Athena is a free, simplified LCA tool for building professionals with reporting consistent with EPA TRACI methodology.

The Athena LCI database contains regionalized construction data available in North America. All data is ISO 14040/14044-compliant.
The user inputs building information, operational energy, assembly information, and material quantities through pre-defined assemblies or as extra materials.

The software then analyzes these inputs and gives the user options for output reports, tables, and graphs.

Athena allows the user to use this impact information to inform design decisions and compare between design options.

You may select between SI and Imperial units.
Preset assemblies

**Foundation:** Concrete footing, Concrete SOG

**Walls:** Concrete block, CIP, tilt-up, CLT, curtain, insulated concrete form, steel/wood stud, SIPs, metal building system

**Columns and beams:** Column and beam spacing, metal building system

**Roof:** Composite metal, concrete hollow-core, suspended slab, parking garage, precast double T, CLT, light frame wood truss, open web steel joist, metal building system, steel joist, glulam joist, wood I-joist, wood joist, wood chord and steel web truss

**Floors:** Same as roof

Direct material quantity input available for all assemblies as ‘**Extra Materials**’
Concrete
10" Lightweight Concrete Block
10" Normal Weight Concrete Block
12" Lightweight Concrete Block
12" Normal Weight Concrete Block
6" Lightweight Concrete Block
6" Normal Weight Concrete Block
8" Lightweight Concrete Block
8" Normal Weight Concrete Block
Concrete Blanket CAN 15 MPa
Concrete Blanket CAN 25 MPa
Concrete Blanket CAN 30 MPa
Concrete Blanket CAN 40 MPa
Concrete Blanket CAN 55 MPa
Concrete Blanket CAN 60 MPa
Concrete Blanket USA 2500 psi
Concrete Blanket USA 3000 psi
Concrete Blanket USA 4000 psi
Concrete Blanket USA 5000 psi
Concrete Blanket USA 6000 psi
Concrete Blanket USA 8000 psi
Concrete Tile
Grout-Classic
Grout-Fine
Mortar
Precast Concrete
Concrete additives
Fly Ash
Hydrated Lime
Silica Fume
Slag Cement
Gypsum
1/2" Fire-Rated Type X Gypsum Board
1/2" Gypsum Fibre Gypsum Board
1/2" Moisture Resistant Gypsum Board
1/2" Regular Gypsum Board
1/2" Glass Mat Gypsum Panel
5/8" Fire-Rated Type X Gypsum Board
5/8" Gypsum Fibre Gypsum Board
5/8" Moisture Resistant Gypsum Board
5/8" Regular Gypsum Board
5/8" Glass Mat Gypsum Panel
Joint Compound
Paper Tape
Insulation
Blown Cellulose
Expanded Polystyrene
Extruded Polystyrene
FG Batt R11-15
FG Batt R20
FG Batt R30
FG Batt R40
FG Batt R50
FG LF Cavity Fill R15
FG LF Cavity Fill R22
FG LF Cavity Fill R30
FG LF Cavity Fill R38
FG LF Open Blow R13-20
FG LF Open Blow R21-30
FG LF Open Blow R31-40
FG LF Open Blow R41-50
FG LF Open Blow R51-60
MW Batt R11-15
MW Batt R20
MW Batt R30
MW Batt R40
MW Batt R50
Polyiso Foam Board (unfaced)
Roofing
#15 Organic Felt
30# Organic Felt
3 mil Polyethylene
6 mil Polyethylene
Ballast (aggregate stone)
Clay Tile
Concrete Tile
DuroFire® PVC membrane 50, 60, 80 mil
DuroLast® PVC membrane EV 50 mil
DuroLast® PVC membrane EV 60 mil
DuroLast® white PVC membrane 40 mil
DuroLast® white PVC membrane 50 mil
DuroLast® white PVC membrane 60 mil
DuroTuff® PVC membrane 50 mil
DuroTuff® PVC membrane 60 mil
DuroTuff® PVC membrane 80 mil
EPDM membrane (black, 60 mil)
EPDM membrane (white, 60 mil)
GAF Everguard® Extreme white TPO membrane 60 mil
GAF Everguard® Extreme white TPO membrane 70 mil
GAF Everguard® Extreme white TPO membrane 80 mil
GAF Everguard® white TPO membrane 60 mil
GAF Everguard® white TPO membrane 70 mil
GAF Everguard® white TPO membrane 80 mil
Glass Based shingles 20yr
Glass Based shingles 25yr
Glass Based shingles 30yr
MBS Metal Roof Cladding - Commercial (24 Ga.)
MBS Metal Wall Cladding - Commercial (24 Ga.)
Metal Roof Cladding - Commercial (30 Ga.)
Metal Wall Cladding - Commercial (26 Ga.)
Metal Wall Cladding - Residential (30 Ga.)
Metal Studs
MBS Secondary Components (purlins,graft,bracing)
Metal Roof Cladding - Residential (30 Ga.)
Metal Wall Cladding - Commercial (26 Ga.)
Metal Wall Cladding - Residential (30 Ga.)
Nails
Open Web Joists
Rebar, Rod, Light Sections
Screws, Nuts & Bolts
Steel Plate
Steel Tubing
Welded Wire Mesh / Ladder Wire
Wide Flange Sections
Wire Rod
Wood
Cross Laminated Timber
Glulam Sections
Laminated veneer lumber
Large dimension softwood lumber, kiln-dried
Oriented strand board
Small dimension softwood lumber, kiln-dried
Softwood plywood
Semi-Cementitious Material
Fly Ash
Silica Fume
Slag Cement
Steel
Bolts, Fasteners, Clips
Cold Rolled Sheet
Galvanized Decking
Galvanized Stud
Hollow Structural Steel
Hot Rolled Sheet
MBS Metal Roof Cladding - Commercial (24 Ga.)
MBS Metal Roof Cladding - Commercial (26 Ga.)
MBS Metal Wall Cladding - Commercial (24 Ga.)
MBS Metal Wall Cladding - Commercial (26 Ga.)
MBS Primary Frames
MBS Secondary Components (purlins,graft,bracing)
Metal Roof Cladding - Residential (30 Ga.)
Metal Wall Cladding - Commercial (26 Ga.)
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Nails
Open Web Joists
Rebar, Rod, Light Sections
Screws, Nuts & Bolts
Steel Plate
Steel Tubing
Welded Wire Mesh / Ladder Wire
Wide Flange Sections
Wire Rod
Wood
Cross Laminated Timber
Glulam Sections
Laminated veneer lumber
Large dimension softwood lumber, kiln-dried
Oriented strand board
Small dimension softwood lumber, kiln-dried
Softwood plywood
Semi-Cementitious Material
Fly Ash
Silica Fume
Slag Cement
<table>
<thead>
<tr>
<th>Information Module</th>
<th>Processes included</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1: Raw material supply</td>
<td>Primary resource harvesting and mining</td>
</tr>
<tr>
<td>A2: Transport</td>
<td>All transportation of materials up to manufacturing plant gate</td>
</tr>
<tr>
<td>A3: Manufacturing</td>
<td>Manufacture of raw materials into products</td>
</tr>
<tr>
<td>A4: Transport</td>
<td>Transportation of materials from manufacturing plant to site.</td>
</tr>
<tr>
<td>A5: Construction-installation process</td>
<td>Construction equipment energy use, and A1-A4, C1, C2, C4 effects of construction waste</td>
</tr>
<tr>
<td>B1: Installed product in use</td>
<td>n/a (currently insufficient consensus in methodology and data for this module to be addressed)</td>
</tr>
<tr>
<td>B2: Maintenance</td>
<td>Painted surfaces are maintained (i.e. repainted), but no annual maintenance aspects are included</td>
</tr>
<tr>
<td>B3: Repair</td>
<td>n/a (not currently well-supported with data)</td>
</tr>
<tr>
<td>B4: Replacement</td>
<td>A1-A5 effects of replacement materials, and C1, C2, C4 effects of replaced materials</td>
</tr>
<tr>
<td>B5: Refurbishment</td>
<td>n/a (this module applies to known future refurbishment and needs to be addressed on a case-by-case basis if applicable)</td>
</tr>
<tr>
<td>B6: Operational energy use</td>
<td>Energy primary extraction, production, delivery, and use</td>
</tr>
<tr>
<td>B7: Operational water use</td>
<td>n/a</td>
</tr>
<tr>
<td>C1: De-construction demolition</td>
<td>Demolition equipment energy use</td>
</tr>
<tr>
<td>C2: Transport</td>
<td>Transportation of materials from site to landfill</td>
</tr>
<tr>
<td>C3: Waste processing</td>
<td>Most material data does not include waste processing effects, however, the newer metals “avoided burden” methodology data does include waste processing effects, but it is not separated into its own C3 module (see Metal Recycling on page 28)</td>
</tr>
<tr>
<td>C4: Disposal</td>
<td>Disposal facility equipment energy use and landfill site effects</td>
</tr>
<tr>
<td>D: Benefits and loads beyond the system boundary</td>
<td>Carbon sequestration and metals recycling</td>
</tr>
</tbody>
</table>
New Project

This is the first dialog box you see when you add a new project. These decisions trigger specific internal calculations.

**Project location** affects transportation modes and distances, electricity grids, and manufacturing technologies.

**Building type** affects the maintenance algorithm (more aggressive maintenance/replacement for owner-occupied vs. rental/leased properties).

**Building life expectancy** affects maintenance/replacement calculations.

**Building height and floor area** affect some preset assembly calculations.

**Project number and description** are for your own information.

**Operating energy consumption** is described on the next page.
Operating energy consumption

Operational energy is edited from the building information input (right click the project name or ctrl+M)

There are different options for operating energy consumptions that each include an energy calculator.

The impacts from this box will be reported as ‘Operational Energy Use’ in module B6 in your final report.
This is the Athena home screen showing two projects with materials entered as preset assemblies and extra materials.

I recommend adding most or all your materials as “extra materials” because this gives you more control over their calculation. Some of the preset assemblies are reliant on geometry and loading information and may differ from what’s actually in your project. This is best done through a BOM import (bill of materials).
Bill of Materials Import

Right click the project name and select “BOM File Import…”

Use a spreadsheet that is structured in a way that is easy for Athena to interpret with matching material names, units of measure, and material contribution types. A sample spreadsheet will be offered to those attending the CLF Austin LCA Workshop. Otherwise, contact mtorres2941@gmail.com for a copy.

Athena allows you to map your columns to material name, quantity, unit of measure, and material contribution type (assembly). You then verify that Athena correctly matched your inputs to materials within the software. This should be easy and straightforward if the spreadsheet is set up correctly.
Add extra material

You can navigate to adding an extra material by right clicking the project name, selecting the relevant assembly, and selecting ‘extra materials’, or by right clicking the assembly name and selecting ‘extra materials’.

You may then find and add materials after searching, sorting by material type, or browsing through all available materials.

The input box will show you the construction waste factor and correct unit for input.
User defined concrete mix design record

You can define your own concrete mix in Athena with the ‘User Defined Concrete Mix Design Library’ under Tools.

Open the library, click ‘Add’, and start adding components to your concrete mix.

You can select materials from Athena’s entire database and proportion the mix by unit quantity, percent weight, or percent volume.

The new concrete mix will then appear under the ‘Concrete’ material type when adding extra materials. It is also available to be used on assemblies that have you select a concrete strength (shown to the right).
Output Reports

To produce reports, click the ‘Reports’ tab up top or right click the project and click ‘Reports’

If you have multiple projects open, you will have a comparison option. Otherwise you may select from table, graph, and rating system reports.

The different graphs and charts are shown on the next page.
<table>
<thead>
<tr>
<th>LCA Measures</th>
<th>Unit</th>
<th>Manufacturing</th>
<th>Transport</th>
<th>Total</th>
<th>Construction-Installation Process</th>
<th>Transport</th>
<th>Total</th>
<th>Replacement</th>
<th>Manufacturing</th>
<th>Transport</th>
<th>Total</th>
<th>Operational Energy Use</th>
<th>Total</th>
<th>De-construction, Demolition, Disposal &amp; Waste Processing</th>
<th>Transport</th>
<th>Total</th>
<th>Material</th>
<th>Transport</th>
<th>Total</th>
<th>A to C</th>
<th>A to C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Warming Potential</td>
<td>kg CO2 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Acidification Potential</td>
<td>kg SO2 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>HJ Particulate</td>
<td>kg PM2.5 eq</td>
<td>x</td>
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<tr>
<td>Eutrophication Potential</td>
<td>kg N eq</td>
<td>x</td>
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<tr>
<td>Ozone Depletion Potential</td>
<td>kg CFC-11 eq</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Smog Potential</td>
<td>kg O3 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Total Primary Energy</td>
<td>MJ</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Non-Renewable Energy</td>
<td>MJ</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Fossil Fuel Consumption</td>
<td>MJ</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<table>
<thead>
<tr>
<th>LCA Measures</th>
<th>Unit</th>
<th>Foundations</th>
<th>Walls</th>
<th>Columns and Beams</th>
<th>Roofs</th>
<th>Floors</th>
<th>Project Extra Materials</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Warming Potential</td>
<td>kg CO2 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
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<td>kg PM2.5 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Eutrophication Potential</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<td></td>
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<tr>
<td>Ozone Depletion Potential</td>
<td>kg CFC-11 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Smog Potential</td>
<td>kg O3 eq</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Total Primary Energy</td>
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<td>x</td>
<td>x</td>
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<td>Non-Renewable Energy</td>
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<td>x</td>
<td>x</td>
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</table>

**Operational vs Embodied Global Warming Potential (A to C)**

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit</th>
<th>Total Quantity</th>
<th>Columns &amp; Beams</th>
<th>Roofs</th>
<th>Floors</th>
<th>Foundations</th>
<th>Project Extra Materials</th>
<th>Mass Value</th>
<th>Total Mass Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; Five-Rate Type X Gypsum Board</td>
<td>ft²</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
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</tr>
<tr>
<td>Aluminum Extrusion</td>
<td>Tons (short)</td>
<td>x</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Bolts, Fasteners, Clips</td>
<td>Tons (short)</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Benchmark USA 3000 psi</td>
<td>yd³</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Concrete Benchmark USA 4000 psi</td>
<td>yd³</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<table>
<thead>
<tr>
<th>Summary Measure</th>
<th>Unit</th>
<th>Reference Design Total Effects</th>
<th>Proposed Design Total Effects</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global warming potential</td>
<td>kg CO2 eq</td>
<td>2.92E+01</td>
<td>5.23E+01</td>
<td>83.73%</td>
</tr>
<tr>
<td>Styrofoam core</td>
<td>kg CFC-11 eq</td>
<td>1.05E+01</td>
<td>1.71E+01</td>
<td>64.17%</td>
</tr>
<tr>
<td>Acoustical sound barrier</td>
<td>kg GIC-11 eq</td>
<td>3.78E+01</td>
<td>3.19E+01</td>
<td>17.12%</td>
</tr>
<tr>
<td>Concrete</td>
<td>Tons (short)</td>
<td>4.06E+02</td>
<td>1.77E+02</td>
<td>56.06%</td>
</tr>
<tr>
<td>Composite</td>
<td>Tons (short)</td>
<td>1.23E+01</td>
<td>1.90E+01</td>
<td>54.66%</td>
</tr>
<tr>
<td>Reuse of non-renewable energy resources</td>
<td>MU</td>
<td>3.22E+02</td>
<td>5.71E+02</td>
<td>78.62%</td>
</tr>
</tbody>
</table>
Demo tasks

- Create new project
- Define building information, add operational energy
- Add material with preset assembly, as extra material
  - Search
  - Material type
  - Sort through everything
- Define a concrete mix
- Add that concrete mix to an assembly and extra material
- Duplicate project
- BOM import
- Output report
Biogenic carbon and wood products

END-OF-LIFE CLT ASSUMPTIONS

ATHENA
- CLT panel
- 10% recycling
- 80% landfill
- 10% aerobic landfill
- 10% incineration
- 90% anaerobic landfill
- (69.8% of original CLT panel's carbon permanently stored in landfills)
- 87% stored
- 23% decompose

TALLY
- CLT panel
- 14.5% recycling
- 63.5% landfill
- 22% incineration
- (31.75% of original CLT panel's carbon permanently stored in landfills)
- 50% stored
- 50% decompose

Product in use
- Recycling
- CO₂

End-of-life
- Direct combustion
- CO₂

Landfill
- Aerobic landfill
- CO₂

Anaerobic landfill
- No landfill gas capture
- CH₄

Landfill gas capture in place
- Landfill gas combustion
- CO₂

Source: CLT Buildings: a WBLCA case study series, TallWood Design Institute
Resources

Download Athena

Athena IEB Tutorials

User manual and transparency document (Athena IEB v5)