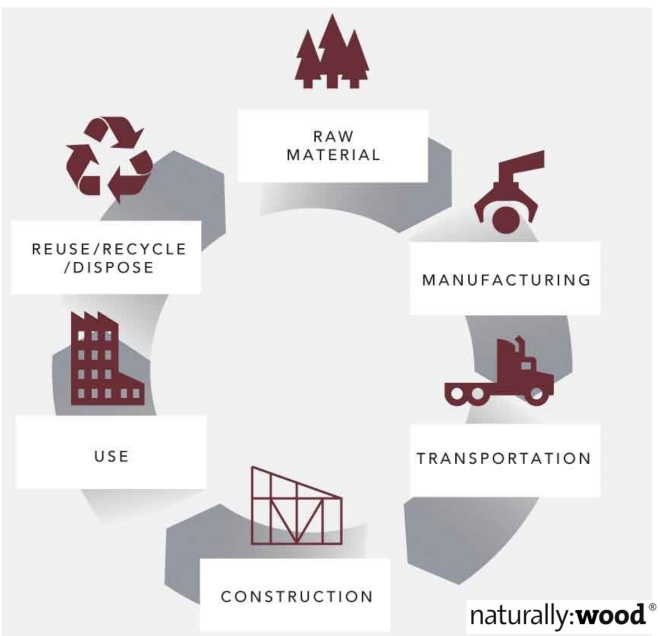
MEASURING POTENTIAL ENVIRONMENTAL IMPACTS THROUGH LIFE CYCLE ASSESSMENT

Aspen Art Museum, Aspen. Photography: Michael Moran/OTTO

FACT SHEET
SUSTAINABILITY

BACKGROUND

The best way to understand the potential environmental impacts of a building product or structure is to look at its full life cycle – from raw material acquisition and manufacturing through construction, operation, maintenance and renovation to the end of its life. Life cycle assessment (LCA) is a scientific, performance-based approach to evaluating the potential environmental impacts of building choices that is accepted around the world.



The choice of construction products has a significant impact on the environment.

WHAT YOU NEED TO KNOW

What is Life Cycle Assessment?

LCA analyses the potential impact of products, systems or services on environmental areas of concern such as water quality, air quality and climate change, at every life cycle stage. It is a standardized process that is accepted internationally and is based on the ISO 14040[1] and 14044 standards.[2] Some jurisdictions, including Germany, Zurich and Brussels, have made it a mandatory requirement for a building permit. There are two types of LCA:

- Cradle-to-grave measures the potential environmental impacts of a product through the entire life cycle; from raw material acquisition through manufacturing, transportation, construction, use, and end-of-life treatment (reuse, recycle, recover for energy, dispose).
- Cradle-to-gate measures the potential environmental impacts of a product from resource extraction to the point before the product is sent to the consumer. This option is used more often since there may not be enough information to create specific assumptions for all life cycle stages in a full cradle-to-grave assessment.

LCA is a decision-making tool that can help to identify a design approach that yields improved environmental performance. Scenarios estimate the potential environmental impacts of construction materials as well as a whole building once it is occupied. They also take into account the choices available at the end of the product's service life or the overall structure's realistic life.

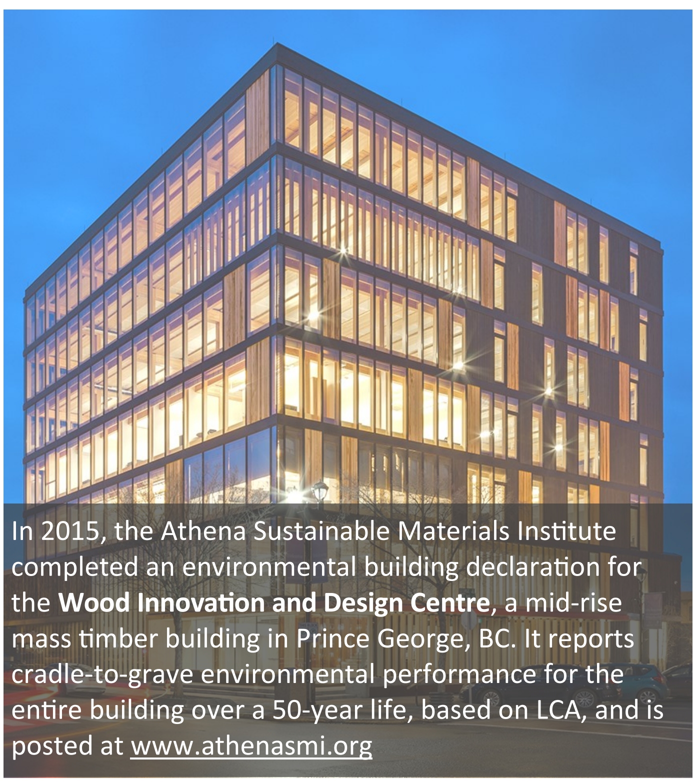
Comparing design options using functional equivalence

An LCA which examines alternative design options must ensure functional equivalence. Each design scenario considered, including the whole building, must meet building code requirements and offer a minimum level of technical performance – or functional equivalence. For something as complex as a building, this means tracking and tallying the environmental inputs and outputs for the multitude of assemblies, subassemblies and components. FPInnovations conducted a LCA of a four -storey building in Quebec constructed using cross-laminated timber (CLT). The study assessed how the CLT design would compare with a functionally equivalent concrete and steel building of the same floor area, and found improved environmental performance in two of six impact categories, and equivalent performance in the rest.[3]

Environmental Product Declarations

Environmental product declarations (EPDs) for building products use LCA to provide a transparent declaration of a product's potential environmental impacts. Based on international standards (ISO 14025[4] and 21930[5]), they have worldwide applicability and include information about impacts such as use of resources, energy use, global warming potential, emissions to air, soil and water, and waste generation.

Green building rating systems, including LEED®, Green Globes™ and BREEAM®, recognize the value of the information derived from LCA and EPDs to assess the potential environmental impacts of building products.


In 2015, the Athena Sustainable Materials Institute completed an environmental building declaration for the **Wood Innovation and Design Centre**, a mid-rise mass timber building in Prince George, BC. It reports cradle-to-grave environmental performance for the entire building over a 50-year life, based on LCA, and is posted at www.athenasmi.org

Wood Innovation and Design Centre, BC. Photography: Ema Peter

The North American wood products industry has obtained third-party certification from Underwriters Laboratories Environment (ULE) for a selection of generic wood product EPDs. They are posted on the Canadian Wood Council website at http://cwc.ca/green/epds/ and include softwood lumber, softwood plywood, glue laminated timber (glulam), I-joists, laminated veneer lumber (LVL), laminated strand lumber (LSL), medium density fiberboard (MDF), cellulosic fiberboard, oriented strand board (OSB), particle board, and redwood decking.

Steamworks Brewing Co, Vancouver - original building built in 1890s

The longevity of a building system impacts the environmental performance. Wood buildings can last a long time if they are designed, built and maintained properly.

FOR MORE INFORMATION

- Building for Environmental and Economic Sustainability (BEES) - the National Institute of Standards and Technology (NIST).
- LCA software tools. Athena Sustainable Materials Institute
- reThink Wood
- naturally:wood

[1] International Organization for Standardization 14040. *Environmental management -- Life cycle assessment -- Principles and framework.*
[2] International Organization for Standardization 14044. *Environmental management -- Life cycle assessment -- Requirements and guidelines.*
[3] FPInnovations. *A Comparative Life Cycle Assessment of Two Multistory Residential Buildings: Cross-Laminated Timber vs. Concrete Slab and Column with Light Gauge Steel Walls, 2013.*
[4] International Organization for Standardization 14025. *Environmental labels and declarations.*
[5] International Organization for Standardization 21930 *Sustainability in building construction – Environmental declaration of building products.*