III. Building LCA 101: Housing

What is building LCA? Building life cycle assessment (LCA) is used to estimate the embodied carbon of a building over its full life cycle, from raw material extraction through end-of-life and disposal. It is often used to compare design decisions at the building scale, identify reduction opportunities, or estimate the life cycle embodied carbon of a project.

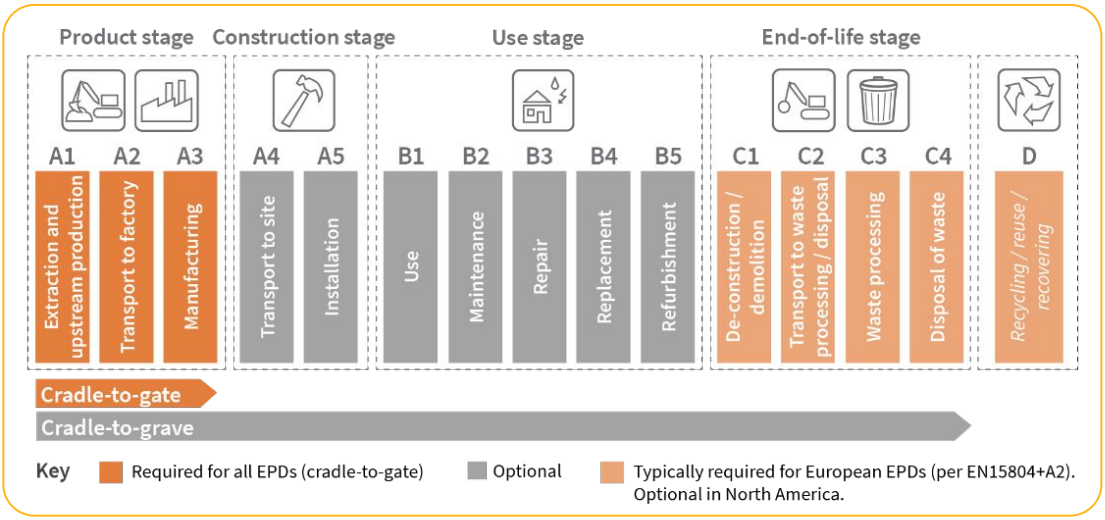

Figure 1. Life cycle stages typically included in north american building life cycle assessments. Module names are in accordance with ISO 21930.

How is building LCA different than EPDs?

EPDs report out an individual product's embodied carbon, while building LCAs report out an individual building's embodied carbon. Building LCAs use EPDs and other data sources to provide a holistic picture of the embodied carbon emissions throughout a building's life cycle. Building LCAs often include more life cycle stages (A-C) compared to EPDs which often focus on A1-A3 impacts.

What data is used in building LCAs?

LCA models draw from a variety of both generic and product specific data sources. Most of the data below is accessible through building LCA tools, with the exception of material quantities, which must be specific to the project (and therefore provided by the project team).

- **Material quantities** describing the type and quantity of each material used. These are typically collected from BIM software during design (or from contractors after construction).
- **Transportation data** for the distances and vehicles used to deliver materials and along the supply chain can be used to update generic estimates included in LCA tools.
- **Construction data,** such as site electricity use, water use, equipment and fuel usage for excavation, demolition, and construction can be collected by contractors and used in LCA.
- **Use and end-of-life scenarios** include data about how and when materials will be used and how long they will last, helping calculate landfill emissions and other impacts.
- **Emissions factors** quantify a material or process's environmental impact per unit, (e.g., 854 kg CO_2e per metric ton of fabricated rebar).[1]

As the building is closer to being complete, data can become more specific to the project and include procurement decisions. As data resolution increases, the potential to make decisions with a large reduction impact decreases, so while 'as-built' estimates are most accurate, they are least likely to facilitate embodied carbon reductions.

TIPS

In the context of a building LCA, EPDs often must be complemented by other more generic data sources to capture impacts for life cycle stages beyond A1-A3, and are most appropriate for assessing projects that have already been built.

REFERENCES

1. Waldman, B., Habchi, R., and Palmeri, J. (2025). 2025 CLF North American Material Baselines Report. Carbon Leadership Forum.

Low carbon design strategies for housing

There is no one-size-fits-all strategy for reducing the embodied carbon of residential buildings. Strategies for reducing embodied carbon generally fall into four broad categories:

1. **Build less, reuse more** by giving materials another life such as lumber, flooring or cladding, from other project sites or material resale companies.
2. **Build lighter and smarter** by using less of a given material (or floor area) to do the same work
3. **Substitute materials** by replacing high-carbon materials with lower-carbon alternatives such as alternative cladding, flooring, or bio-based insulations.
4. **Procure low-carbon products** by comparing different products or manufacturers with the same function using databases like EC3 and procuring the lower carbon option (i.e. low carbon concrete or gypsum wallboard).

Whether these strategies can be used on a specific housing project varies by geography, height, code requirements and other factors.

Figure 2. Four primary categories of opportunities for embodied carbon reduction strategies.

Standards and guidelines are key to consistency and quality

Clear requirements on international LCA standards and other guidance to follow is critical to create consistency, facilitate compliance and encourage alignment across tools and practitioners. RESNET Standard 1550[2] is a whole building LCA reporting standard for residential construction that is currently in development. This standard will offer a first of its kind a methodology for quantifying, verifying and reporting the embodied carbon emissions of dwelling units and sleeping units in residential and commercial buildings.[2]

Building LCA: showing Reductions from a "Baseline" Building

To comply with a reduction requirement via a building LCA, a baseline building often needs to be created against which reductions can be demonstrated. The baseline building typically must be functionally equivalent to the actual project, which means the two must be compliant with applicable building codes and laws, and have the same massing, function, thermal and structural performance. Strategies that can be used to show reductions typically include: material quantity reductions, material alternatives, and product alternatives.

Embodied Carbon Reduction Type	Example Strategies
Material quantity reduction	• Asset (building) or material reuse • Advanced structural design for material efficiency • Prefabricated construction
Material alternative	• Structural type alternative • Wall, roof or floor assembly alternative • Salvaged products
Product alternative*	• Lower carbon products (documented via EPDs*)

*EPDs must represent the product being installed and the manufacturing facility that the product came from. EPDs must have an active validity period (e.g. not expired).

REFERENCES

2. RESNET (forthcoming 2025). Draft PDS-02, RESNET 1550, Embodied Carbon.