Measuring Sustainability

Life Cycle Assessment: Example 2

Comments:
This is an exercise, where the first page is the system bill of materials and the second page is the LCA results as calculated in SustainableMinds.com software.

Whole Systems + Lifecycle Thinking for Sustainable Design

Life Cycle Assessment Worksheet (Refrigerator Example)

Data on the environmental impact of the materials, processes, and lifecycle stages of products is key to redesigning those products to be more environmentally friendly. This simple worksheet presents some sample data for a refrigerator to help students get familiar with a simplified lifecycle assessment (LCA) methodology.

This type of analysis is used in Step 2 and Step 4 of the Whole Systems and Lifecycle Thinking For Sustainable Design methodology.

Take an Inventory to Determine Baseline Impacts

To sum up all the impacts of your product's life cycle, you must create an inventory of everything within your chosen boundaries that causes an environmental impact. This is done after you've spent some time understanding the product and the system(s) that it's a part of. Be sure to document your assumptions and sources.

Refrigerator Data[1]:

Material	kg	lbs	%	Where used
Steel, primary	47.6	104.8	56%	Refrigerator exterior paneling, structural
Iron	4.5	10	5%	Compressor housing
Aluminum, primary	2.1	4.7	3%	Equipment for refrigeration cycle
Copper, primary	2.7	6	3%	Equipment for refrigeration cycle
Rubber, synthetic	0.2	0.4	0.2%	Seals and gaskets
Polystyrene, primary	6.3	13.8	7%	Shelving, drawers, and interior surfaces.
ABS	5.1	11.2	6%	Shelving, drawers, and interior surfaces.
PVC	0.5	1.2	1%	Shelving, drawers, and interior surfaces.
Polyurethane foam	5.6	12.3	7%	Insulation
Glass	2.9	6.3	3%	Shelving.
Refrigerant	0.1	0.2	0%	Refrigerant cycle.
Other materials	7.0	15.3	8%	Misc.
TOTALS	84.6	186.2	100%	

Manufacturing
Cold Roll Steel
Plastic Injection molding
Aluminum extrusion
Iron casting (compressor)
Copper drawing

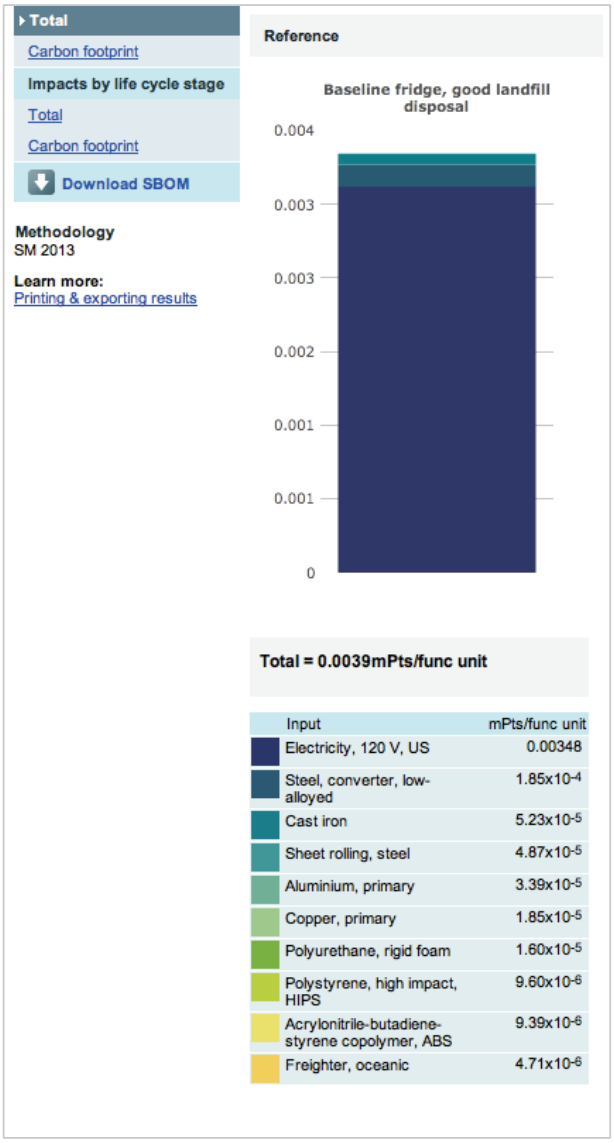
Use		
Lifetime	15 years	
Hours / Day Use	24.0	
Power Required (Avg.)	70.0	watts
Yearly Power Use	613.2	kWh / year

Transport	
Ocean Freight	6000 miles
Rail	500 miles
Truck	50 miles

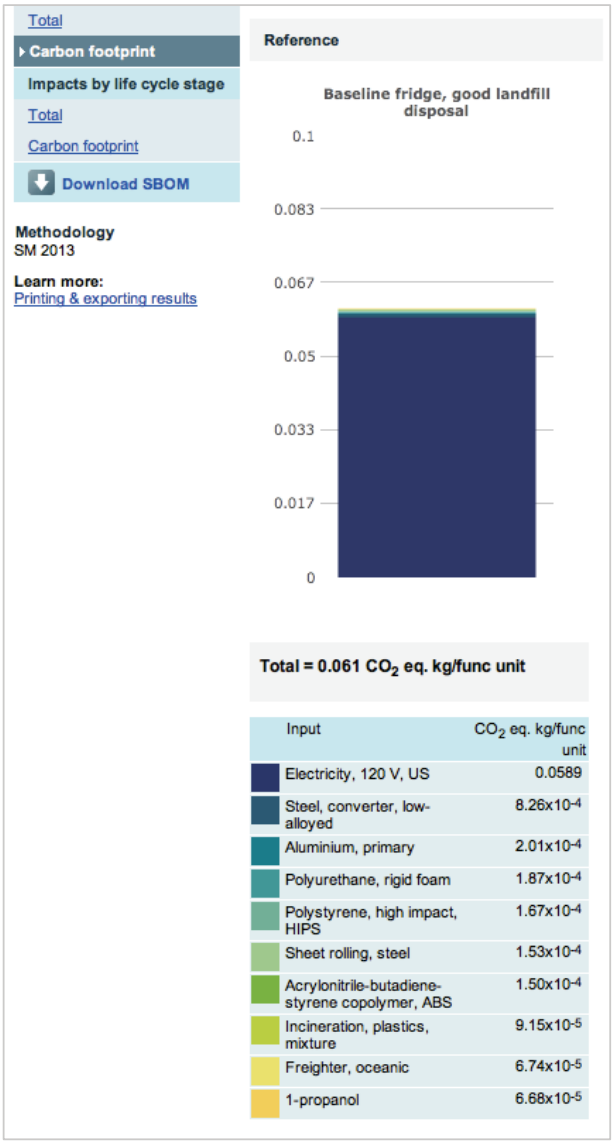
Disposal
Landfill

[1] SOURCE: Horie, Yuhta Alan. "Life Cycle Optimization of Household Refrigerator-Freezer Replacement." Center for Sustainable Systems, University of Michigan. August 14, 2004. http://css.snre.umich.edu/css_doc/CSS04-13.pdf
(+ other assumptions on lifetime and transport methods)

Life Cycle Assessment Worksheet (Refrigerator Example)
Correct Results



TRACI points per hour of life



kg CO_2-equivalent per hour of life

These are the best graphs to show where the biggest impacts come from. Not the donut graph (it show kinds of impacts but not where they come from), and not the Impacts by Life-Cycle Stage graphs, because it's not specific enough—it lumps together all manufacturing & materials.

Check your numbers in the color key below the graph. Most BOM items here have such small impacts you can't see whether they're correct on the graph itself.

Finally, notice how different the results are for CO_2-only vs. total (TRACI) impacts.