STRATEGIC SUSTAINABILITY CONSULTING

Introduction to Life Cycle Assessments

A Primer for Business Owners

Before you can begin to efficiently and effectively green your business, it is essential to conduct a Life Cycle Assessment (LCA). The LCA will clarify your company's current impacts and set out steps to prioritize your next initiatives and what goals will make the biggest difference. Many businesses are now using the LCA to keep up with the green market and this white paper lays out the LCA process in detail to aid you in both conducting and deciphering an LCA. This paper will help you identify an appropriate strategy while illustrating the different approaches you have available to choose from.

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Preface

What is a Life Cycle Assessment?

A Life Cycle Assessment (LCA) is a tool that allows companies to evaluate the level of environmental impact produced by their services or products. The LCA looks at the entire life cycle of the product, including the sourcing of raw materials, manufacturing, distribution, transportation, and end-of-life disposal. Many companies use an LCA to develop a sustainability strategy, which can improve operational performance and serve as a commercial and promotional tool. Regardless of whether a company hires a third-party company to perform the LCA, or purchases software to do it in-house, an LCA informs companies on ways to improve its product's environmental impact.

Why is the LCA Important?

In this economic climate, many companies have had to make significant cut backs. Companies may ask: why should we invest in an LCA? An LCA can help a company identify areas for improvement in both performance and efficiency, and thus help reduce costs. Additionally, this assessment can help provide substantive support for marketing claims made by a company and thus help improve corporate image. The The Institute for Environmental Research and Education supports this by stating, "the gold standard for environmental marketing claims is still a life cycle assessment." By performing an LCA, a company also gains a set of metrics by which it can compare year-to-year performance as well as the performance of suppliers and partners (Network for Business Innovation and Sustainability, 2008).

Who is Utilizing the LCA?

Companies across a myriad of industries are engaging in LCAs and integrating the results into their business operations. Some of the largest and most influential companies have taken proactive steps to lessen their environmental impact through LCAs. Apple used an LCA to determine the origin of its greenhouse gas emissions, more on this initiative can be found at www.apple.com/environment . The LCA analyzed and provided ways to reduce the emissions resulting from the manufacturing, transportation, use, and the end-of-life disposal of both the product as well as the facilities in which the products were created.

Regarding manufacturing, Apple developed smaller, thinner, and lighter products, necessitating fewer materials and subsequently fewer carbon emissions. The current iMac is made with 50% less material and generates 35% fewer carbon emissions than the first-generation iMac. Apple's physically smaller product line enables the company to design smaller and lighter packaging. The iMac's current packaging is 53% smaller than for the initial iMac, mirroring the decrease in the

product's size. Apple also made a more efficient mobile processor – the A4 chip. This chip maximizes battery life and is the most power-efficient battery produced by the company. Regarding the final stages of product life, Apple incorporated end-of-life issues into its initial design process. In this respect, it started using more easily-recycled materials, including arsenic-free glass, high-grade aluminum, and strong polycarbonate (Apple, 2011).

The Process.

According to ISO 14001, an LCA can be broken down into four distinct phases (International Organization for Standardization, 2011):

Phase One: Define the purpose, goal, and boundaries of the assessment.

***Phase Two*:** Collect data and perform inventory analysis.

Phase Three: Evaluate environmental effects including the classification of results.

Phase Four: Interpret results and identify key issues.

Phase One

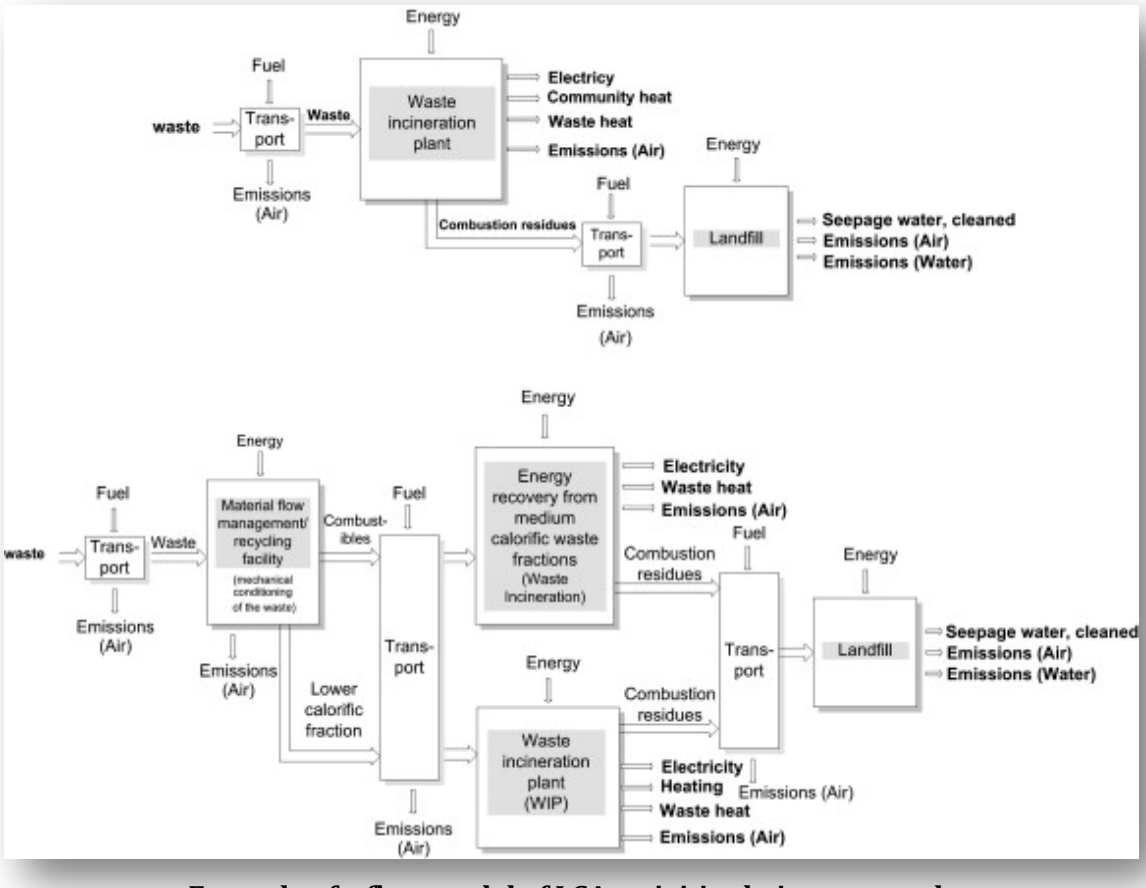
In the first phase , the LCA lays out the parameters of the study and indicates to whom the assessment will be delivered. The goal and scope define exactly what is being studied, which functional areas are being analyzed, and which precise inputs and outputs are related to the product or service.

Additionally, Phase One must lay out the environmental impact categories to be included as well as the limitations and assumptions of the study. Once these boundaries have been established, companies can proceed with Phase Two.

Phase Two

The second phase of the LCA is a labor-intensive data collection of quantitative and qualitative data for every unit process system related to the product. In most cases, this stage of the LCA will include a flow model of the activities being assessed and will accurately depict the inputs and outputs addressed in Phase One.

These inputs and outputs usually include water, energy, raw materials, and air and water emissions (LCA Food Database, 2012). The results of Phase Two take the form of a Life Cycle Inventory, from which some initial interpretations can be made.



Example of a flow model of LCA activities being assessed.
www.sciencedirect.com/science/article/pii/S0956053X08003930

Phase Three

The third phase of an LCA is designed to evaluate the significance of the results of the environmental impacts discovered in Phase Two. The Life Cycle Impact Assessment (LCIA) must include the following (LCA Food Database, 2011):

- Selection of environmental impact categories to demonstrate how each category affects the environment, as well as which human activities contribute to each category
- Sorting the inventory into the aforementioned environmental impact categories
- Characterization of the inflows and outflows into a common metric unit that can then be summed into an overall total impact number

Once the data is processed and the results are given, companies can move on to Phase Four.

Phase Four

Phase Four is where the results of the three previous stages are verified, quantified, analyzed, and evaluated. This phase includes a final summary that outlines the significant issues identified in the process, limitations inherent to the study, a set of conclusions, and overall

recommendations. This phase of the LCA is a time to not just present results, but to make assertions as to the confidence level of the recommendations. The conclusions must therefore reflect the accuracy of the assessment, the sensitivity of the data elements, and the completeness of the study.

The Approaches.

The next step is to decide how to approach performing an LCA. There are two main methods for engaging in an LCA: using a full-service tool that requires either training or hiring a third-party firm to perform the assessment, or purchasing do-it-yourself software and performing the assessment yourself.

Full Service

The two most respected and widely used LCA tools are GaBi, owned by PE International, and SimaPro, owned by PRé Consultants. Both of these tools are either used by LCA professionals or can be taught directly to companies through training offered by the tools' vendors. These tools are ideal for companies that require access to a wide range of methodologies, want various options for their results, and possess a much larger database of materials and processes (Hicks, 2010).

GaBi: The GaBi assessment tool supports a large amount of data and provides companies with solutions related to process optimization, cost control, environmental criteria, and external representation of results (GaBi, 2011).

The tool, which was designed nearly 15 years ago for the sole purpose of LCA studies, covers:

- Greenhouse Gas Accounting
- Life Cycle Engineering
- Design for Environment
- Energy Efficiency Studies
- Substance Flow Analysis
- Company Ecobalances
- Environmental Reporting
- Sustainability Reporting
- Strategic Risk Management

There are a few main benefits to using the GaBi tool that set it apart from competitors:

- The software has a fairly intuitive user interface and structure.
- The tool allows for the use of parameters in the calculations as well as the ability to create various diagrams from flexible inputs and outputs.
- The database is large and covers many industrial branches including, but not limited to, plastics, organic and inorganic products, energy supply, and end-of-life management.

Two main drawbacks of the tool are its complexity and its inability to support multiple users.

SimaPro: The SimaPro tool, which pulls from several inventory databases, allows companies to perform an LCA on products with

complex life cycles. The tool is able to set parameters, return interactive results, and provide access to a large database. Some main benefits of the SimaPro tool include:

- An intuitive and easy to learn interface, the ability to immediately compare two or more products, the capability to parameterize your model, and a sophisticated impact assessment.
- SimaPro, with its comprehensive database and flexibility, states that this is the most widely used LCA tool on the market.

Self-Assessments

Within the self-assessment realm of the LCA, there are tools that cover all sectors and there are ones that are industry specific (LifeCycle.org, 2011).

Industry Specific: Some of the more widely used industry-specific LCA tools are described below:

- BEES 4.0: The Building for Environmental and Economic Sustainability (BEES) is owned by the National Institute for Standards and Technology (NIST) Building and Fire Research Laboratory. The software is aimed at designers, builders, and product manufacturers as a way to balance the environmental and economic performance of building products (Building Ecology, 2011).
- GEMIS: The Global Emission Model for Integrated Systems (GEMIS), offered by the Öko-Institut, is a life cycle analysis program and database for energy, material, and transport systems. The GEMIS database offers information on fossil fuels, renewables, processes for electricity and heat, raw materials, and transports (Building Ecology, 2011).
- GREET: The Greenhouse Gases, Regulated Emissions, and Energy use in Transportation (GREET) model is the U.S. Department of Energy's Office of Transportation Technologies fuel-cycle model. It allows researchers to evaluate various engine and fuel combinations on a consistent fuel-cycle basis (Building Ecology, 2011).
- IDEMAT: Offered by the Delft University of Technology, is a tool for material selections in the design process. It provides a database with technical information about materials, processes, and components and allows users to compare information.

Cross Industry: The more popular self-assessment tools that cover all industries include:

- ECO-it 1.4: Offered by PRé Consultants, this software comes with over 500 ReCiPe environmental impact and carbon footprint (CO2) scores for commonly used materials such as metals, plastics, paper, board, and glass, as well as for production, transport, energy, and waste treatment processes (LifeCycle.org, 2011).
- Sustainable Minds: The impact methodology in this program is limited to one approach, in which all the environmental impacts are

rolled into a single number or indicator. This simplifies the results and provides clear information to act on, which is very useful for LCA beginners (Hicks, 2010).

- WISARD™: Offered by the Pricewaterhouse Coopers Ecobilan Group, Waste – Integrated Systems Assessment for Recovery and Disposal (WISARD™) is an LCA software tool designed to help inform decision making and evaluate policy options concerning the disposal of household waste (Building Ecology, 2011).
- TEAM™: Offered by Pricewaterhouse Coopers Ecobilan Group, TEAM™ is a professional tool for evaluating the life cycle environmental and cost profiles of products and technologies. It contains a comprehensive database of over 600 modules with worldwide coverage (Building Ecology, 2011).

Conclusion

This paper has outlined the process and various approaches to an LCA. The next question you should ask is:

"Which approach is right for my organization?"

The answer to this question is not as straightforward as it seems. Yes, most companies would prefer an extremely accurate model for their LCA. However, this level of accuracy is both costly in time and money. Many software vendors have responded to this concern and now offer cheaper and simpler options. In order to figure out which of these options is the best-suited to your company, you must be able to answer these basic questions:

- What do I want to accomplish?
- How detailed of an analysis do I need?
- How strict are the levels of compliance in my particular industry?
- Do I need a product that emphasizes optimization and cost reduction?
- Do I want a product that assists in the design process?
- How flexible do I want to be in my assessment output?
- Will I require a product that will help in the marketing or communications aspects of my company?

Once your company has answered these questions, the product overviews provided in the previous section will be integral in choosing the most appropriate LCA tool for your organization.

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