**Life Cycle Analysis Analysis**

The Life Cycle Analysis of a building is the process of accounting for the impacts of the building resulting from the materials and processes associated with the production, use, and recycling/disposal of the building at the end of its life. This includes harvesting raw materials, manufacturing of products, transportation of materials and products, assembly into a structure, maintenance and operations during use, and disposal at the end of its useful life.

LCA is a way of quantifying and analyzing many different factors which affect the human environment, one of which is embodied energy. Embodied Energy of a building is defined as the total energy input consumed during the life cycle of the materials and products of the building. A life cycle analysis could include factors like Global Consumption, Embodied Energy, Life Cycle Analysis Factors, and Waste Generation.

**CO2 Emissions**

- **U.S. Municipal Solid Waste**
- **U.S. Emissions**
- **U.S. Building Sector Waste**
- **U.S. Building Sector Energy Sectors**

**Energy Consumption**

**Global Consumption**

**Embodied Energy**

- **Steel Stud**
- **ICF**

**Assembly Options**

- **Foundation Assemblies**
- **Columns**
- **Interior Wall Assemblies**
- **Exterior Wall Assemblies**
- **Exterior Wall Assemblies**

**Athena EcoCalculator**

The Athena Sustainable Materials Institute (www.athenainstitute.org) is a Canadian not-for-profit whose objective is "to foster sustainability of the built environment, by meeting the building community's need for better information and tools that allow environmental considerations to be factored into the design process."

The EcoCalculator Software, used in this project, was created by the Athena Institute as a free spreadsheet software available for download on their website. The software analyzes 7 assembly categories for 8 different impact measurement categories. The results indicate that the Athena Institute has completed as well as the National Renewable Energy Laboratory's (NREL) research and data. For each category, the user inputs the area or volume associated with that assembly. The last tab summarizes the results with graphs for each impact measurement.

The software does have some limitations. It is limited in the types of materials and construction assemblies to choose from. Any material that is relatively new or unique is not included. You can not add assemblies to the spreadsheet; you may only use what they provide. The software also makes a number of assumptions. For example, column heights are set to 10 ft with bays of 30 ft x 30 ft.

**Assembly Categories**

- Foundations and Footings
- Columns and Beams
- Interior Floors
- Windows
- Interior Walls
- Roofs

**Impact Measurements**

- Energy Consumption
- Material Resource Use
- Global Warming Potential
- Acidification Potential
- Human Respiratory Effects Potential
- Aquatic Eutrophication Potential
- Ozone Depletion Potential
- Smog Potential

**Current Walmart Supercenter Construction**

- **Roof Construction**
  - **CMU**
  - **Steel**
  - **Concrete**
  - **Gyp. Bd. + Paint**

- **Exterior Wall Construction**
  - **CMU**
  - **Steel**
  - **Concrete**
  - **Gyp. Bd. + Paint**

**Typical Walmart Supercenter**

- **Foundations and Footings**
  - **Concrete**

- **Floor Area**
  - **108,019 ft²**

- **Electrical**
  - **3,230 cu ft**

- **Wall Area**
  - **8,464 sq ft**

**Walmart by the Numbers**

- **2011 Sales in the U.S.**
  - **$307.7 billion**
  - **$78.3 billion**
  - **$65.8 billion**

- **Number of Supercenters in the U.S.**
  - **3,209**

- **Square footage of a Walmart Supercenter**
  - **185,000**

- **Current Number of Supercenters**
  - **110**

- **Future Plans to open in the U.S. to 2012**
  - **256**

**Energy Consumption**

- **Global Consumption**
  - **76%**

- **Embodied Energy**
  - **17%**

- **China**
  - **63%**

- **Other**
  - **24%**

**Assembly Options**

- **Foundation Assemblies**
  - **Concrete**
  - **Gyp. Bd. + Paint**

- **Columns**
  - **Wood Stud**
  - **Steel Stud**
  - **CMU**

- **Interior Wall Assemblies**
  - **CMU**
  - **Steel Stud**
  - **Metal Stud**

- **Exterior Wall Assemblies**
  - **CMU**
  - **Steel Stud**
  - **Gyp. Bd. + Paint**

**Assembly Categories**

- **Foundations and Footings**
- **Columns and Beams**
- **Interior Floors**
- **Windows**
- **Interior Walls**
- **Roofs**

**Impact Measurements**

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- **Material Resource Use**
- **Global Warming Potential**
- **Acidification Potential**
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Assembly LCA data

Foundation Assemblies

Columns

Interior Wall Assemblies

Exterior Wall Assemblies

Exterior Wall Assemblies

Roof Assemblies

Roof Assemblies

Foundation Assemblies

Columns

Interior Wall Assemblies

Exterior Wall Assemblies

Exterior Wall Assemblies

Roof Assemblies

Roof Assemblies

Fossil Fuel Consumption (MJ/sf)

Global Warming Potential (kg CO2 eq/sf)

Weighted Resource Use (kg/sf)

Results: Construction Type Comparisons

Current Walmart Construction Baseline

Lowest EcoCalculator Values Condition

All Wood Construction

Brick retains exterior aesthetic of existing assembly

Interior is wood structure

Retains interior and exterior aesthetic of existing

Metal stud interior walls and CIP exterior structure

What impact would Walmart have if they switched to one of these constructions?

They would be able to...

- power 159,800 houses (8 million MJ annually)
- remove 70,290 cars from the road (227,100 tonnes CO2 eq annually)
- reduce by 39,600 elephants (200,000 tonnes of waste annually)

Global Warming Potential (kg CO2 eq/sf)

Weighted Resource Use (kg/sf)

*based on 110 supercenters per annum

**each icon equals 5,000 units

PRODUCED BY AN AUTODESK STUDENT PRODUCT

(264,000 tonnes CO2 eq annually)

...remove 35,200 cars from the road

...remove 61,820 cars from the road

...remove 11,220 tonnes of waste annually

...increase by 99,615 elephants

...power 17,582 houses

...power 168,219 houses

...increase by 1,650 elephants