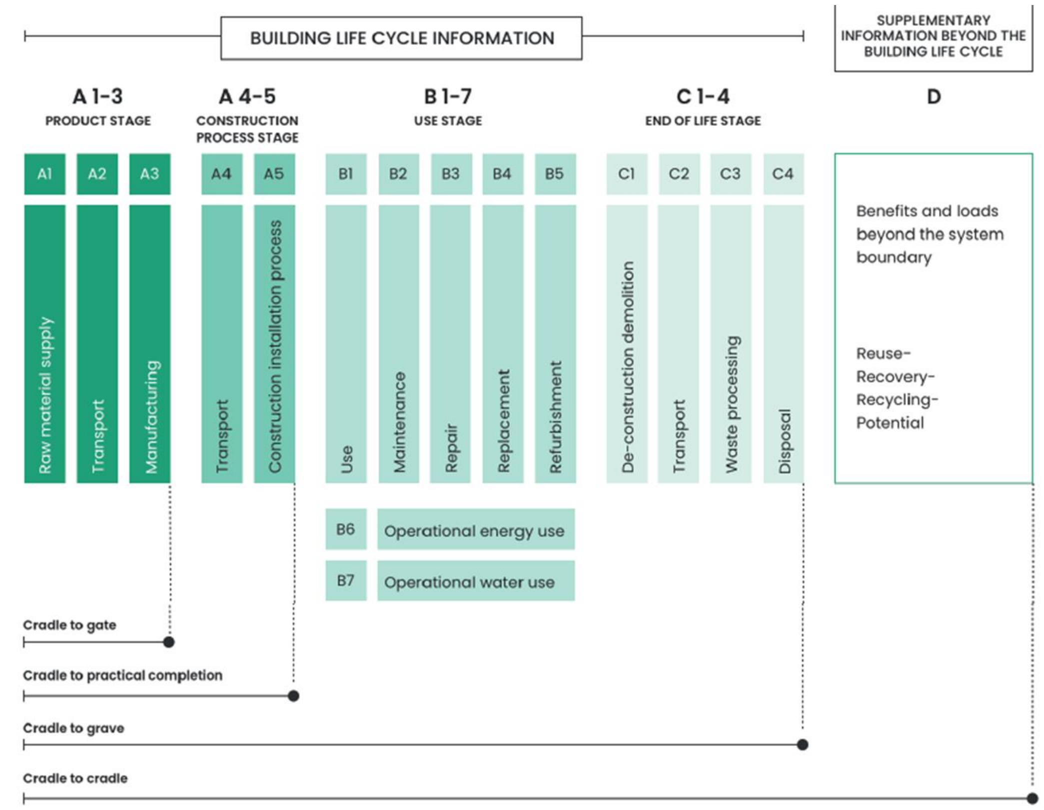
Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Step 1: Define goal and scope

System boundary
For building LCA, the **life-cycle scope** is specified according to the standardised module designations (A1, A2, A3... through D) as defined in EN 15804 and ISO 21930.

Right: Life-cycle scope specified according to the standardized module designations



Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Scope

A1-A3 (Product Stage)

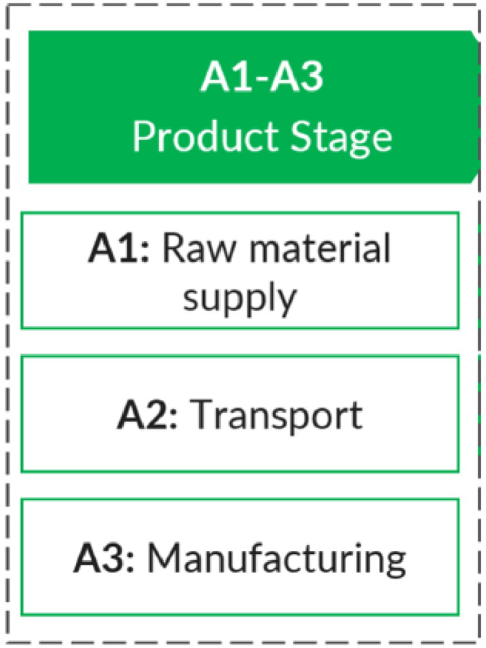
Reporting of different life-cycle stages depend on the certification or scheme, A1-A3 is **mandatory in most cases**.

- Calculated by including material quantities which are linked to **EPDs** (explained later in this presentation)

A4 & A5 (Construction process)

Stages A4 & A5 include all impacts and aspects related to any **losses during the construction process stage** (e.g. production, transport, waste processing and the disposal of lost products and materials).

- A4 emissions include the transport to the construction site
- A5 emissions include the installation / assembly of the building



Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Scope

B1 – B7 (Use Stage)

- Use stage emissions include the use or application of installed products(e.g. refrigerants), maintenance, repair, replacement, refurbishment (often grouped with B4), operational energy usage (heating, services) and operational water use

C1 – C4 (End of life stage)

- End of life stages are emissions which happen after and during the building or asset is demolished. The emissions of these stages depend heavily on how materials are handled during this phase.

D – (Benefits and loads beyond the system boundary)

- Module D includes the reuse, recovery and or recycling potentials. Module D allows supplementary information beyond the building lifecycle to be considered and is consistent with a Cradle-to-Cradle (C2C) approach

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Step 2: Collect inventory

LCA tools, such as One Click LCA, can simplify the inventory collection process by **importing materials**, providing ready-to use scenarios and database. One Click LCA can support integration with **design data from BIM**, IES-VE, Excel and more.

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Step 2: Collect inventory

The information needed to perform building LCA is known as the life-cycle inventory (LCI).

The inventory can be broadly classified into building **materials and operations.**

Building Materials: Includes information about the type, quantity, lifespan, and life-cycle stage of the building in which the material is used. This information can be generally

obtained from cost plans, drawings, **and BIM models**. Design tools such as Revit, Tekla, Rhino and Grasshopper can be used for material quantities related information.

Building operations: Includes transportation details, material replacements, energy and water consumption, and end-of-life scenarios. This information can be obtained from designers, contractors, and project owners. The energy consumption can be tracked separately using energy tools such as IES, Design Builder, IDA ICE, etc.

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Scope

Scope	Cradle-to-gate	Cradle-to-grave	Cradle-to-cradle
Life-cycle stages	A1-A3	A1-C4	A1-D
Examples	Product LCA	LEED	BREEAM, RICS, GLA

The scope can be restricted to meet the requirements (of certifications or regulations), as shown below.

The building area

Gross Internal Floor Area (GIFA) is used in most popular certifications (LEED, BREEAM). It is used to calculate the LCA impacts per floor area and for the purpose of benchmarking. To read more on building area, refer to this article.

The service life of the building

The environmental impacts are calculated over this time frame. It is typically dependent on the LCA methodology and standards or can be set based on the property owner's requirements.

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Details of inventory analysis in One Click LCA

	Inventory	Source of inventory (varies by module used)	Required for
	A1 - raw material extraction/supply **A2** - transport to the manufacturing site **A3** - manufacturing	Bill of materials (BOM) are manually inputted, imported from BIM models or cost schedules or created with Carbon Designer, possibly completed with One Click LCA default structures.	Level(s), LEED, BREEAM, RICS, GLA.
	A4 - transportation scenarios **A5** - construction installation process	One Click LCA provides appropriate default values for transport distances, which can be used when a specific source is not known.	Level(s), LEED-only A4, BREEAM, RICS, GLA.
	B1 - installed products **B2** - maintenance **B3** - replacement **B4** - repair **B5** - refurbishment	B1-B3 are based on user input of quantities. B4 and B5 are based on default material service life settings and the asset calculation period.	Level(s)- except B2, LEED (only B3, B4-B5), BREEAM, RICS, GLA, (only B4, B6)
	B6 - details of annual electricity, fuel, and energy consumptionIncludes district heating and cooling	Based on user input of consumption quantities. In One Click LCA database, the impacts of electricity and district heat are based on the energy production fuel mixes provided for each country by IEA, or local and regulatory sources..	Level(s), BREEAM, RICS, GLA.
	B7 - estimated annual water consumption during the operational stage of the building	Based on user input of consumption quantities.	Level(s), BREEAM, RICS, GLA
	C1-C4 - details of processes that occur during and after the building or asset is demolished	Based on options such as Material-locked and End of life (EOL) scenarios. EOL processes are based on regulatory scenarios. For non regulatory tools, One Click LCA provides its own end of life default processing methods for various materials.	Level(s), BREEAM, RICS, GLA.
	D - includes reuse and recovery of materials and energy, based on their recycling potential **D2** - is the exported energy	Based on the material and on the end-of-life process that is chosen.	Level(s), BREEAM, RICS, GLA.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

LCA Data

Once the building information-related queries are filled in, **mapping each material to its respective environmental profile** is the next step.

This process is simplified by using **LCA data** which contains information about the environmental impacts of each material of interest.

An **Environmental Product Declaration (EPD)** provides an independently verified summary of the environmental impact of a product throughout its life-cycle, calculated via LCA.

Single product EPDs are the most common type, but group and industry average EPD are available.

- **Single product and manufacturer EPD:** One product and manufacturer.
- **Product group EPD:** Average of very similar products, one manufacturer.
- **Industry average EPD:** One product and several manufacturers.

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

LCA Data- EPDs

- EPDs are based on **internationally-accepted** and valid methods for life cycle assessment (LCA)
- They are **credible and Neutral-** critically reviewed, approved, and maintained by an independent verifier and absent of claims of environmental preference
- **Open:** It has the widest range of applicability to all products and services, and easily accessible to all interested parties
- EPDs are based on Life-cycle assessment calculations according to **ISO 14040 and ISO 14044**
- An EPD is created and verified in accordance with the International **Standard ISO 14025.**
- In Europe, the European Committee for Standardization has published common Product Category Rules (PCR) for EPD development in the construction sector, **EN 15804.**

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

GENERAL INFORMATION

MANUFACTURER INFORMATION

Manufacturer	Rearden Steel
Address	Philadelphia, Pennsylvania, United States
Contact details	John Galt john.galt@reardensteel.com
Website	www.reardensteel.com

PRODUCT IDENTIFICATION

Product name	Rearden Metal
Product number / reference	RM-001
Place(s) of	Philadeplhia, PA, United States

EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

EPD program operator	Program operator name here
EPD standards	This EPD is in accordance with EN 15804+A2 and ISO 14025 standards.
Product category rules	The CEN standard EN 15804+A2 serves as the core PCR. Program operator PCR here.
EPD author	Bionova Ltd, Suvilahdenkatu 10 B, 00500 Helsinki, Finland
EPD verification	Independent verification of this EPD and data, according to ISO 14025: ☐ Internal certification ☒ External verification
EPD verifier	Werner Verifier
EPD number	00001
ECO Platform nr.	-

ADDITIONAL ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, PEF

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Particulate matter	Incidence	3.16E-06	2.86E-07	1.40E-07	3.59E-06	3.54E-07	MND	MND	4.10E-07	2.29E-07	2.14E-06	8.76E-06	-1.02E-06
Ionizing radiation, human health	kBq U235e	3.06E+00	3.09E-01	2.10E+00	6.67E+00	3.92E-01	MND	MND	9.96E-02	2.44E-01	1.51E-01	6.33E-02	-1.20E+00
Eco-toxicity (freshwater)	CTUe	1.77E+01	2.10E+00	2.03E-01	2.01E+01	2.74E+00	MND	MND	1.20E-01	1.70E+00	1.82E-01	8.00E-02	-2.14E+00
Human toxicity, cancer effects	CTUh	8.81E-08	1.22E-09	1.11E-09	9.04E-08	1.54E-09	MND	MND	4.29E-10	9.59E-10	6.43E-10	1.96E-10	-6.46E-08
Human toxicity, non-cancer effects	CTUh	2.21E-06	7.09E-08	7.74E-08	2.36E-06	9.76E-08	MND	MND	8.96E-09	6.07E-08	1.28E-08	7.45E-09	-8.45E-07
Land use related impacts/soil quality	-	8.20E+02	6.49E+01	1.88E+00	8.86E+02	8.19E+01	MND	MND	3.41E-01	5.28E+01	5.15E-01	9.79E+00	-3.58E+01

EN 15804+A2 disclaimer for Ionizing radiation, human health. This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

ENVIRONMENTAL IMPACTS - TRACI 2.1

Impact category	Unit	A1	A2	A3	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4	D
Global warming potential	kg CO2e	9.42E+01	3.89E+00	2.74E+00	1.01E+02	4.82E+00	MND	MND	1.58E+00	3.06E+00	2.39E+00	4.95E-01	-1.22E+01
Ozone depletion	kg CFC11e	4.32E-06	9.51E-07	5.60E-07	5.83E-06	1.21E-06	MND	MND	3.64E-07	7.51E-07	6.51E-07	2.21E-07	-1.02E-06
Photochemical smog formation	kg O3e	2.73E-01	7.48E-03	8.51E-03	2.89E-01	9.51E-03	MND	MND	2.22E-03	5.91E-03	3.36E-03	2.00E-03	-4.52E-02
Acidification	kg SO2e	1.73E-01	3.67E-03	4.42E-03	1.82E-01	4.66E-03	MND	MND	9.67E-04	2.89E-03	1.46E-03	7.40E-04	-5.90E-02
Eutrophication	kg Ne	3.35E+00	7.59E-02	1.50E-01	3.58E+00	5.75E-02	MND	MND	2.24E-02	6.08E-02	3.38E-02	2.90E-02	-5.41E-01
Depletion of non-renewable energy	MJ	3.87E+01	8.52E+00	4.54E+00	5.27E+01	1.08E+01	MND	MND	3.21E+00	6.72E+00	4.92E+00	2.85E+00	-9.02E+00

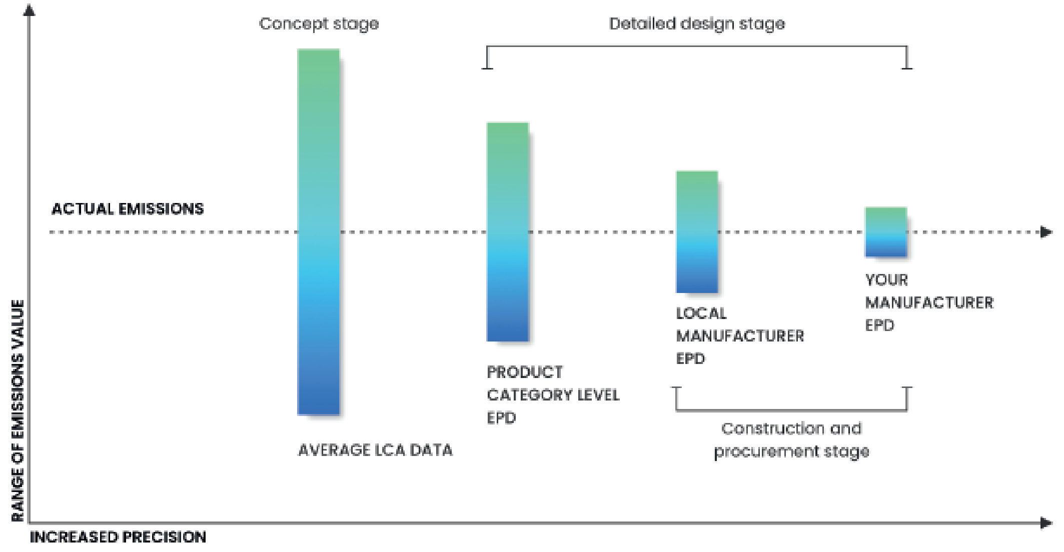
Left: Sample EPD generated with One Click LCA EPD generator

rant agreement No 101033740

LCA Data

When selecting building material data for LCA calculations, the principle is always to choose the most appropriate and highest accuracy option.
Data should be used in the following order of priority.

1. EPD of the product from the specific manufacturer, if available.
2. Technically similar product data from a local manufacturer if the manufacturer is not confirmed yet.
3. Product category level EPD or LCA.
4. Average LCA data for the product in question (same product from different manufacturers)



Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Where do I find LCA Data?

BUS GoCircular

- LCA data can be obtained from EPD program publishers or a **building LCA database (such as One Click LCA)**.
- It is essential to have an accurate and robust database to get accurate results and identify the best material alternatives. For example, during the design phase, it helps to compare the environmental performance of building materials before finalizing the design.

To view some EPDs

SCAN ME

https://www.epdhub.com

EPD Hub

EPD® THE INTERNATIONAL EPD® SYSTEM

RAKENNUSTIETO

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

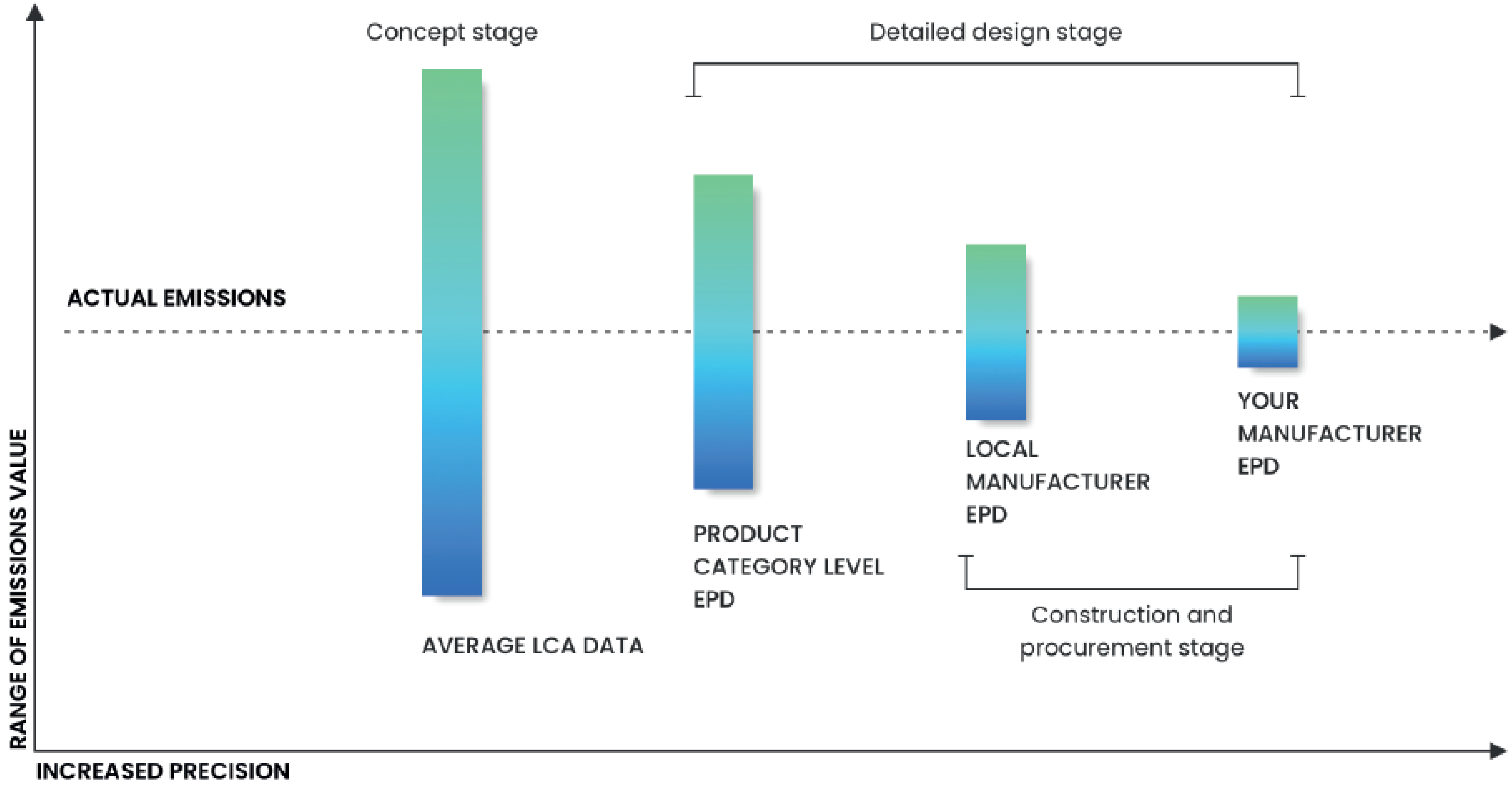
LCA Data for different project stages

- Individual products of any building material type have significant variations in environmental performance, which is reflected in their EPDs.
- Generic data represents average environmental performance for all products within that category.
- During the concept design phase, it is best to use generic data, rather than a specific single product EPD, to avoid making design decisions based on the performance of a single product that may not be representative.
- EPD data can be used when you are ready to buy the material from a specific supplier. For example, the level of detail required for the construction material steel increases as the project progresses.

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

The use of data depends on the stage of the project .



E.g. The level of detail required for the construction material steel increases as the project progresses

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Information required for carrying out a building LCA at various project stages.

Project stage	Material quantities	LCA data	One Click LCA tools or integrations
Concept stage **Advantages in this stage:** » More carbon savings » Very high flexibility » Ability to set targets and make major choices	• Data can be obtained from cost estimation tools or early design tools like Rhinoceros 3D, Tekla Structural Designer • Alternatively, model can be generated with Carbon Designer	• Generic data or using assemblies for building elements (slabs etc.) that contain all the layers and materials. These are available in Carbon Designer • EPDs can be used (if the architects and engineers have decided on the suppliers) **Other options if you do not have ideal data:** • Use material manufacturing localization method	• One Click LCA Carbon Designer • One Click LCA Carbon Heroes Benchmarks
Detailed design stage **Application of LCA in this stage:** » Comparisons between different design alternatives » Carbon benchmarking	• Detailed design drawings or BIM models	• EPD can be used once the materials are finalized. If not, generic data can be used. **Other options if you do not have ideal data:** • Use generic data or EPD that has mid-range performance	• One Click LCA Autodesk Revit, IES, BIM and 15+ integrations

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Summary: Information required for carrying out a building LCA at various project stages.

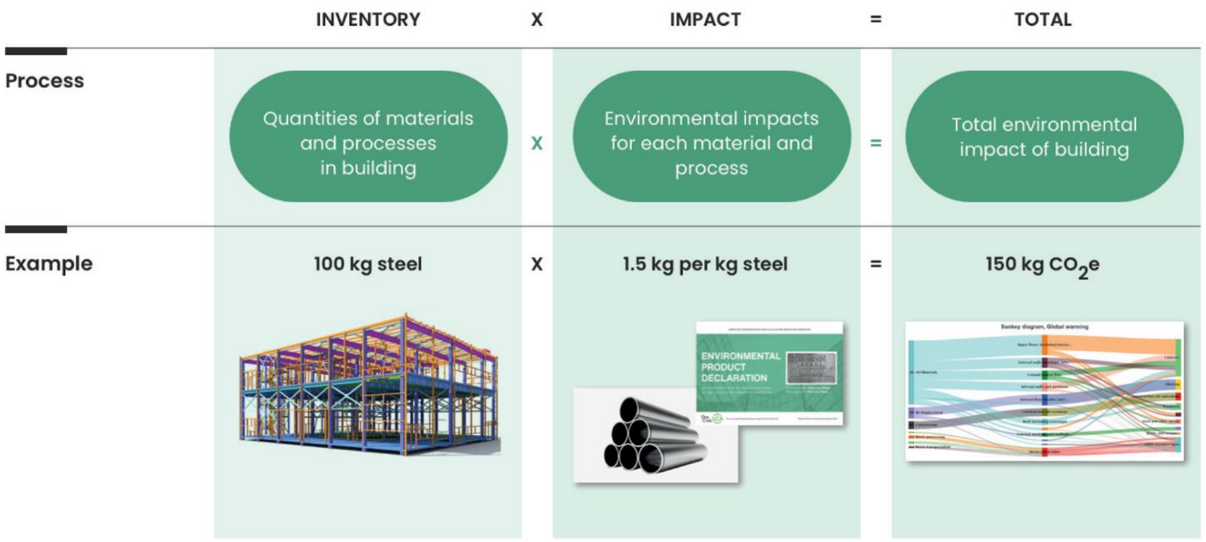
Project stage	Material quantities	LCA data	One Click LCA tools or integrations
Construction and procurement stage **Purpose of LCA in this stage:** » Detailed LCA for certifications » Comply with regulations	• Construction drawings, BIM models and cost plans of final materials	• Specific supplier EPDs can be used as the suppliers will be finalized **Other options if you do not have ideal data:** • Use private EPDs using private data feature • Model the product yourself • Use most similar data, otherwise	• One Click LCA for buildings • One Click LCA global LCA database • One Click LCA Carbon Heroes Benchmarks

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Step 3: Impact Assessment

- The overall environmental impact of a building is calculated by performing an Impact assessment.
- The results are expressed as impact categories based on the scope of your LCA.
- For example, the **Level(s)** assessment requires you to report GWP, AP, EP, ODP, POCP, and biogenic carbon.



Left: Example of impact assessment calculations

Impact assessment is carried out by **multiplying the life-cycle inventory (LCI) with the appropriate impacts for each material or process** during the life-cycle impact assessment step. The environmental profile of the inventory is obtained from the respective EPDs or generic data.

LCA tools such as One Click LCA can fully **automate the calculation of impacts** from building materials, scenarios and can **give results by life-cycle stage and building component**.

nt agreement No 101033740

Step 4: Results and Analysis

- Once you have the building LCA results, it is useful to **break down the environmental impacts** by building component, material type, and life-cycle stages and then visualize the results.
- This helps to identify hotspots and **reduce impacts where it matters most.**
- After conducting a building LCA analysis, you **must verify the completeness and plausibility** of your data to ensure it complies with your required scope.
- In One Click LCA, this process can be simplified using the LCA Checker feature. It indicates the completeness of the project and identifies weak areas in the analysis.

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Summary: Simplified steps for how LCA is performed

After scope is defined…

1. Find out the type of building, life cycle (60 years) and size as well as geometry (optional)
2. Collect the **material information.**
3. Import details from models, cost plans, Carbon Designer or add manually per material layer or constructions.
4. Add energy use (SBEM, SAPs), water use (water calculations for BC or BREEAM), construction site operations (actual data or scenarios), repair
5. in % and withdrawals
6. Check the results, do optioneering, report

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Visualising building LCA

- By performing a building LCA, you can identify and analyse the environmental **impacts distributed across life-cycle stage, materials, and structural elements**.
- Once the environmental impacts and hotspots have been identified, you can optimise your designs and make informed decisions to lower the impacts of your project.

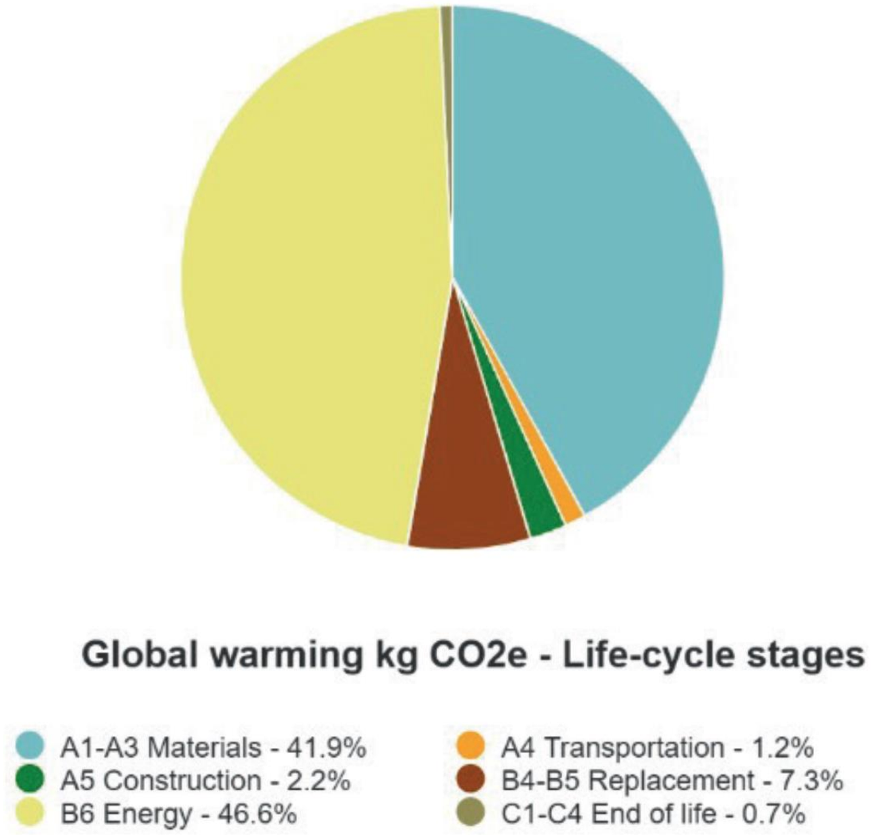
To understand how this works in practice, we will look at the results of an example building LCA project carried out according to the EN 15978 standard using One Click LCA software.

*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Impacts from life cycle stages

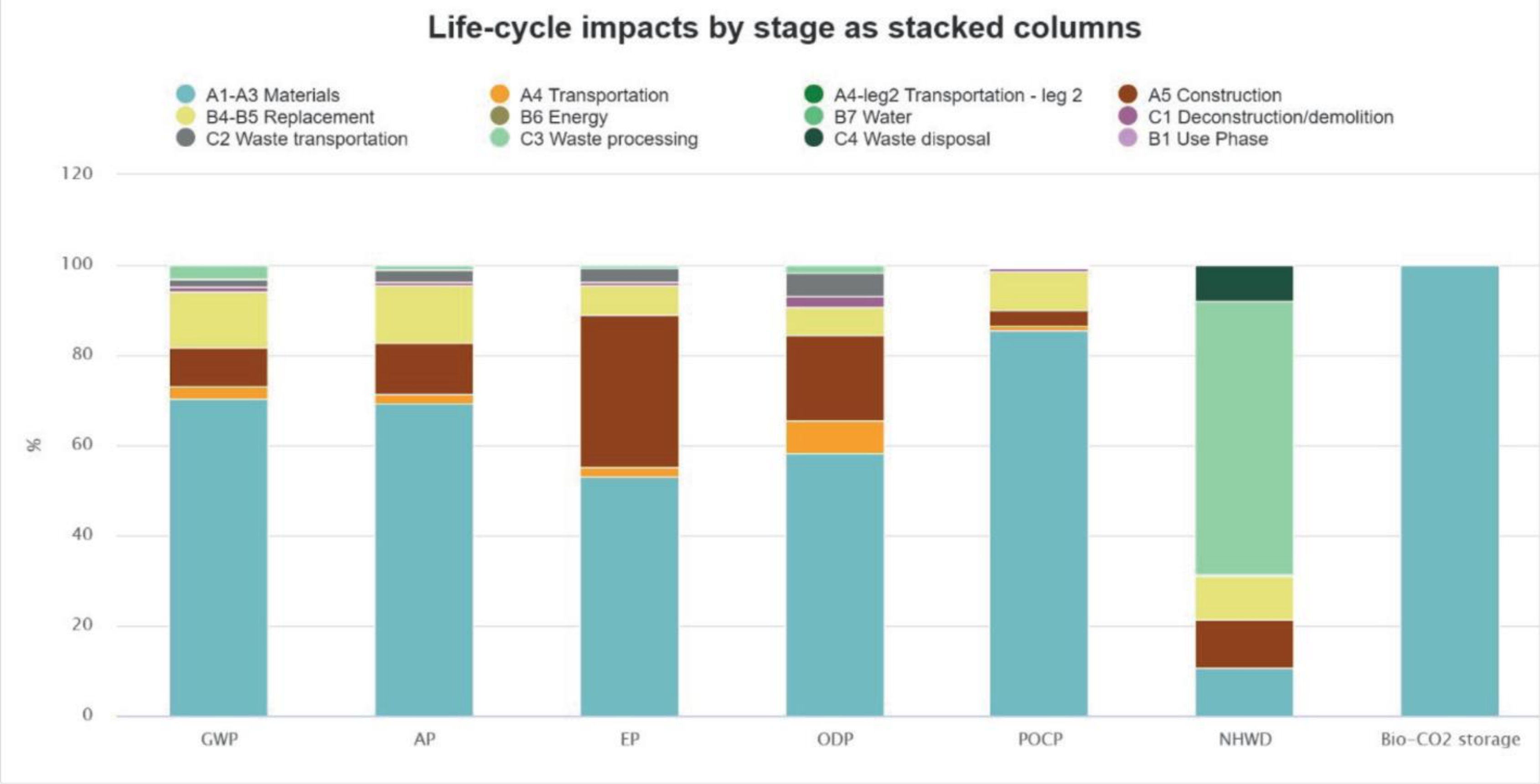
- This chart illustrates an example of how Green Warming Potential (GWP) is distributed among the different life-cycle stages of a building.
- The results imply that efforts must be focused on the product stage of the building to reduce the GWP.
- Other environmental impacts measured per life-cycle stage are shown on the following slides.
- Construction materials (product stage) contribute to most of the impacts irrespective of the environmental impact category.



Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Distribution of environmental impacts across different life-cycle stages

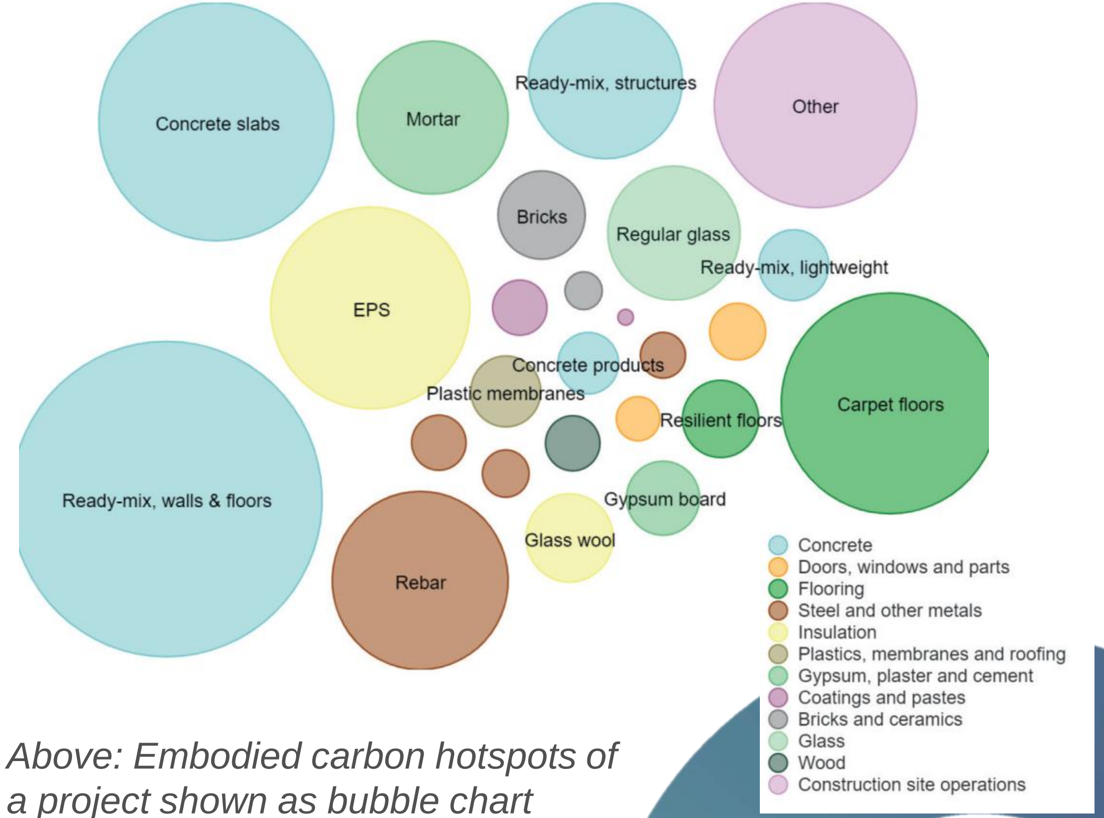


Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Impacts from building materials

- Building materials are significant sources of emissions.
- Carbon emissions released before using a building (**upfront carbon**) are of great concern as they are irrevocably released before construction.
- Building LCA results can show which materials have high environmental impact



Above: Embodied carbon hotspots of a project shown as bubble chart

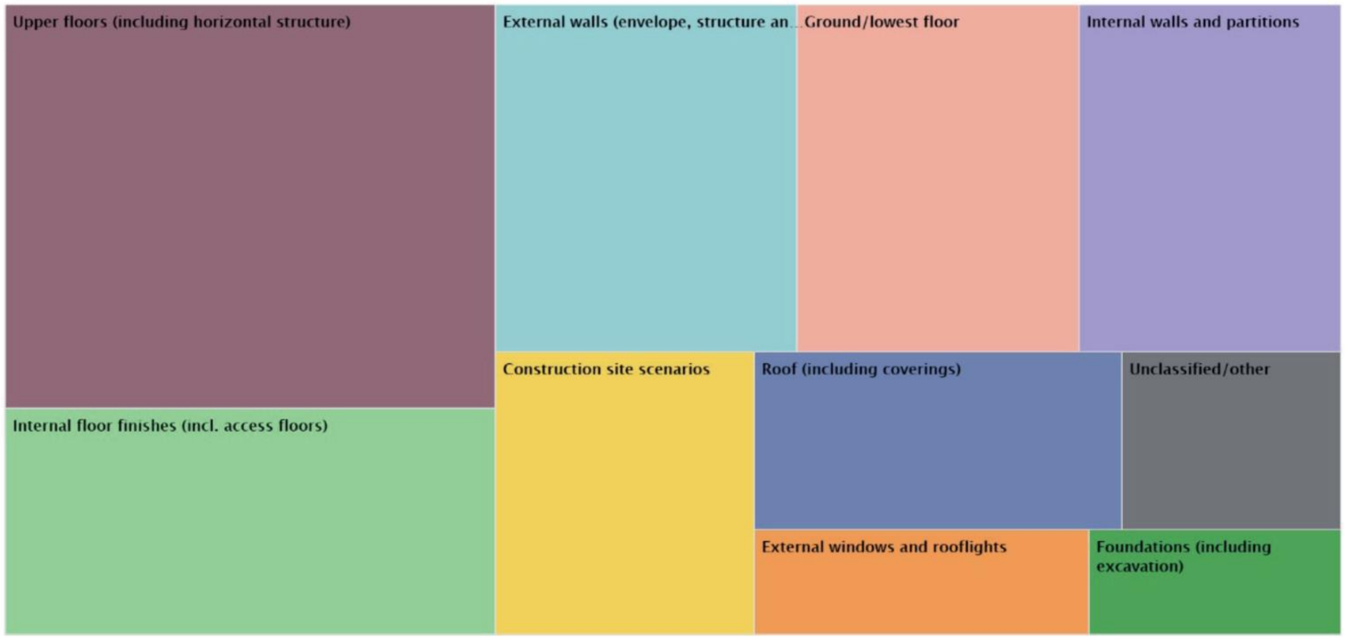
Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Impacts from building elements

A Building LCA also identifies which building elements are significant environmental concerns. For example, the results shown below indicate that the upper floors are the major contributor to global warming.

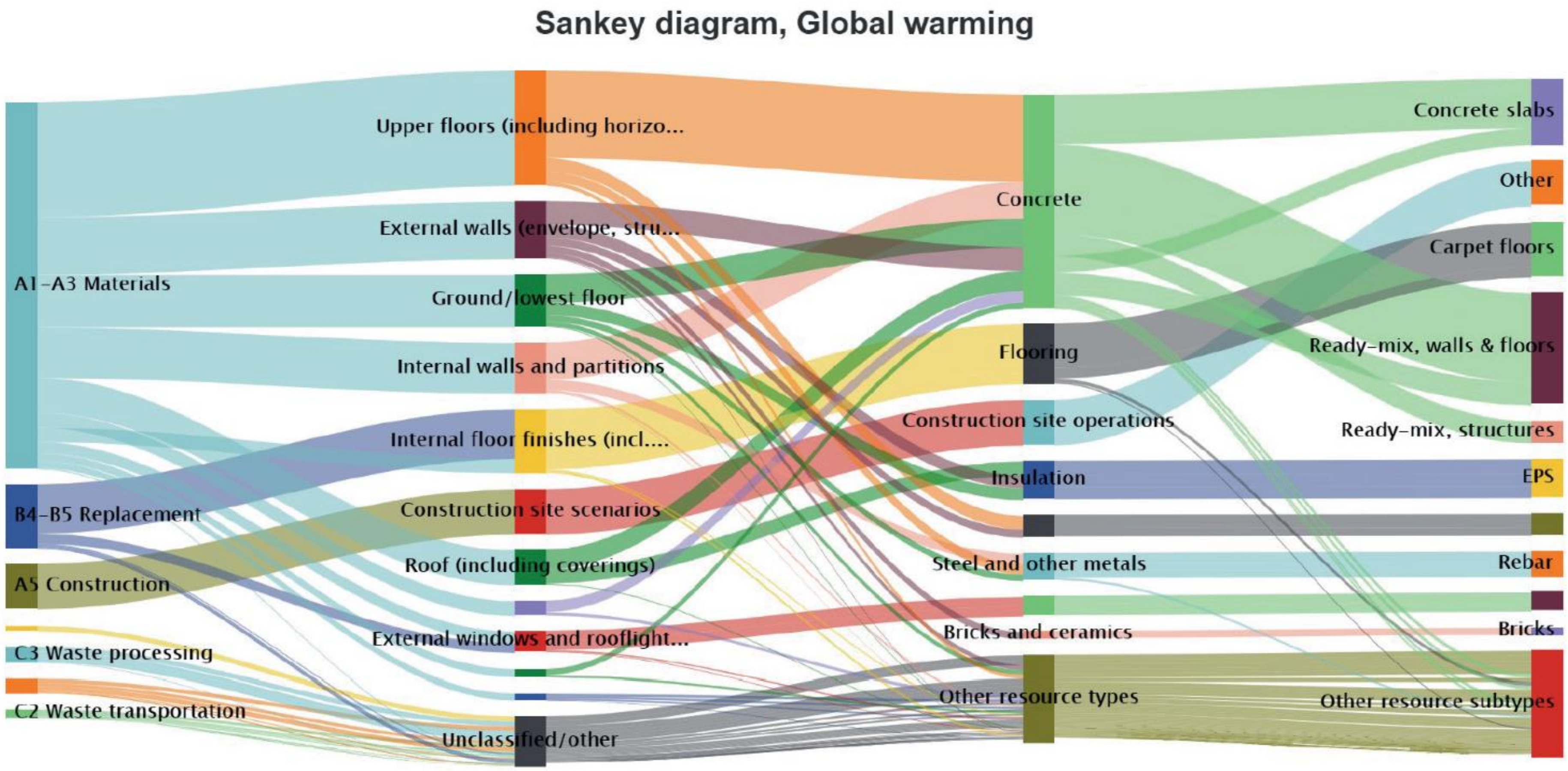
Global warming kg CO2e - Classifications



Source:[https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB]

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Impacts from building elements



Embodied carbon breakdown by key building elements

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Design Alternatives

- Comparing the **impacts of different design alternatives** is helpful for decision-making.
- For example, the same building constructed with concrete, steel, or wood will differ in environmental impact, as shown below:

Design optioneering can help in reducing emissions

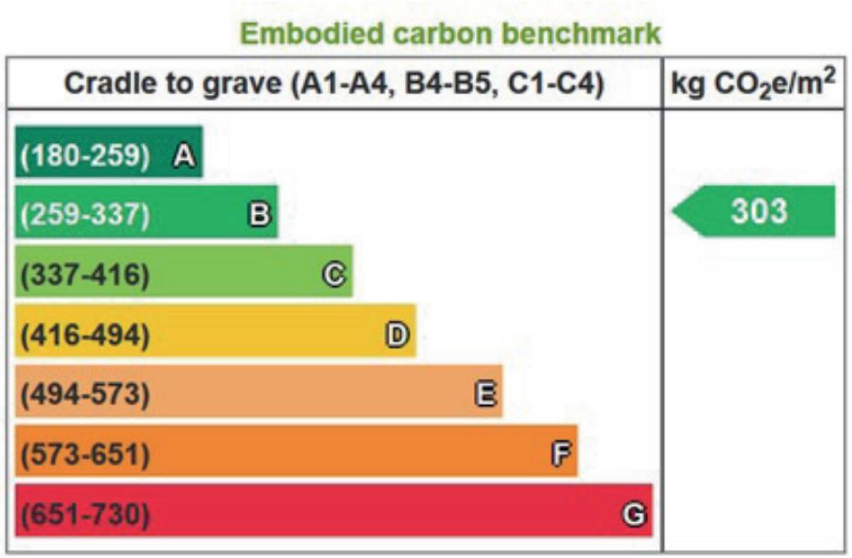
*Source:*https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Benchmarking your project

The Carbon Heroes Benchmarks feature in One Click LCA can benchmark your project's embodied carbon with thousands of buildings across different countries

OneClick LCA's research on Embodied Carbon Benchmarks for European buildings provides benchmark data for buildings across Europe



One Click LCA Carbon Heroes Benchmarks

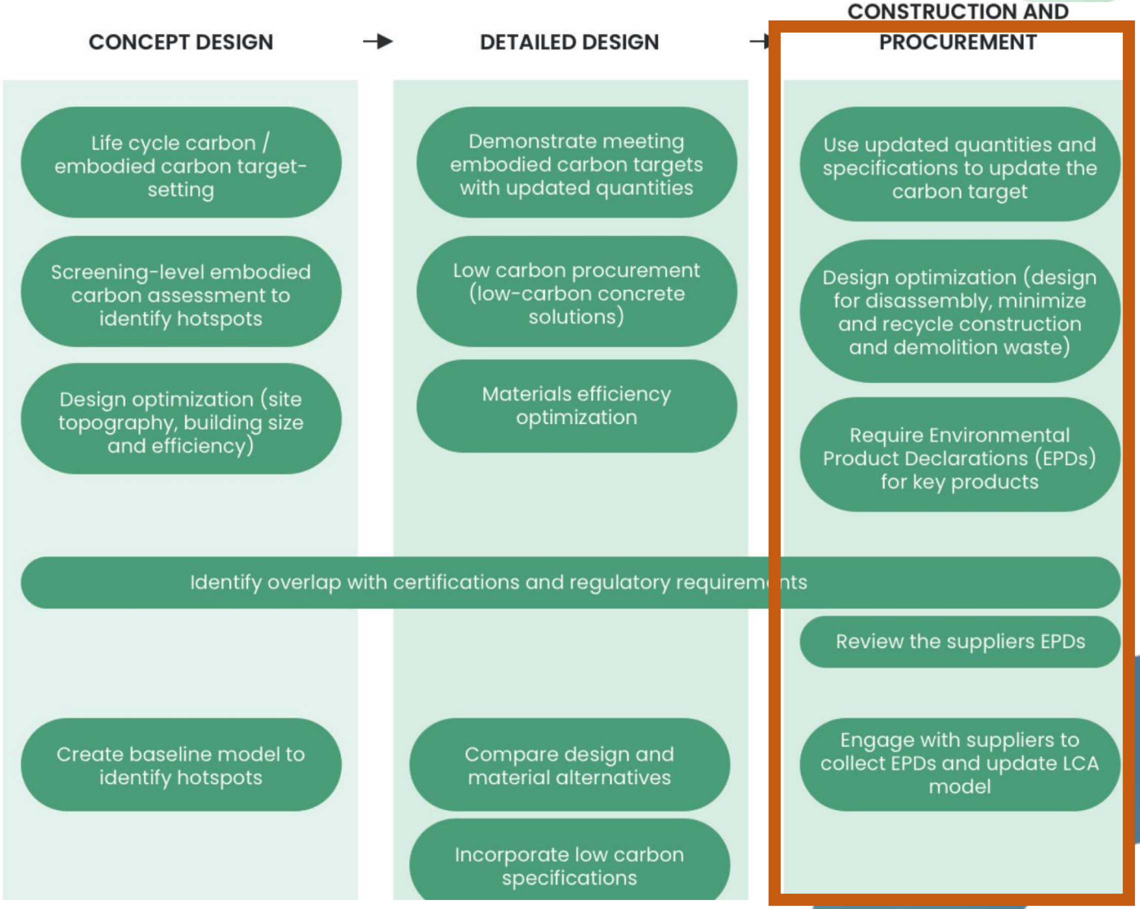
Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

The role of various stakeholders

Alignment and collaboration between various stakeholders in the construction industry is crucial to decarbonization since **no stakeholder can achieve this alone.**

Right: Measures to reduce embodied carbon at each project stage



Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Standards governing building LCA

- Building LCA is performed according to international standards **(ISO 14040, 14044, or EN 15978).**
- These standards (below) ensure transparency and consistency, meaning that the results obtained from an LCA are robust and widely respected.

Cornerstone standards	Construction works specific standards	EPD standards
ISO 14040 (fundamentals for LCA)	EN 15978 – LCA standard for construction projects (European standard, basis for all EU regulations)	ISO 14025 – cornerstone standard for all kinds of EPDs
ISO 14044 (fundamentals for LCA)	ISO 21929-1 and ISO 21931-1 (less used LCA standards)	EN 15804 (EPD data) and EN 15942 (EPD format) (European standard, basis for all EU regulations) ISO 21930

Source:https://www.oneclicklca.com/?utm_source=google&utm_medium=paid_search&utm_campaign=UK_brand&gclid=Cj0KCQiA2-2eBhClARIsAGLQ2RnJcpa2E6lBkhJTRzaViQlFsIOdOETq4HPgPtspcj6UM1Hdi5VRklgaAq6wEALw_wcB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Conclusion

- The adoption of LCA by building professionals came as a result of increasing awareness of the environmental impact of buildings and followed a backlash against greenwashing and vague eco-labelling. In short, performing a building LCA is **the only reliable way to evaluate the sustainability of a building**.

Image source: Blue North

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Learn More!

OneClick LCA - World's fastest Building Life Cycle Assessment software - One Click LCA

IGBC LCA Tools - Life Cycle Assessment tools and other useful links - Irish Green Building Council (igbc.ie)

LETI embodied carbon primer - Embodied Carbon Primer | LETI

UN Sustainable Development Goals - Home - United Nations Sustainable Development

Building Life Cycle Assessment Case Studies with One Click LCA

Emissions Gap Report 2021 (unep.org)

Embodied carbon review- wc_am-embodiedcarbonreview2018pdf.pdf (divio-media.com)

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

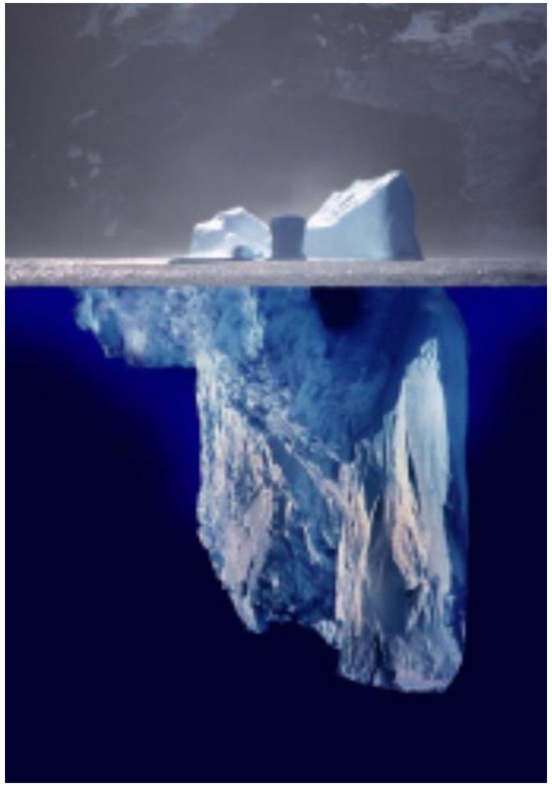
BUS GoCircular

Life Cycle Costing

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Introduction to Life Cycle Costing

- Technique for evaluating the total cost of ownership or real cost of goods, services and works
- Can be applied at pre-procurement (cost estimation) stage, during tender evaluation (MEAT) and as part of contract monitoring
- Most often used for purchases where a significant part of the cost is not reflected in the purchase price, e.g. energy-using products, vehicles, buildings, civil engineering works, lighting systems



Source:Greenville Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Role of LCC in green public procurement

While LCC may be used for strictly financial reasons, it also allows the environmental costs of purchases to be evaluated. For example:

- Emissions or other environmental impacts associated with raw materials or production process;
- Energy, water consumption and emissions during use phase;
- Other consumables
- Environmental impact of maintenance activities;
- Durability/time-to-replacement
- Recoverability or recyclability of materials at end-of-life

Some environmentally preferable goods/services have a higher initial purchase price, LCC allows purchasers to analyse whether this will be compensated for by lower operational costs.

Source:Greenville Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Role of LCC in green public procurement

Life-cycle costing (LCC) means considering all the costs that will be incurred during the lifetime of the product, work or service:

- **Purchase price** and all associated costs (delivery, installation, insurance, etc.)
- **Operating costs**, including energy, fuel and water use, spares, and maintenance
- **End-of-life costs** (such as decommissioning or disposal) or residual value (i.e. revenue from sale of product)

LCC may also include the cost of externalities (such as greenhouse gas emissions) under specific conditions laid out in the directives. The current (2014) directives require that where LCC is used, **the calculation method and the data to be provided by tenderers are set out in the procurement documents**. Specific rules also apply regarding methods for assigning costs to environmental externalities, which aim to ensure that these methods are **fair and transparent.**

Source:Greenville Academy

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Article 68 – LCC methods

Must indicate method to be applied and data required from tenderers in the procurement documents. Method must be:

- Based on objectively verifiable & non-discriminatory criteria;
- Accessible to all interested parties;
- Data required can be provided with reasonable effort by normally diligent economic operators, including operators from third countries.

Transparency principle applies: bidders need to understand what data is required and how the costs will be calculated.

In most cases, the authority can choose its own methodology, but must make this clear in the tender documents (e.g. by including a spreadsheet with detailed instructions).

Mandatory common EU methods may be developed

Source: Greenville Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Including LCC in award criteria - Example

AC1. Life-cycle costs

The cost of each valid and responsive tender will be evaluated on the basis of total life-cycle costs (LCC). Tenderers are required to complete the spreadsheet included in the tender documents with the requested data regarding their products. This information will be used to calculate LCC and the tender with the lowest life-cycle cost will be awarded [X] marks, with other tenders being scored according the following formula:

$$\text{Score TENDER A} = [X] * \frac{\text{Lowest LCC}}{\text{LCC TENDER A}}$$

Verification: The completed spreadsheet must be submitted with the tender and where indicated, supporting documentation verifying the data must be provided. The data entered in the spreadsheet regarding costs, energy consumption, time to replacement and other parameters will become binding under the contract.

Source: Greenville Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

LCA & LCC

- Building Life Cycle Costing provides a credit in many green building certification credits and 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. For example, if you perform LCC calculations you might find out that a product that has a cheaper initial cost might end up being much more expensive in the long run because it will need to be replaced more times during the building use phase, which is usually around 60 years.
- LCC provides reliable metrics on costs and savings over the whole lifetime of the building and there is a strong business case for building LCC. When paired with LCA, it can help design buildings that are more sustainable both from an environmental and financial perspective.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

LCC Conclusion

LCC makes good sense regardless of a public authority's environmental objectives. By applying LCC public purchasers take into account the costs of resource use, maintenance and disposal which are not reflected in the purchase price. Often this will lead to 'win-win' situations whereby a greener product, work or service is also cheaper overall.

The main potential for savings over the life-cycle of a good, work or service are:

- Savings on use of energy, water and fuel
- Savings on maintenance and replacement
- Savings on disposal costs

Image source: Wikimedia Commons

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Tools for Life Cycle Costing

There are two possible ways of assessing lifecycle costs in building planning services:

1. Calculation of the life cycle costs of the submitted architectural contests by **independent experts appointed by the client.** […].
2. Calculation of the life-cycle costs of the building design **by the bidders themselves**. For this purpose, the client must provide normative specifications for the calculation methodology as well as provide the predefined normatively determined data for the calculation to all bidders.

Source:SCSI Guide to LCC

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Tools for Life Cycle Costing

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 proprietary software bought from a software company.

Source:SCSI Guide to LCC

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

LCC and BIM

A Building Information Modelling/Management (BIM) approach to construction procurement is being increasingly utilised as a collaborative set of procedures and associated technologies that assist design and construction professions in conceiving, designing, constructing and operating the built environment. (See LU 11)

Although **5D BIM (Cost Modelling**) is currently being used in Quantity Surveying practice, 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

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Learn more!

The following section provides links to a number of videos, workbooks and solutions to get started on carrying out LCC estimates. The intention is that the user will 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

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.

Life Cycle Costing Exercise 1 - Video
LCC Excel Template - 1
LCC Excel Solution - 1

Life Cycle Costing Exercise 2 - Video
LCC Excel Template - 2
LCC Excel Solution - 2

Life Cycle Costing Exercise 3 - Video
LCC Excel Template - 3
LCC Excel Solution - 3

Life Cycle Costing Exercise 4 - Video
LCC Excel Template - 4
LCC Excel Solution - 4

Source:SCSI Guide to LCC

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Case Study 1

Case Study 1: Berlin Police cars

Technical specifications:

- Must meet Euro 5 European Emission Standard (the most demanding standard at the time of tendering)
- Carbon particulate filter (for diesel engines)
- Must meet or exceed German 4 standard or equivalent for particle emissions –this allows the vehicle to be driven in inner-city environmental zones

Award criteria: Technical performance (40%) and Life-cycle costs (60%)

Life-cycle costing: Maintenance costs calculated based on projected future maintenance and repair work of the vehicles (e.g. tyres, window replacement). Environmental costs calculated based on a) fuel consumption, b) energy consumption, c) CO2 emissions, d) NOx, e) non-methane hydrocarbons and f) particulate matter.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Case Study 2

Case Study 2: Lighting in Syddjurs, Denmark

- LCC/TCO included purchase price, replacement (including labour costs) and operational costs
- Product sheet listing a range of lighting solutions in different technology categories which may be required over the course of the framework
- 15-year evaluation period

Results: For a standard bulb with a E27 socket, 405-470 lumen

Halogen –2,354 krone kr (**€316**)

Low energy bulbs -581 kr (**€78**)

LED -362 kr (**€49**)

Link to full case study here

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Level(s)

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Level(s) is a common framework for sustainable buildings across Europe.

- **Greenhouse gas emissions along a buildings life cycle**

Use stage energy performance (kWh/ M² /yr)
Life cycle Global Warming Potential (CO2 eq./M² /yr)

- **Resource efficient and circular material life cycles**
- **Efficient use of water resources**

Use stage water consumption (M3 /occupant/yr)

- **Healthy and comfortable spaces**
- **Adaptation and resilience to climate change**
- **Optimised life cycle cost and value**

Life cycle costs (€/m²/yr)

https://environment.ec.europa.eu/topics/circular-economy/levels/lets-meet-levels/how-does-levels-work_en

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Introduction to EU Level(s)

- EU Level(s) is a common framework for sustainable buildings across Europe.
- It is an assessment and reporting tool for sustainability performance of buildings, firmly based on circularity.
- As we respond to the Paris Agreement's demand that the building and construction sector **decarbonise by 2050**, Level(s) supports the essential **assessment over the full lifecycle** through design, construction, use, and end of life.
- Building upon the objectives of both the EU Green Deal and the EU Circular Economy Action Plan, Level(s) supports the efforts of the building sector **in improving energy and material efficiency**, thereby reducing overall carbon emissions

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Introduction to EU Level(s)

EU Level(s) uses core sustainability indicators to measure carbon, materials, water, health, comfort and climate change impacts throughout a building's full life cycle.

It is a flexible solution for identifying sustainability hotspots and for future-proofing your project or portfolio.

By using EU Level(s) you are contributing to EU policy goals to strengthen the sustainability of Europe's buildings, which are responsible for:

- 1/2 of all extracted materials
- 1/2 of total energy consumption
- 1/3 of water consumption
- 1/3 of waste generation.

Level(s) is open source and freely available to all

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Benefits of Level(s)

With a limited number of indicators, Level(s) helps you by:

- ✔ Providing a **simple entry point to circularity** and lifecycle thinking;
- ✔ Identifying hotspots and **future-proofing buildings** by making them more sustainable and carbon efficient.
- ✔ Supporting **initial discussions between contractors and clients** regarding what to focus on to **make the project more sustainable**, and perhaps taking it further to detailed design and construction.
- ✔ **Greening buildings/portfolios** and discussing between designers and clients how to best align with European or other policy;
- ✔ **Demonstrating how policy initiatives can align with a European framework** that has been developed, tried, and tested by a large number of building professionals across the EU.
- ✔ Providing flexibility to the users during implementation, adapting it to their needs, pace, and understanding of the framework.
- ✔ Being a **valuable framework for all those committed to improving environmental performance** and resource use.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Level(s) and GPP

- Level(s) will be the basis for the revision of the EU GPP Criteria for office buildings. These criteria will be expanded to cover schools and social housing, and will pay particular attention to renovation
- Level(s) guides part of the technical screening criteria used to identify new buildings for sustainable finance
- International sustainability certification tools are aligning their schemes to Level(s), ensuring common EU policy objectives are integrated.

Source: https://gupp-class.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

How Level(s) can support you

- Level(s) helps built environment and sustainability professionals, investors and policy makers in their efforts to transform the built environment into a sustainable and circular one.

Built Environment and Sustainability professionals

Level(s):

- Uses consistent indicators for all project stages, based on best practice industry standards.
- Brings together building professionals to discuss sustainable objectives.
- Supports comparison of design options and encourages monitoring of real performance.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

How Level(s) can support you

Policy makers / Procurers / Public authorities

Level(s):

- Is based on a method tried and tested across the EU and underpins future EU policy.
- Allows public authorities to develop and implement policies and actions.
- Brings minimum numbers of indicators with maximum leverage to deliver sustainability.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

How Level(s) can support you

Investors / Building Owners / Landlords

Level(s):

- Ensures future proofing of buildings as it tracks performance throughout the full life cycle.
- Brings consistency, accountability and, thus, investor confidence.
- Supports communication on value based on Environmental, Social and Governance factors (ESG).

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

How does Level(s) work?

- Level(s) is based on six **macro-objectives.** These can be tracked through 16 **indicators.**
- The **6 macro-objectives** address key sustainability aspects over the building life cycle.
- The sustainability **indicators** within each macro-objective describe how the building performance can be aligned with the strategic EU policy objectives in areas such as energy, material use and waste, water, indoor air quality and resilience to climate change. The following slides will explain what each entails.

Source: *EU Academy*

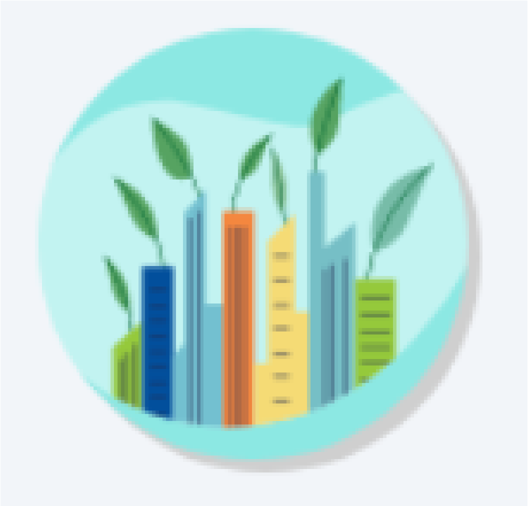
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

1. Greenhouse gas emissions along a building's life-cycle

Macro Objective 1: **Greenhouse gas emissions along a building's life-cycle**

Intention: to minimise whole life cycle carbon emissions, taking into account both energy consumption during the use stage of the building and embodied energy in building materials and construction products.
Indicators:

1.1 Use stage energy performance.
1.2 Life cycle Global Warming Potential.



Source: EU Academy

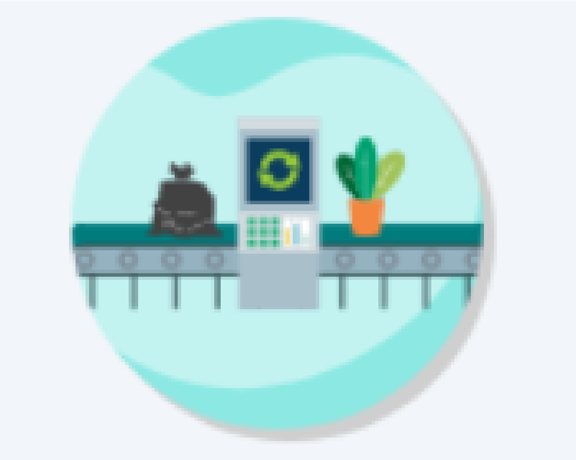
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

2. Resource efficient and circular material life cycles

Macro Objective 2: **Resource efficient and circular material life cycles**
Intention: to optimise the building design to support lean and circular product and material flows, including:

- Quantification of construction products and materials used.
- Planning, estimation and monitoring of circular outcomes for construction and demolition waste generated.
- Assessment and scoring of the adaptability of building designs.
- Assessment and scoring of the potential for deconstruction in building designs as opposed to demolition.

Indicators:
2.1 Bill of quantities, materials, and lifespans.
2.2 Construction & demolition waste and materials.
2.3 Design for adaptability and renovation.
2.4 Design for deconstruction.



Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

3. Efficient use of water resources

<u>Macro Objective 3.</u> **Efficient use of water resources**

<u>Intention:</u> to use water efficiently, particularly in areas with identified long-term or projected water stress.
<u>Indicator:</u>

3.1 Use stage water consumption.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

4. Healthy and comfortable spaces

Macro Objective 4. **Healthy and comfortable spaces**

Intention: to create building spaces that are comfortable, attractive, and productive. This includes four aspects regarding the quality of the indoor environment:

- The quality of indoor air for specific parameters and pollutants.
- The degree of thermal comfort.
- The quality of artificial and natural light and associated visual comfort.
- The capacity of the building fabric to provide a comfortable acoustic environment for its occupants.

Indicators:

4.1 Indoor air quality.

4.2 Time outside of thermal comfort range.

4.3 Lighting and visual comfort.

4.4 Acoustics and protection against noise.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

5. Adaptation and resilience to climate change

<u>Macro Objective 5.</u> **Adaptation and resilience to climate change**

<u>Intention:</u> to future proof building performance:

- Adapt to future climate changes that will impact thermal comfort.
- Make the building more resilient and resistant to extreme weather events (including flooding: fluvial, pluvial and coastal).
- Improve the building design to reduce the chances of pluvial/fluvial flood events in the local and downstream area (i.e. incorporating sustainable drainage features).

<u>Indicators:</u>

5.1 Protection of occupier health and thermal comfort.

5.2 Increased risk of extreme weather events.

5.3 Sustainable drainage.

Source: EU Academy

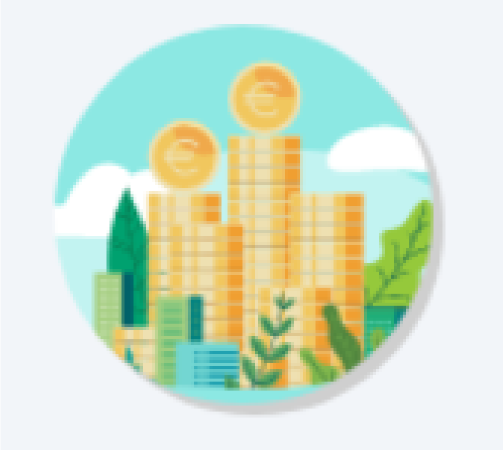
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

6. Optimised life cycle cost and value

Macro Objective 6. **Optimised life cycle cost and value**

Intention: to gain a long term view of the whole-life costs and market value of more sustainable buildings, including:

- Life cycle costs (construction, operation, maintenance, refurbishment, and disposal).
- Encourage the integration of sustainability aspects into market value assessment and risk rating processes and ensure that this is done in as informed and transparent a way as possible.



Indicators:

6.1 Life cycle costs.

6.2 Value creation and risk exposure.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Establish a Level(s) project plan

To set up a project to use the Level(s) common framework, you must establish a Level(s) project plan.

- Once you have selected the macro-objectives and indicators to address, you next decide at which 'level' the project performance will be assessed.
- A design team could use different levels for the different indicators, use one or several levels for each indicator to follow the development of performance throughout the project.
- The more levels that can be addressed, the more complete the picture of the project's sustainability performance.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Level 1: Conceptual Design Assessment

- Early-stage qualitative assessments and reporting on the concepts that will be considered during the initial project definition and conceptual design phases.
- It provides a simple structure that can be presented to clients to focus attention on the most relevant sustainability aspects for each indicator.
  - *L1a. Project definition and brief.*
  - *L1b. Concept design.*

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Level 2: Detailed Design and Construction Assessment

- Quantitative assessment of the performance of the design.
- Allowing comparison of estimates for different design options and monitoring of the construction according to standardized measurements and methods.
    - *L2a. Outline design (Spatial planning and permits).*
    - *L2b. Detailed design (Tendering).*
    - *L2c. Technical design (Construction).*

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Level 3: As-Built and In-Use Assessment

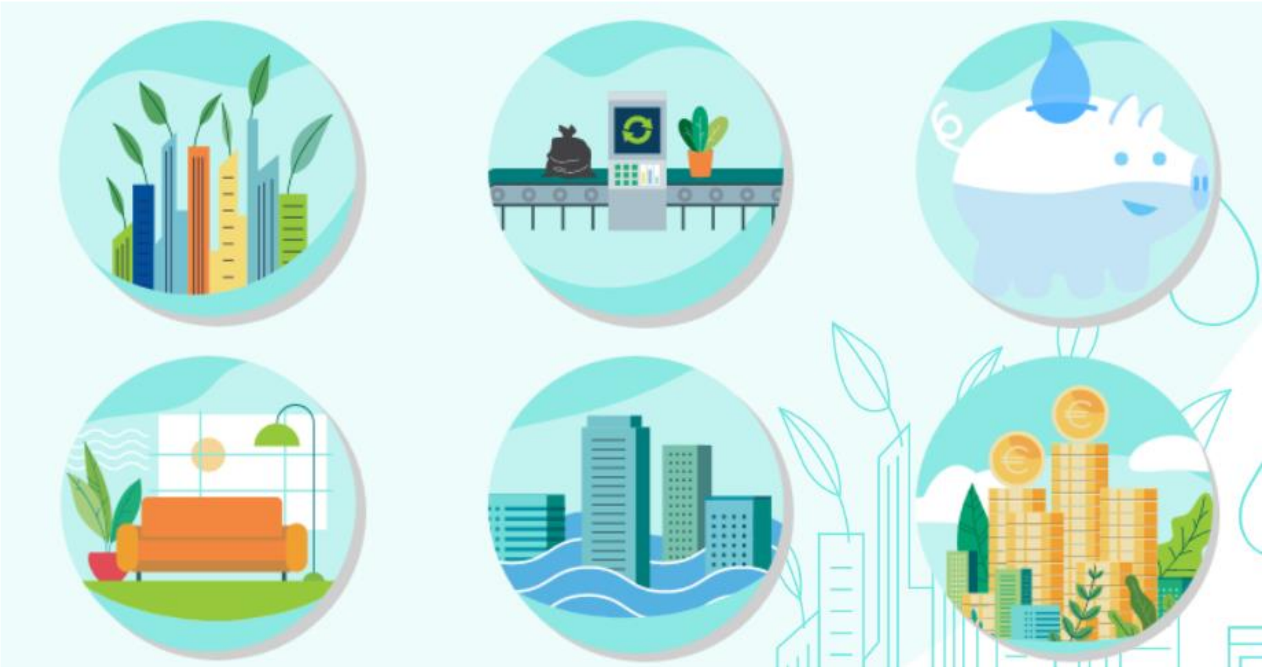
- Monitoring and surveying of activity on the construction site and of the completed building and its first occupants.
- Level 3 helps the entire team understand actual building performance and identify lessons learned from the design to inform and improve future projects.
  - *L3a. As-built design.*
  - *L3b. Commissioning and testing.*
  - *L3c. Completion and handover.*
  - *L3d. Occupation and use.*

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Setting up a Project- An overview of the levels

The next sequence of slides will provide an outline of how you would use the different indicators at the three levels.



Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

1.1 Use stage energy performance

Level 1

For users who would like to:

- ✔ Understand the energy uses associated with the type of building they are working on.
- ✔ Know where they can focus attention to reduce the use of non-renewable primary energy associated with the building's use of the delivered energy during the use stage.

This includes a checklist with information on design energy concepts.

Level 2

For those users who are at the stage where they need to

- ✔ estimate the delivered and primary energy use of a building for the purposes of design comparisons, building permits or tendering.

This could include, for example, an energy simulation.

Level 3

For those users who would like to:

- ✔ Collect metered data to understand the energy use associated with the building.
- ✔ Carry out testing of the building in use to identify any performance issues with the building fabric and technical services.

This could include an energy meter that measures real-time energy consumption.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

1.2 Life cycle Global Warming Potential

Level 1

For those users who would like to:

- ✔ Incorporate some important life cycle concepts into the design and, later, into the detailed designs.
- ✔ Interpret and use the results from life cycle Global Warming Potential assessments and Life Cycle Assessments carried out previously, which were based on the analysis of similar building types.

This includes a checklist to integrate life cycle concepts.

Level 2

For those users who would like to:

- ✔ Calculate the life cycle Global Warming Potential emissions of their project and select software tools and databases in accordance with to the standard EN 15978.
- ✔ Interpret and use the results from a 'hot spot' analysis.

Level 3

This is the same procedure as defined in Level 2 but supported by the final materials procured, technical building systems installed, and the energy consumed.

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

2.1 Bill of quantities, materials and lifespans

Level 1

For those users who would like to:

- ✔ Find out about the six highly relevant aspects for optimising the consumption of construction materials and products.
- ✔ Describe how these aspects were considered (or not) during discussions and decision-making at the concept design stage.

Level 2

For those users who would like to:

- ✔ Make an estimate of the Bill of Quantities during the design stage that ensures budgetary limits are respected.
- ✔ Use an inventory template to insert and manage the Bill of Quantities data. Furthermore, by entering optional cost data and lifespans, the Bill of Quantities template can generate outputs that are useful for other Level(s) indicators.

Level 3

For those users who would like to:

- ✔ Register and log Bill of Quantities data as materials and products are procured and delivered to the site based on actual quotations and purchases.
- ✔ Use an inventory template to centralise purchasing records and track spending in line with project budgets and schedules.
- ✔ Compare with estimates during the design stage.

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

2.2 Construction & Demolition Waste (CDW) and materials

BUS GoCircular

Level 1

For those users who would like to:

- ✔ Find out about highly relevant aspects for reducing Construction & Demolition Waste and optimising its management.
- ✔ Describe how these aspects were considered (or not) during discussions and decision-making at the concept design stage.

Level 2

For those users who would like to:

- ✔ Report on and to make reliable quantitative estimates of Construction & Demolition Waste.
- ✔ Use inventory template(s) for Construction Waste and /or Demolition Waste estimations.

Level 3

For those users who would like to:

- ✔ Measure the quantities of Construction & Demolition Waste in their project, using the Level(s) Excel templates for Construction Waste and Demolition Waste reporting to collate data.
- ✔ Compare estimates with actual data.

Source: EU Academy

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

2.3 Design for adaptability and renovation

Level 1

For those users who would like to:

- ✔ Understand how the design of a building could facilitate future adaptation to changing occupant needs and market conditions.
- ✔ How these design aspects could extend the service life of the building as a whole, either by ensuring it can continue to be used as intended or through possible future changes in use.

Level 2

This level is for those users who wish to set design objectives or who are at the stage of making design decisions and wish to compare design options to determine their relative adaptability.

Level 3

This level is for those users who wish to compare the final as-built design with the earlier detailed designs.

It can also form the starting point for long-term monitoring of the building and how it performs in the local property market.

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

2.4 Design for deconstruction

Level 1

For those users who would like to:

- ✔ Understand how the design of a building could facilitate future deconstruction to access, dismantle and disassemble parts and materials.
- ✔ Determine the extent to which these building parts may be recovered for reuse and/or recycling.

.

Level 2

This level is for those users who wish to set design targets or who are at the stage of making design decisions and wish to compare design options to determine their deconstruction potential.

Level 3

This level is for those users who wish to compare the final as-built design with the earlier detailed designs.

It can also form the starting point for preparing the technical content of a building passport or building material bank record.

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

3.1 Use stage water consumption

Level 1

For those users who would like to:

- ✔ Find out about five highly relevant aspects for reducing and optimising water consumption in the use stage.
- ✔ Describe how these aspects were considered (or not) during discussions and decision-making at the concept design stage.

This includes a checklist with information on water efficient design concepts.

Level 2

This level is for those users who wish to

- ✔ Estimate the water consumption per person in the building through the use of water-consuming devices, appliances and irrigated areas via an Excel-based calculator.
- ✔ Minimise potable water consumption by specifying more efficient devices and appliances and by collecting rainwater and/or reusing greywater.

Level 3

This level is for those users who would like to:

- ✔ Measure of actual water consumption over the course of one year considering an estimation of building occupation rates.
- ✔ Compare estimates with measures.

Source: EU Academy

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

4.1 Indoor Air Quality

Level 1

For those users who would like to:

- ✔ Find out about three highly relevant design aspects that represent the main factors that influence Indoor Air Quality and contribute to optimising the ventilation strategy for a building.
- ✔ Describe how these aspects were considered (or not) during discussions and decision-making at the concept design stage.

Level 2

For those users who wish to:

- ✔ Design the ventilation system, specify indoor fit-out materials and, in the case of major renovations, design insulation and make other design improvements to the air tightness and integrity of the building fabric.
- ✔ Quantify the ventilation rates needed in different zones of the building.
- ✔ Factor into the design the potential influences on the quality of outdoor air (e.g. proximity of roads, traffic volume etc.) and on the quality of indoor air (e.g. emissions from materials, bio-effluents, point sources of humidity, etc.).
- ✔ Inform the design team to specify the ventilation system. The difference in quality between outdoor air entering the system and the desired quality of the air to be supplied indoors will directly influence the filter specification, which in turn will influence the sizing of the system and its energy performance.

Level 3

For those users who wish to:

Assess Indoor Air Quality in an objective manner based on the performance of a completed building.

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

4.2 Time outside of thermal comfort range

Level 1

For those users who would like to:

- ✔ Assess the risks of occupant thermal discomfort during the heating and cooling seasons for the building type being assessed.
- ✔ Understand measures that can be taken to create a comfortable thermal environment in the building types being assessed.

Level 2

This level is for those users who wish to

- ✔ Assess the energy requirements of a building.
- ✔ Make a quantitative assessment of the indoor thermal conditions according to the Category II temperature ranges outlined in EN 16798-1:2019 (or national equivalent).
- ✔ Perform an overheating assessment of a building for the purpose of obtaining a building permit.

Level 3

This level is for those users who would like to:

- ✔ Collect monitoring data on the thermal conditions in a building to compare the performance with design simulations.
- ✔ Carry out a post-occupancy survey of occupants to determine the level of dissatisfaction with the thermal comfort conditions and compare the results with the design estimates.

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

4.3 Lighting and Visual comfort

Level 3

Level 1	Level 2
This indicator is currently only specified for Level 1 For those users who would like to: ✔ Get support to learn how to understand and prioritise the most important lighting and visual comfort aspects to focus attention on. ✔ Get support to establish requirements and specifications that enable the production of a detailed design that ensures the health and comfort of occupants during visual tasks and activities.	

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

4.4 Acoustics and protection against noise

Level 1	Level 2	Level 3
This indicator is currently only specified for Level 1 For those users who would like to: ✔ Understand and prioritize the most important design aspects to focus on, taking into consideration five acoustic and noise protection design aspects at the concept stage of a project. ✔ Make the right decisions when setting requirements and specifications. This level also provides initial suggestions for how calculations and field measurements can be made.		

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

5.1 Protection of occupier health and thermal comfort

Level 3

Level 1

This indicator is currently only specified for Levels 1 and 2

For those users who would like to:

- ✔ Assess the risks of occupant thermal discomfort during the cooling seasons for the building type being assessed.
- ✔ Understand and identify measures that can be taken to future-proof a building's thermal environment and/or incorporate adaptation measures.

Level 2

This level is for those users who are at the stage where they need to assess the energy requirements of a building and wish to make a quantitative assessment of the indoor thermal conditions under projected future climate conditions.

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

5.2 Increased risk of extreme weather

Level 3

Level 1

This indicator is currently only specified for Level 1.

For those users who would like to:

- ✔ Learn about the steps to take during the conceptual design stage (and even earlier) to ensure maximal awareness of extreme weather events at the building location.
- ✔ Optimise the design of the building and any surrounding plot area to adapt to extreme weather events.

Level 2

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

5.3 Sustainable drainage

Level 3

Level 1	Level 2	Level 3
This indicator is currently only specified for Level 1. For those users who would like to: ✔ Set out the steps to take during the conceptual design stage in order to embrace sustainable drainage options as much as possible. ✔ Be aware of both the risk of flooding at the building and the possible effect of the building itself on flood risk in surrounding and downstream areas.		

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

6.1 Life cycle costs

Level 1

For those users who would like to:

- ✔ Calculate the life cycle cost of their building project but want to understand how to achieve a longer-term understanding on the costs associated with a building project.
- ✔ Incorporate some important life cycle cost concepts into conceptual designs and, later, detailed designs.

Level 2

This level is for those users who wish to

- ✔ Calculate the life cycle costs of their building project.
- ✔ Select software tools and databases.
- ✔ Understand the basic elements of the calculation and the calculation steps in line with the Cost Optimal method, EN 15459 and the ISO 15686-5 standard, including assumptions and default parameters that shall be used and data gap filling.

Level 3

This level is for those users who would like to:

- ✔ Revise the life cycle costs of their building project based on the as-built initial costs and any associated revisions in the projected annual and periodic costs.
- ✔ Report on the life cycle costs for a completed building.

Source: EU Academy

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

6.2 Value creation and risk factors

Level 1	Level 2	Level 3
This indicator is currently only specified for Level 1 For those users who would like to: ✔ Understand how sustainability aspects addressed by Level(s) can have an influence on property financial value and risk appraisals. ✔ Have a starting point for dialogue between the design team, the client and their property market specialists. ✔ Ensure that improved sustainability performance, which can be reported on and verified using Level(s), is amongst the factors taken into account when making a property market valuation.		

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Establishing a Level(s) project plan

- Finally, having decided at which level project performance will be assessed, ensure your planning is associated with key workflow requirements.
- As such, sustainability will become a key priority for the building project alongside factors such as cost and yield.
- In the following slides you will see which questions the team needs to consider when establishing the workflow from the outset. This will enable effective planning and integration into the project Level(s) assessment.

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Establishing workflow

Level(s) performance assessments

- ✔ Does the team have the training and expertise to make an assessment at all levels? If not, how will the gaps be bridged?
- ✔ Has the team read the introduction material on Level(s) such as the European Commission website, fact sheets, flyers and introduction manuals?
- ✔ Have milestones been established by the team for each indicator assessment?
- ✔ Who will be assigned the responsibility for performing each indicator assessment?
- ✔ Who will coordinate the Level(s) indicator assessments?

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Establishing workflow

Information and data management

- ✔ How will the flow of information and data required to make each indicator assessment be managed?
- ✔ Will Building Information Modelling be used and, if so, how could it support Level(s) assessments?

Renovation baseline

- ✔ Will it be a major renovation project?
- ✔ If so, how comprehensive is it planned to be?
- ✔ How will the baseline survey of the building and its fabric be carried out?
- ✔ What information will be needed from the baseline survey to perform the indicator assessment?

Source: EU Academy

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Establishing workflow

Property market valuation

- ✔ How will Level(s) indicator performance aspects be considered in the buildings market valuation?
- ✔ How and at what points in the project will dialogue be established between the project team and the valuer?

External verification

- ✔ Will third party verification of the Level(s) assessment results be required?
- ✔ If so, by whom and at what point in the project?

Source: *EU Academy*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Completing the building description

An important part of working at Levels 2 and 3 is the completion of the building description. Its role is to provide a transparent basis for comparing the performance of different buildings.

The following topics must be included and the required information associated with each one.

Location and Climate-	1.1 The country and region where the building is located. 1.2 Heating and cooling degree days. 1.3 The climate zone where the building is located.
Building Type and age-	2.1 The project type. 2.2 The year of construction. 2.3 The market segment
How building will be used-	3.1 The intended conditions of use. 3.2 Building occupation and usage patterns. 3.3 The intended (or required) service life.
The building model and characteristics-	4.1 The building form. 4.2 The total useful floor area within the building and measurement standard used. 4.3 The scope of building elements to be assessed and categorisation system used.

Source: *EU Academy*

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

Learn more!

EU Level(s) User manuals:

- **User Manual 1** - introduction guide to Level(s). It provides detailed information on who Level(s) is for and how to use it.
- **User Manual 2** shows you how to set up a project according to the Level(s) methodology.

All the user manuals and accompanying Level(s) documentation are available to download on the Level(s) website

For more courses on Level(s).

- EU Level(s) academy
- Level(s) Building Sustainability Performance - Irish Green Building Council (igbc.ie)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Application for Multi-functional Green Roofs Facades and Interior Elements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Application for Multi-functional Green Roofs Facades and Interior Elements

Have you worked on a project containing a green roof?

Can you attempt to utilise all of the above topics on a Multi-functional Green Roofs Facades or Interior Element.

What comparison can you draw with other projects and what improvements can you notice?

What elements can be kept or removed and how would this affect your LCA and LCC?

Source:http://2030palette.org/green-roof/

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

QUIZ/ASSIGNMENT/ACTIVITY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

EXTRA READING/STUDY

Activity

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

EXTRA READING/STUDY

For Further Case Studies and Training Material Please Follow the Link Below

https://docs.google.com/spreadsheets/d/1DTte4Ph8pQ4lKzYGFt2_S-d1Z_Rmd9-i/edit?usp=sharing&ouid=112148808974461842163&rtpof=true&sd=true

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740

EXTRA READING/STUDY

BIMzeED

https://bimzeed.eu/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

https://busgocircular.eu/

Follow us

https://twitter.com/BusGoCircular

https://www.linkedin.com/company/busgocircular

https://www.youtube.com/channel/UCXu4Rjs5WDXBE-yqda5kt5A

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033740

Colophon

BUS GoCircular

Partners

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101033740