SP.721 (D-Lab) Fall 2004

Session #24 Lecture notes

Life-Cycle Assessment / Charcoal Lab

This class session includes two segments: a lecture on life-cycle assessment and a lab on charcoal manufacture.

Handout:

- MIT form: "Checklist and Risk Acknowledgement for International Travel by Members of the MIT Community in Connection with MIT Sponsored Programs." Gives MIT travel policies and lists helpful background info, i.e. links to State Dept, CDC, WHO. Fill out and give it to your trip leader.

Soon, we will be doing a latrine-building session – a ¼ sized version. Even though it'll be small, it will still take more than 90 minutes, so we'll do this on a Saturday.

Life-Cycle Assessment Lecture

We'll focus on qualitative in this lecture, but in reality quantitative is both possible and very useful.

Prep Discussion/Example

Compare a 1kW diesel generator that costs $2,000 and a 1kW PV panel system that costs $10,000. What costs more per kW-hour?

Answer: it depends. Look at this question in terms of inputs and outputs. What's the cost of diesel fuel? How much energy and other hidden costs required to manufacture the engine and PV panel? What are the costs of pollution? How long does each last before repair and replacement? How do you dispose of it when it's replaced?

Lecture Slides

1: Used tires are a huge problem. Awareness of their disposal is a great example of why Life-Cycle Assessment is important.

2: We want you to think about whether the technologies you work with, develop, and promote lead to net benefits for the community. Goal definition, scoping, inventory analysis, impact assessment, and interpretation of results are components of the analysis.

3: What is the scope of "the process?" Does it include all the inputs, e.g. extraction and transportation of raw materials? (GHG = greenhouse gases, includes chlorofluorocarbons and methane as well as CO2).

4: Why do an LCA? E.g. choose between PV, diesel generator, and biogas, based on true consideration of costs, impacts, and benefits.

5: Take care to include ALL the impacts, i.e. "cradle-to-grave." Consider all the impacts that result from using fossil fuels: extraction, processing, transportation, processing infrastructure…

6: Consider an example of corn-based ethanol production, shown in this slide's schematic. There's a debate about corn production subsidies for ethanol production – the fossil fuels involved in corn production may/may not (?) outweigh the benefits downstream of burning ethanol? Today's readings present two perspectives on this debate.

7: Units of energy. Note that the energy in a gallon of different liquid fuels varies somewhat (propane=91k Btu, gasoline=124k Btu, diesel=139k Btu).

8: Consider different energy sources for an automobile, and whether they produce any CO2? Gasoline/diesel combustion clearly produces CO2; what about fuel cells? The final step in the cell, burning H2, only produces water, but the prior process of creating the hydrogen and manufacturing the cell produces some CO2. Same idea applies to manufacturing solar cells – some CO2 is probably produced in manufacturing the PV panel.

9: Compare direct burning natural gas to produce heat, and using natural gas to produce electricity for an electric heater. Direct burning of the gas is much more efficient!

10: PV example from Dutch study (Utrecht University). While current PV technology is much lower impact than average current electric plant, it still produces significant CO2 and other pollutants in manufacture.

11: Carnegie Mellon website: eiolca.net, "Economic Input-Output Life Cycle Assessment." This internet-based model attempts to capture all the externalities associated with various sectors.

Question & Answer

Q: When you do LCA, you seem to focus on negative impacts of inputs i.e. pollution. What about positive impacts, i.e. job creation associated with oil production?

A: Sure, you can take these things into account. That's why the up-front scoping is so important.

Q: To whom would you present an LCA?

A: A lot of NGOs work in renewable energy, for which LCA is an essential tool. Overall, government policy evaluations use huge complex LCAs.

Q: How can you tell whether an LCA is done "well?" What about biases and bad assumptions?

A: At least as an evaluator, you can see what assumptions were made. It's not an exact science, but it is at least a helpful tool.

Charcoal Lab

See separate notes describing this lab.