Using LCA for sustainable design
Introduction to LCA
What is LCA?

Life cycle assessment inventories all the flows between a product and nature, and then estimates the environmental impact of those flows.
This is called **life cycle** assessment because it looks at every stage (phase) of the product’s life, for a comprehensive cradle-to-grave environmental footprint.
Inputs and outputs are measured in each life phase – this results in an environmental inventory.
Next is **impact assessment**, where the inventory is projected to potential for environmental damage to air, land and water due to, for example, construction of a building.

- Potential to create smog
- Potential to deplete the ozone layer
- Potential to increase climate change
- Potential to cause water eutrophication
- Potential to create acid rain
The Value of LCA

• Provides real data to inform green choices (replacing guesswork).

• Is the basis for transparent disclosure of environmental performance.

• Addresses embodied impacts (which are too often ignored).

• Identifies hot spots so we know where to look for improvements.
Are the typical characteristics we look for in green products real environmental performance measures or are they proxy measures where we assume there is a related green benefit?

55% recycled content!

Local product!

(Sounds good, but what’s the environmental benefit?)
Environmental Facts
One square meter of carpet
Life cycle impact from cradle to one year of usage

<table>
<thead>
<tr>
<th>Energy Consumption</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Total nonrenewable primary energy</td>
<td>209.12 MJ</td>
</tr>
<tr>
<td>Total renewable primary energy</td>
<td>4.02 MJ</td>
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<tr>
<td>Total primary energy</td>
<td>213.14 MJ</td>
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<table>
<thead>
<tr>
<th>Resource Consumption</th>
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</thead>
<tbody>
<tr>
<td>Nonrenewable resources</td>
<td>15.40 kg</td>
</tr>
<tr>
<td>Water</td>
<td>0.5338 m³</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Waste Produced</th>
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<tbody>
<tr>
<td>Non-hazardous waste</td>
<td>15.52 kg</td>
</tr>
<tr>
<td>Hazardous waste</td>
<td>0.0706 kg</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Impact Measures</th>
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<tr>
<td>Acidification potential</td>
<td>2.06 mol H+ Equiv.</td>
</tr>
<tr>
<td>Eutrophication potential</td>
<td>0.0044 kg N-Equiv.</td>
</tr>
<tr>
<td>Global warming potential</td>
<td>10.61 kg CO₂-Equiv.</td>
</tr>
<tr>
<td>Ozone depletion potential</td>
<td>9.34E-07 kg CFC 11-Equiv.</td>
</tr>
<tr>
<td>Smog potential</td>
<td>0.50 kg NOx-Equiv.</td>
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</table>

This kind of measured environmental performance data is much more useful.
Manufacturers are starting to publish LCA-based information in Environmental Product Declarations.
LCA addresses more than just operating energy performance – it includes *embodied* environmental impacts.

(If we don’t count everything it took to make the building.....)
Embodied impacts are important because we feel them \textbf{today}, not 60 years down the road. Taking steps to reduce embodied impacts of construction has an immediate benefit.

Over the life of the building, embodied impacts are less important than operating impacts so we often ignore them. This is a \textbf{mistake}. 

![Energy Consumption Chart]

- Year 0
- Year 5
- Year 60

- Embodied
- Operating
LCA uncovers the **hot spots** – where in the building the biggest impacts are happening. This tells us where to focus our attention when seeking improvements.
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Big contribution here … let’s drill down.
In this example, we’ll see a difference if we address the glass – maybe use a different type, or maybe reduce the area.
A few words about LCA **limitations:**

- LCA is just one tool in the sustainability kit.
- It only addresses some of the environmental impacts we may be concerned about.
- We need other tools for different impacts.
- For example:
  - Indoor air quality and human health.
  - Responsible resource extraction (e.g., sustainable harvesting) including all site-specific impacts like biodiversity.
- LCA is an estimating science, not an exact science.
- LCA helps inform direction, it does not deliver absolute answers.