

EMBODIED ENERGY CALCULATIONS

If you are curious about the calculations that went into the embodied energy estimate for 301 Monroe, this spreadsheet contain all the numbers your heart desires: [Embodied Energy Calculation](#).

This is not a polished document. It is the working spreadsheet into which I put all of my calculations on the embodied energy of the house. The first sheet is the house broken down by material or system with the calculation of the total embodied energy for that material. These calcs reference the materials sheet (the third worksheet in the document) and should be fairly understandable. These are all done in kWh rather than the building industry's standard of BTUs, but coming from the alternative transportation industry, kWh is a number I have a "feel" for. It can be easily converted to BTUs if that is the way you think ($1 \text{ kWh} = 3413 \text{ BTU}$).

The bottom of the first sheet includes calculations for how much volume of each material is in the house. Many of these formulas are simply long additive lists because they are taken directly from the house plans or on-site measurements. These will be peculiar to the design of our house, and should you be so crazy as to want to analyze an alternate structure with this method, you would need to spend most of your time generating these numbers that would be particular to your structure. You will notice lots of 1.25 fudge factors to account for offcuts, waste, and simple systemic undercounting that tends to happen in a "bottoms up" estimate like this. Where I use a fudge factor I try to indicate the rationale in a note.

The second sheet is operating energy calculations. It has a lot more than just the operating energy of the house. It also has the paper towel calculations and my flying and other energy use for the year. It has all the numbers you would need to figure out, for example, how far it is OK to drive your car to a farmer's market for local produce before the trip adds more food miles energy to your food than your local market where all the fruit comes from Chile. (Not that far unless you buy a LOT of produce! Luckily, our farmers' market is in bicycling distance.) This is also the sheet where you can find the tool to calculate your

personal flying energy (yikes!) and has some conversions for using lbs of carbon as your “common currency” for comparisons. It should be said, though, that conversions aren’t necessarily simple multiplication if the energy in your summation comes from sources with widely varying carbon production per kWh. All my calcs get done with Northern California conversion factors, but if your energy comes from coal or hydro or solar, you’ll get very different numbers. If you want to calculate your carbon footprint, there are many better web based calculators out there that are pretty simple to use.

The third sheet is the individual material embodied energy values with a long list of the websites where these numbers were harvested. The embodied energy of a “raw” material like stone or sand is very location dependent as it is minimally processed, so the shipping costs predominate. Highly processed materials like aluminum or paints or laminated plastics are much less location dependent as the processing energy put into them dwarfs the energy of transportation. Luckily for the accuracy of the calculations, the low EE materials with the greatest regional variability in their value, are a relatively small portion of the overall EE, and the error generated by using an average value is small compared to the inaccuracies associated with things like estimating how many steel fasteners are in a structure. (I actually went and counted the hangers and fasteners in typical studs, joists and trusses in the house to make a reasonable estimate, and I could only do that because there was no drywall up yet!)

This whole thing has many sources for error, so small differences between two choices should not be considered significant. What I was really looking for was where materials choices made unexpectedly large or small differences in the overall embodied energy of the house. Without adding it all up, it would have been impossible to really understand the repercussions (or lack thereof) of each choice.

Source : <http://www.301monroe.com/?p=291>