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Life Cycle Assessments Of GHGs

Understanding the Global Impact

by Marc Karell

Climate change, sustainability, and greenhouse gas (GHG) emissions are topics that differ in many ways from traditional environmental or air programs. For example:

- There is less concern about point source emissions.
- There is no concern about exact locations of ground-level impacts and health effects.
- Reduction in fuel use is the cornerstone of GHG reductions, less so chemical usage.
- There are 40 years of complex environmental rules while there are almost none for GHGs.

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- Environmental impacts center only on emissions/discharges from your plant, while GHGs also count indirect sources (e.g., transportation, electricity usage).

This article will focus on the last point: taking a more holistic view of GHG emissions. Estimating impacts from GHG emissions (and other parameters) from your products as a whole is known as a life cycle impact or a *life cycle assessment* (LCA).

Life Cycle of a Product

According to EPA, an LCA is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service
by compiling an inventory of relevant energy and material inputs and environmental releases; evaluating the potential environmental impacts associated with identified inputs and releases; and interpreting the results to help you make more informed decisions about those impacts.

LCAs are being used increasingly in the more energy-intensive industries. A quick Internet survey of industries/products wherein LCAs are influencing a wide range of decisions includes chemical manufacturing, packaging, municipal solid waste management, plug-in hybrid vehicles, other automotive products, steel manufacturing, public transportation, nuclear energy, animal agriculture, fertilizer production, food manufacture, forestry, and wood and paper products. The activities of several well-known companies that are using LCAs to promote business are summarized at the end of this article.

Companies in the abovementioned sectors are concerned not only with emissions from processes over which they have direct control, but also from other life stages, many of which are contracted out, such as:

1. Infrastructure necessary for your products (e.g., research, factories, roads)
2. Mining and production of raw materials
3. Manufacturing the product
4. Transporting materials to the factory and product to warehouses and retail stores
5. Consumer sale and use of product
6. End of life and waste disposal

Generally, Item 1 is ignored as the typical building or building retrofit or road will last for decades, and GHG emissions from the building or road construction and maintenance are negligible when compared to GHG emissions associated with the other listed stages.

Standards

As interest in and the need for LCAs grow, companies and other interested parties are calling for standardized methods to conduct such assessments. A November 2007 survey of 300 "companies, experts, and other stakeholders" conducted by the World Business Council for Sustainable Development and World Resources Institute found a "clear and urgent

need" for GHG protocols for emissions occurring in their value and supply chains.

One result of this developing need is that LCAs, which were considered a business luxury item not long ago, have moved mainstream. The International Organization for Standardization (ISO) recognized this strong trend and issued guidelines on how to perform a proper LCA (ISO 14040 and 14044). Until their issuance, there was no agreed-to method for doing an LCA, and thus, "apples and oranges" comparisons were the norm.

The ISO and related standards have improved resultant data that can assist companies that want to quality-check their own LCAs. For example, using the ISO LCA standards, the European Platform on LCA has developed the International Reference Life Cycle Data System (ILCD) Data Network, which provides a registry for consistent quality-assured life cycle inventory (ecoprofile) data sets. This network is open to all data providers from business, national LCA projects, research groups, consultants, research projects, and others.

Government Interest

Regulatory agencies are also relying more on LCAs, particularly in conjunction with renewable fuels such as ethanol and biodiesel. For example, in developing its National Renewable Fuel Standard Program, EPA analyzed life cycle GHG emissions from increased renewable fuels use. The regulatory purpose of this LCA was to determine whether renewable fuels meet the GHG thresholds required by the Energy Independence and Security Act of 2007 (EISA), which requires a 20 percent reduction in lifecycle GHG emissions for any renewable fuel produced at new facilities.

In discussing this LCA, EPA addressed the major challenge of identifying indirect emissions. "Currently, no single model captures all of the interactions associated with estimating lifecycle GHG emissions for renewable fuels, taking into account the 'significant indirect emissions' required by EISA," the Agency states. "EPA's approach has been to use the best tools available for each specific component of the lifecycle to create a comprehensive estimate of GHG emissions."

The importance of using the "best tools available" is a point made again and again by LCA advocates and encompasses all sectors where LCAs are conducted.

Conducting an LCA

For each product that is assessed, an LCA requires the following:

- Define the life cycle stages of each product (mainly numbers 2-6 listed above).
- Quantify GHG emissions from each life cycle stage, taking weighted averages where necessary (e.g., transportation to different parts of the country). As with a general GHG emissions inventory, data quality is the key. For example, it is important to use high-quality activity data when calculating GHG emissions from specific activities (e.g., reliable mileage data of actual truck travel).
- Determine impacts by normalizing emissions to an appropriate product value.
- Interpret where reductions are most cost-effective.

Remember that an LCA does not need to be constrained to GHG emissions only. LCAs have been performed for other parameters such as water usage and waste generation.

Proactive Approach

An LCA typically results in a bar graph ("5-headed" plot) that shows normalized GHG emissions (i.e., lb or kg per "widget" or product unit) from the six categories discussed above. This can graphically show the sources of GHG emissions and tell you whether GHG emissions are mainly from processes in your control. Regardless of how the results are represented, they provide a starting point for emissions reductions or business adjustments that can reduce indirect emissions.

"The defining feature of an LCA is that it captures multi-media environmental impacts associated with all upstream and downstream stages of a system," states the California Integrated Waste Management Board.

"This feature enables analysts to assess not only the total environmental profile of a system, but also to identify where impacts may be shifted from one life cycle stage to another or from one media to another. Life cycle approaches shift environmental management from traditional 'end-of-pipe' or 'gate-to-gate' approaches to a more proactive and preventive approach."

Company LCAs

Far from being a concept that has yet to find practical business applications, GHG LCAs are being used now by well-known companies, some of which are applying the generated data in their business strategies. For exam-

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ple, Timberland has performed LCAs for many of its products and shows customers the results on labels that look similar to nutrition labels found on food packages. Instead of listing the number of calories and other dietary values, these labels list the number of grams of GHGs emitted to produce the pair of boots (including the boot box) and other information.

Another interesting LCA application has been made by Stonyfield Farms, a yogurt maker, which conducted an LCA for phases of the production and consumption of their product and determined that a large percentage of GHG emissions derived from processes out of their control, such as from the raw materials (methane from cows, electricity used in pasteurizing milk) and transportation (refrigerated trucks).

The LCA became a powerful strategic tool for focusing their GHG emissions reduction strategies. While Stonyfield Farms is trying to reduce GHG emissions from their own processes (use of renewable energy, where possible), the LCA enabled them to focus on exact ways to reduce GHG emissions from their suppliers and truckers.

For example, they are attempting to reduce packaging to lower truck weight.

Wal-Mart and Tesco are also among the small but growing number of companies educating the public about LCAs, which become a selling tool to generate consumer interest. Other companies are using LCAs to determine whether a new product they have developed or a new use has lower GHG emissions than a competitor's and is thus a better buy, putting it in a more competitive sales position.

LCAs in the environmental field have been around for years, but it appears that with the emergence of GHG reduction strategies, they will see growing and more sophisticated use and receive closer scrutiny.

This document is not meant to be a complete how-to on LCAs. All entities should work with an experienced professional when performing an LCA.

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