FOREST-CLIMATE WORKING GROUP

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Terminology

Carbon footprint of a building:

- Scope 1: Direct ("site") GHG emissions (e.g., emissions from gas boilers, fleet vehicles)
- Scope 2: Indirect ("source") GHG emissions for energy (from utilities, e.g., heating)
- Scope 3: Other indirect GHG emissions ("embodied carbon") occurring from unowned or uncontrolled sites (incl., emissions associated with material extraction, production, and transportation).

Embodied carbon: global warming potential (GWP) result of an LCA (may or may not reflect full life cycle). Otherwise known as Scope 3 emissions or "value chain", "upstream/ downstream", or "indirect" emissions. Does not include: 1) carbon stored in the material itself or 2) operational carbon (e.g., emissions associated with heating a wood building).

LCA: Life Cycle Assessment: A multi-step technique for assessing environmental impacts (*including the embodied carbon/ Scope 3 emissions*) associated with a product, whole building, or service (guided by ISO standard 14025:2006). LCAs aid decision-making by:

1) Replacing guesswork with data;
2) Identifying the primary sources and/or hot spots of carbon impacts; and
3) Encouraging holistic carbon accounting (i.e., moving away from single issues (e.g., buying local; recycling) and ensuring that action in one part of the value chain does not have negative carbon implications elsewhere).

LCI: Life Cycle Inventory. The data collection portion of an LCA.
LCIA: Life Cycle Impact Assessment. Environmental impact estimation for the LCA.

EPD: Environmental Product Declaration. Public-facing way to report LCA data – an independently verified and registered summary of the LCA report (follows ISO 14025 type III protocols). EPDs signal 1) transparency and 2) that the manufacturer has undertaken an LCA, which may suggest sustainability awareness and the possibility for environmental improvements (should the manufacturer use the LCA results to take such steps)

Process: Four steps in conducting an LCA

1. Identify goal, scope, functional unit (i.e., what will be included in the study) – e.g.:
    a. Specific to the product, a particular sawmill/brand, or an industry-average?
    b. Scope: the system boundary. Which life cycle stages? Cradle to gate or grave?
    c. Functional unit: what is the reference to which results are compared?
2. Inventory the flows, *i.e., conduct an LCI*. Survey the plant/ mill or a representative sample; account for everything going in and coming out (primary data); get background data, e.g., upstream materials and energy.
3. Estimate environmental impact of the flows, *i.e., conduct an LCIA* (using impact assessment software).
4. Interpret results. May include a sensitivity analysis (e.g., are results dependent on particular assumptions?)

Optional follow-up steps include: obtaining third party review, making the report public, creating an EPD, making data available to whole building LCA (WBLCA) tools and public LCI or LCA/EPD databases.

Product versus Whole Building LCAs/ EPDs

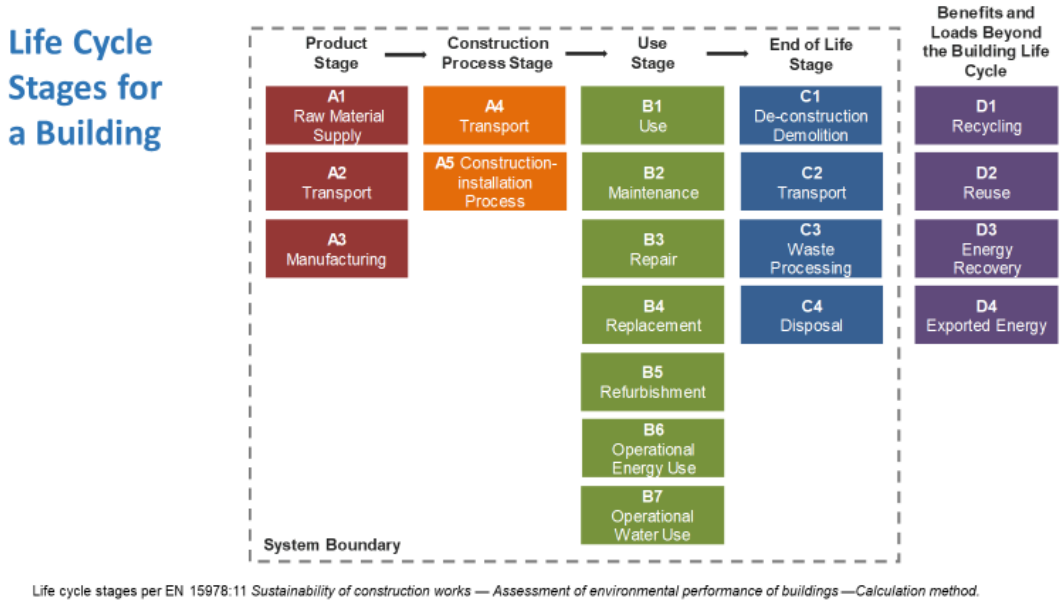


Figure 1

<u>Product-level</u>

Generally, scope is cradle to factory gate [A1 – A3 (figure 1)], or the extraction and manufacturing stages. Downstream phases not included due to uncertainty over product use [B] and end of life [C] stages (myriad use options).

Who uses product EPDs: Certification programs, initiatives, and policies

- Green Building standards (e.g., LEED, Green Globes)
- Initiatives creating databases of product and WBLCAs (e.g., EC3 (focus on within-material comparisons) and LCA^2 (material and WB comparisons)).
- Policies (e.g., Buy Clean legislation) use of lower embodied carbon products *within* material categories.
- The LCI data used in product EPDs provide the underlying data for WBLCAs

<u>WBLCAs (Whole Building Life Cycle Assessments)</u>

- Steps: (figure 1)
    1. Sum all relevant product LCA results (typically A1-A3)
    2. Add transportation to site and construction (A4-A5), use (B), and end-of-life (C) phases. Note that B6 and B7 (operational emissions) are optional.
    3. D1-D4, the phases beyond deconstruction and disposal, are optional.
    - Note: Recent policy discussion about stopping accounting after A3. Though most emissions occur between A1-A3, would be incomplete carbon accounting.

- Results/Output: *environmental impact,* e.g., ATHENA measures GWP (embodied carbon); Acidification, Eutrophication, Smog, and Ozone Depletion Potential; Human Health Particulate; and Fossil Fuel consumption, among others.

NOTE: WBLCAs allow for more carbon impact. Product-level LCAs/ EPDs don't alone measurably reduce building embodied carbon as their application comes *after* the design phase (i.e., choosing the best wood product to use is helpful, but *designing* buildings with less embodied carbon will include rethinking material selection – this is where substitution comes in and where wood products can shine). The WB scope provides greater opportunity to incentivize both material-level and design efficiencies.

Data

WBLCAs are informed by product-level LCI data. It is important that LCI data be up-to-date and publicly available.

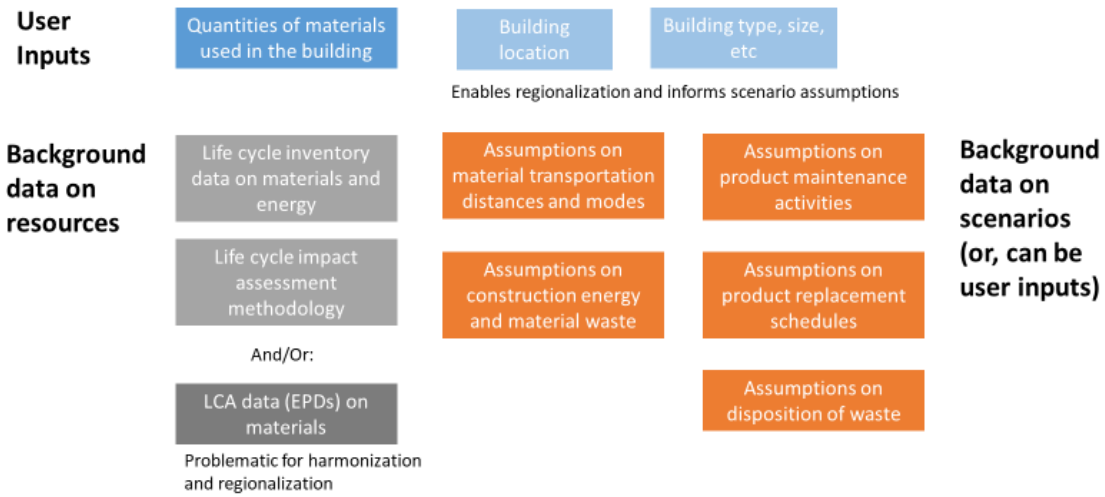
Product-level data: Wood products have been the subject of LCIs since the 2000s (funded mostly through government grants and carried out by organizations like CORRIM, ATHENA, academic institutions, FPL, and LCA practitioners).

Most wood EPDs in North America are industry-average (rather than manufacturer- or mill-specific) due to the way the data are collected. From a carbon perspective, this is probably a good thing, as it encourages choosing by location rather than mill. The alternative (i.e., choosing a particular mill that is associated with lower embodied carbon), may risk greater overall emissions – as wood products have relatively low embodied carbon, additional transportation emissions could easily surpass the difference between mills.

Data collection process:

1. Representative individual mills surveyed across all regions; results compiled at construction ***product*** level (most products have now had two inventories conducted – one in early 2000s, another around 2012; a new round in planning).
2. Underlying data are published in LCA reports and then in public LCI databases, which can then be used as inputs to WBLCA tools
3. AWC/ CWC own the data and issue *industry-average* EPDs (underlying data)

WBLCA inputs and assumptions:



Result Comparability

LCA results will vary depending on selected functional unit and scope. As long as those choices are transparent, it is a *legitimate* LCA, though results are not directly comparable.

Efforts are made to make product EPDs more standardized/comparable *within material-type* (e.g., all wood product EPDs must follow a specific set of "product category rules" (PCR), which standardize the unit and life cycles stages to be included). *However*, PCRs rarely specify rules for background data and assumptions (e.g., whether the data are based on a particular electricity grid and from a particular year), invariably leading to differing results across EPDs even within the same material category.

As a result: due to differing data assumptions and sources, product EPDs are not currently directly comparable, even within materials.

Because of these inconsistencies across EPDs, ***WBLCAs will ideally rely on the underlying product LCI data rather than on product EPDs***. LCI data can be used to model results that ensure better harmonization across products. See this briefing note for more on comparability.

Policy Options

All rely on underlying LCA/EPD data and focus on incentivizing demand (i.e., consume less and consume smarter) – responsibility on owners, designers, and builders.

Example Policy Objectives

- Greater structural and cement efficiency
- *Materials:* material substitution; use of durable and low maintenance materials
- *Design:* adaptable and deconstructable; reduce floor-to-floor height; build smaller

Policy Types

1. *Prescriptive:* Simply follow a prescription for action deemed "good" (e.g., use recycled, local, bamboo products). CON: "Good" actions are subjective – not evidence-based. Risk of unintended consequences.
2. *Performance (material level):* Choose "low carbon" products (choose a best-in-class product, e.g., a specific lumber that has embodied carbon lower than the industry benchmark – LEED v4.1 MRc2; Buy Clean legislation. CONS: 1) Requires widespread LCAs/ EPDs in industry (more than we currently or will likely have – expensive and complications with, e.g., imported goods and establishing benchmarks); 2) Usable within a narrow product category, but risky as you want all industries to try to improve. Won't do much to reduce the overall embodied carbon of buildings.
3. *Performance (building level):* Emissions caps or fees, using LCAs to determine building-level embodied carbon. Can implement with a carbon fee, benchmark target, or fixed cap. PRO: Easy to understand and implement; achievable with current resources; baby steps to help industries ramp up and build skills.

Performance (*building-level*) policy options			
	How It Works	Current Use Examples	Additional Notes
Carbon Fee	Report (and pay for each unit of) embodied carbon	CaGBC Zero Carbon program; Living Building Challenge; ILFI Zero Carbon program	Fees could be earmarked toward climate/ NWL programs; *[technically (but not politically) feasible]*
Benchmark Target	Compare LCA reports from a benchmark building to the *proposed* design – aim to beat benchmark.	LEED; Green Globes; CalGreen; IGCC: ILFI Zero Carbon program; Germany, UK?	*Requires*: a system for generating valid benchmarks *[current programs use self-defined benchmarks, so no guarantee of actual reductions]*
Fixed Cap	LCA on *proposed* design must come in below the fixed cap	ILFI Zero Carbon program; France, Netherlands, Switzerland, UK?	*Requires:* strict guidelines to ensure comparability of LCAs; that numbers be specific to each region, LCA tool, building type, etc.; frequent updating to account for changes in the underlying data, tools, etc. *[burdensome; impractical]*

Policy options supportable with current resources:

- Incentives to use LCA on new construction projects
- Incentives for manufacturers to do LCA and publish EPDs
- Embodied carbon fee on new construction (politically challenging)

Policy options requiring more technical infrastructure:

- Performance targets for new construction (whole-building LCA targets)
- Performance targets for manufacturers (product-specific LCA targets)

References and Relevant Resources

Webinar recording: https://www.youtube.com/watch?v=s4tuwWmtqNY

White paper: "Reducing embodied environmental impacts of buildings."

Briefing note: "Limitations of EPDs for product comparisons."

Magazine article: "What can we do about embodied carbon?"

Wood carbon seminars: https://carbonleadershipforum.org/wood-carbon-seminars/

North American Wood Product LCA Coordination Group: co-initiated by the US Endowment and the Forest Products Lab; goals include increasing EPD efficiency, educating stakeholders, and coordinating research and new LCAs.

WB-LCA software tools for North America: Athena Impact Estimator for Buildings; Tally; One Click LCA. Note: not comparable with one another – inconsistencies in data and assumptions.

DATA:

- American Wood Council EPDs: https://www.awc.org/sustainability/epd
- Wood Product LCAs: https://corrim.org/lcas-on-wood-products-library/