Building Green with Wood

MODULE 2

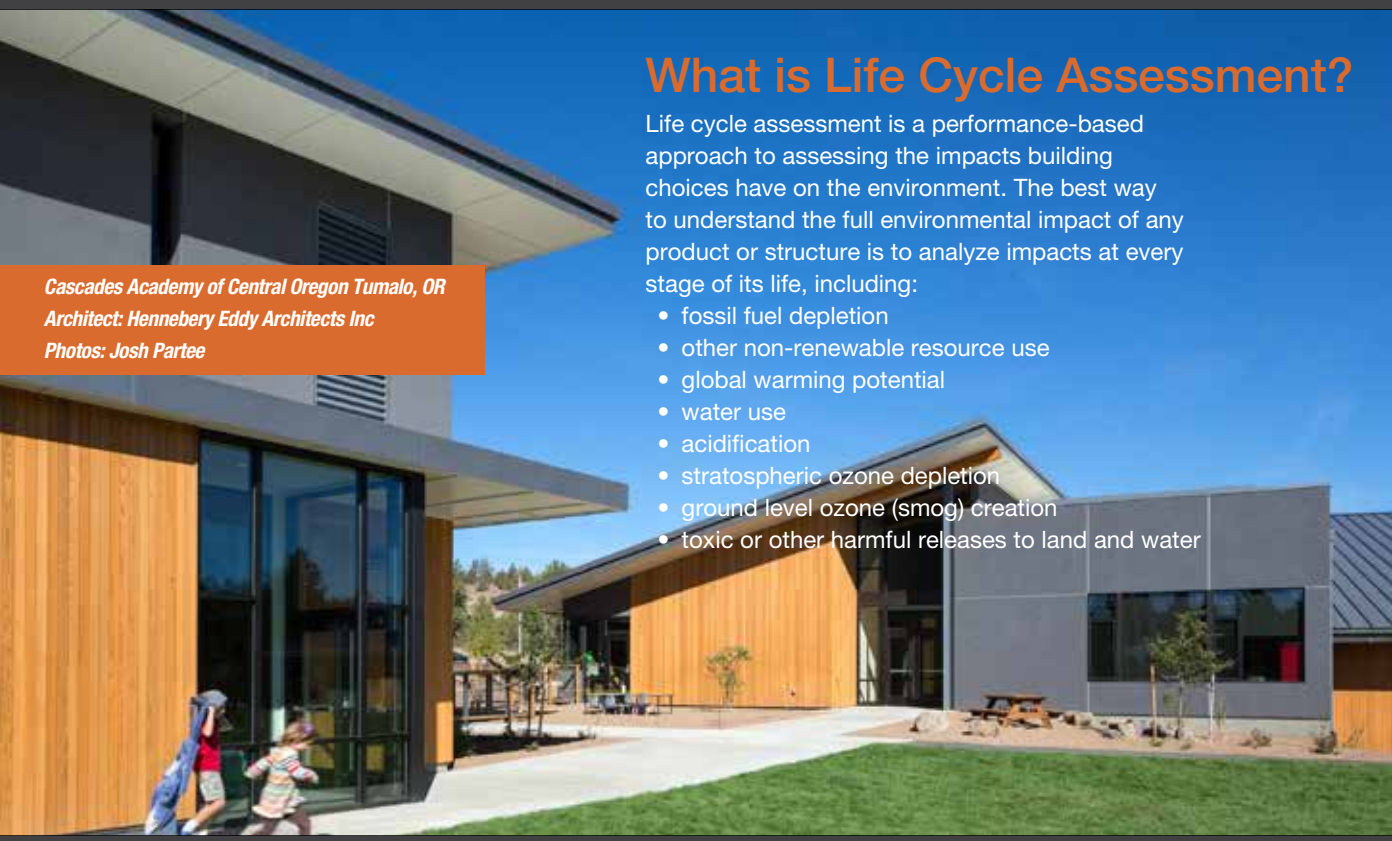
Life Cycle Assessment

Making the Right Environmental Choice

The choice of products used to build, renovate and operate structures of all types has a huge impact on the environment, consuming more of the earth's resources than any other human activity, and producing millions of tonnes of greenhouse gases, toxic emissions, water pollutants and solid waste.

Obviously, building with the environment in mind can reduce this negative impact. But to be effective, decisions need to be based on a standardized, quantified measurement system that allows an impartial comparison of materials and assemblies over their entire lives. Prescriptive approaches to green design often focus on a single characteristic, such as recycled content, with an assumption it will yield the greatest environmental advantage.

The most widely accepted scientific method to compare design choices and building materials effectively is life cycle assessment (LCA). It has existed in various forms since the early 1960s, and the protocol for completing life cycle assessments was standardized by the International Organization for Standardization (ISO 14040-42) in the late 1990s.



Cascades Academy of Central Oregon Tumalo, OR
Architect: Hennebery Eddy Architects Inc
Photos: Josh Partee

What is Life Cycle Assessment?

Life cycle assessment is a performance-based approach to assessing the impacts building choices have on the environment. The best way to understand the full environmental impact of any product or structure is to analyze impacts at every stage of its life, including:

- fossil fuel depletion
- other non-renewable resource use
- global warming potential
- water use
- acidification
- stratospheric ozone depletion
- ground level ozone (smog) creation
- toxic or other harmful releases to land and water

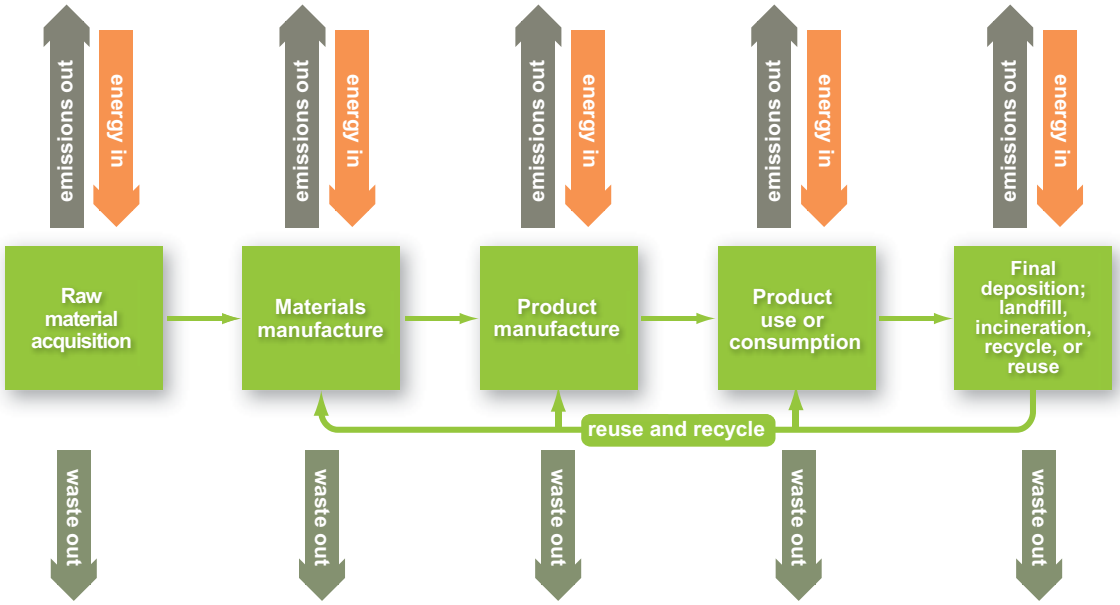
Since its inception in 1997, the Athena Sustainable Materials Institute has focused on bringing rigorous quantification to the pursuit of sustainability in the built environment. Athena works with product manufacturers, trade associations, green building associations, and architectural and engineering firms to help quantify environmental impacts and to demystify and assist teams with LCA.

It enables an objective comparison to be made between alternate materials and assemblies over their lifetime, based on quantifiable indicators of environmental impact. Life cycle assessment clarifies the environmental trade-offs associated with choosing one material over another and, as a result, provides an effective basis for comparing alternate designs in a specific geographic location.

Designers can make informed environmental decisions using life cycle assessment tools such as BEES (Building for Environmental and Economic Sustainability) and the ATHENA Impact Estimator for Buildings or EcoCalculator. BEES evaluates the environmental performance of individual products whereas the ATHENA software tools deal primarily with whole building design.

The ATHENA Institute is also working with other organizations to assist the integration of life cycle assessment methodology into third-party green building rating systems such as LEED (Leadership in Energy and Environmental Design) and Green Globes.

Life cycle assessment considers every input and output
This diagram illustrates the general concept of life cycle assessment, where all of the environmental inputs and outputs are measured at each stage of a product's life.



Life Cycle Assessment and Wood

Life cycle assessment studies worldwide have consistently shown that wood products yield clear environmental advantages over other building materials at every stage. Wood buildings can offer lower greenhouse gas emissions, less air pollution, lower volumes of solid waste and less ecological resource use.

A comprehensive review of scientific literature looked at recent research done in Europe, North America and Australia pertaining to life cycle assessment of wood products. It applied life cycle assessment criteria in accordance with ISO 14040-42 and concluded, among other things, that:

- Fossil fuel consumption, the potential contributions to the greenhouse effect and emissions to air and water are consistently lower for wood products compared to competing products.
- Wood products that have been installed and are used in an appropriate way tend to have a favorable environmental profile compared to functionally equivalent products out of other constructed materials.

Similar results were found for whole buildings in a comparison of three hypothetical buildings of identical size and configuration. Designed for the Atlanta geographical area, the building was two stories in height, had a footprint of 20,000 ft.^{2}, a total floor area of 40,000 ft.^{2}, and was built on a concrete foundation and slab. A commonly used LCA tool, the Athena Eco-Calculator, was used to evaluate three alternative configurations of the building – wood, concrete, and steel. To simplify analysis, the theoretical building was analyzed without windows, doors, or internal partitions. Impacts associated with the steel design as compared to the wood design were found to be 1.02 to 3.0 times greater. Comparison of the concrete vs. wood design shows even greater differences. In this case environmental impacts associated with the concrete design ranged from 1.9 to 5.8 times greater than for the wood design.

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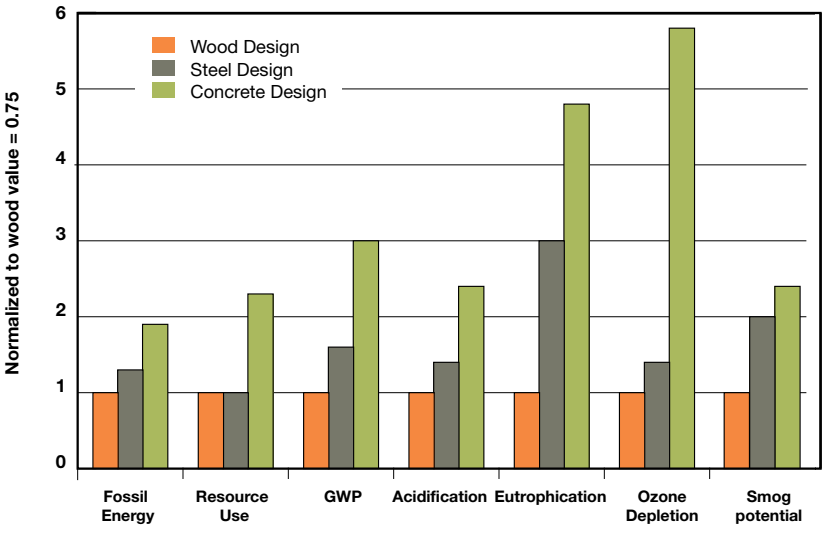

Source: Dovetail Partners using the Athena Eco-Calculator (2014)

Comparing Environmental Impact of a Wood, Steel and Concrete Home

In this graph, three hypothetical buildings (wood, steel, and concrete) of identical size and configuration are compared. Assessment results are summarized into seven key measures covering fossil energy consumption, weighted resource use, global warming potential, and measures of potential for acidification, eutrophication, ozone depletion, and smog formation. In all cases, impacts are lower for the wood design. Source: Dovetail Partners using the Athena Eco-Calculator (2014)

On the cover:
The Craig Thomas Discovery and Visitor Center, Grand Teton National Park, Wyoming
Architect: Bohlin Cywinski Jackson

Green buildings

- Mitigate climate change
- Use less energy and water
- User fewer materials
- Reduce waste
- Are healthy for people and the planet