Environmental Sustainability Assessment of Companies: Applying Life Cycle Assessment at the Enterprise Level

J. Dettling[*], Y. Loerincik[**], M. Margni[*] and O. Jolliet[*]

[*]Ecointesys – Life Cycle Systems, Boston, MA, USA, info@ecointesys.com
[**]Ecointesys – Life Cycle Systems, Lausanne, Switzerland, info-lcs@ecointesys.ch

ABSTRACT

Sustainability is rapidly increasing in emphasis among the world's leading companies. There is increasing pressures on companies to understand and be able to communicate the impacts of their products and activities. This pressure comes internally—from executives, boards and shareholders—as well as externally—from customers, business partners and governments. Life Cycle Assessment (LCA) offers a robust and comprehensive approach to quantify broadly-defined impacts, but is usually limited in scope to a set of products or services. At the level of the entire company, similar methods and tools are not readily available. This makes it difficult to answer simple questions such as: What is the overall impact or "footprint" of our company on the environment? What meaningful goals can we set for overall company sustainability? How can we achieve these goals? Are we being successful?

Here we present a methodology for answering these questions by applying approaches developed in the field of LCA to the activities of entire companies. The methodology calculates the complete environmental impacts of material and service purchases, the company's own operations and activities, and the distribution, use and end-of-life of its products and/or services. The result is a complete and clear picture of the total environmental impacts in a format that is easily-understood and suitable for communications, setting and tracking of goals, and identifying actions to improve a company's performance in key sustainability metrics, such as climate change, ecological damage, and human health.

Keywords: sustainability, assessment, lca, life cycle

1 INTRODUCTION

There is a rapidly increasing emphasis among the world's leading companies on sustainability, caused by pressure from the public, shareholders, regulators, competitors, customers, and clients. While many companies are making commitments and taking stances on sustainability, most companies are struggling to define and quantify what sustainability means within their operation. There is a need for tools and metrics to allow companies to evaluate actions, set goals, track progress and communicate results regarding their environmental sustainability.

Many companies rely heavily in addressing sustainability on their existing environmental information and management systems. However, the purposes and content of these systems are not usually ideally suited to address sustainability. Because these information sources are more narrowly focused (usually on a company's direct emissions and impacts), they can lend a false and often misleading sense of accuracy. These information sets rarely if ever quantify the broader scope of indirect impacts (the extraction of raw materials, the supply chain, transportation, use and product end-of-life, etc.). It is this broader perspective that is needed for an effective sustainability initiative. To work effectively toward sustainability goals, companies need information on all environmental impacts within the life cycle of their products and services.

In addition, the approach of programs centered around the concepts of liability, regulations, permits, compliance, etc., are different than sustainability-focused programs where the goals are to identify opportunities for positive influence wherever a business case exists (and sometimes where it doesn't), regardless of whether one is legally accountable for those impacts. Many excellent and recent examples exist of companies having success in improving sustainability within their supply chains through more stringent purchasing standards and with regard to their products by considering energy efficiency or end-of-life management.

Finding opportunities is best done with the broadest possible view of the company's influence, so that all potential actions can be identified, evaluated and included in tracking progress.

1.1 A Need for New Tools

In order to support an effective sustainability program, tools are needed that are able to quantify the complete impacts of a company's operation on the environment. For particular products and services, the Life Cycle Assessment (LCA) is now a well-developed methodology that is ideally suited to answering such questions. However, for companies with dozens to thousands of products or services being marketed, completing and maintaining LCAs for all their offerings may not be practical. In addition, much work would still be needed to provide an overview of how all these LCAs fit together to represent the company's impacts and it's likely some aspects would either be unrepresented or counted multiple times due to the varying boundaries set in each LCA. While LCA is ideal for answering product-

Clean Technology 2008, www.ct-si.org, ISBN 978-1-4200-8502-0

based sustainability questions, it is not ideally suited to managing sustainability across and entire company.

Ecointesys – Life Cycle Systems has developed a novel method for applying many tools and concepts from the field of LCA to the level of an entire enterprise. It forms a unique and indispensible viewpoint for corporate sustainability managers to see in a quantified and scientifically-rigorous way what their total environmental "footprint" is, has been previously and/or might be under future circumstances. By incorporating costs for each component, potential actions can be uniformly evaluated on a cost/benefit basis. In addition, the framework complements existing or future product/service LCA information by providing a company-wide context in which to interpret that information.

2 THE METHODOLOGY

The methodology is based upon a number of concepts and tools developed previously for LCA.

2.1 LCA: A Short Primer

Life Cycle Assessment provides the only valid basis for establishing the total environmental impacts of a product or service and of comparing alternative to make a claim of "environmentally preferable" or similar.[1] In short, a model is created of the entire life cycle of the product from "cradle to grave." This includes the raw material acquisition, manufacture, marketing, use and disposal of the product, along with transportation between each stage. There is significant flexibility to allow for models of atypical products, services or other systems. At each stage of the life cycle, a thorough accounting is made of all resource and energy inputs, chemical emissions and other impacts. These are summed to create a Life Cycle Inventory (LCI), as shown in Figure 1.

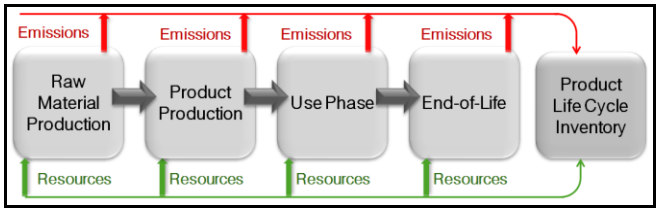

Figure 1: Stages of an LCA and creation of an LCI.

Because and LCI can contain several hundred types of resources used and chemical emissions, a need has arisen for interpretation of this information and a field of science, Life Cycle Impact Assessment, has been developed to offer the ability to distill these large inventories of information into a manageable set of important and understandable indicators. Figure 2 shows a representative set of "mid-point" and "damage" indicators produced by a popular method, IMPACT 2002+.[2]

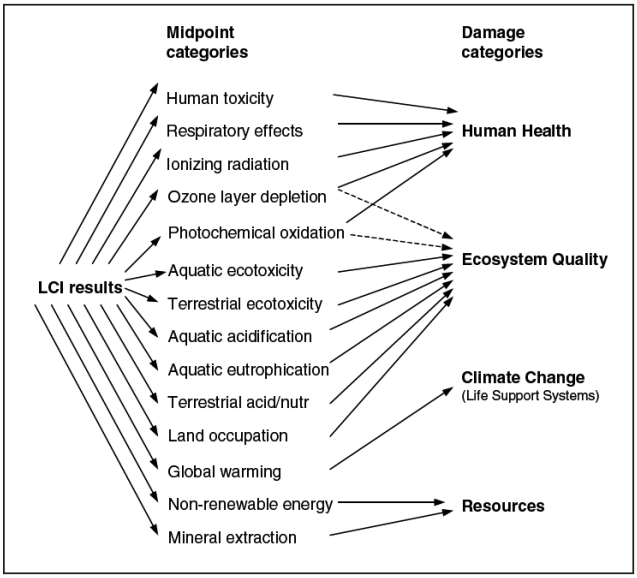

Figure 2: impact indicators created in the IMPACT2002+ method.

The result is a view of the total impacts of the product, service or system in question over its entire life cycle. All results are normalized to a *Functional Unit* to allow comparison among alternatives on the basis of equivalent function.

2.2 Taking LCA to the Enterprise Level

Ecointesys – Life Cycle Systems has built upon the concepts and tools developed for LCA to provide a unique methodology for quantifying environmental performance across all levels of an enterprise. The approach is suitable to companies of all types and sizes and is flexible to allow adaptation for each company's unique structure and other issues.

Four types of information are used to assess the overall activity of a company: (1) purchased goods and services to characterize the supply chain; (2) on-site processes, activities and direct emissions (if any); (3) the sales of products and services to these within the context of the company; and (4) the characteristics of the use and end-of-life of the product or service. This information is combined with existing LCA databases and methods as well as cost information to produce a comprehensive assessment of a company's impacts.

The approach assesses the inputs and outputs of the company's activities, as well as the use and disposal of their products. As shown in Figure 3, a summation is done

[1] International Standards Organization. 2006. *ISO 14040: Environmental Management — Life Cycle Assessment — Principles and Framework.* Geneva, Switzerland.

[2] Jolliet, O., M. Margni, R. Charles, S. Humbert, J. Payet, G. Rebitzer, and R. Rosenbaum. 2003. *IMPACT 2002+: A New Life Cycle Impact Assessment Methodology.* International Journal of Life Cycle Assessment 8:324-330.

among all of the company and product components to create an Enterprise Life Cycle Inventory, analogous to that created for a product in traditional LCA. The Enterprise LCI can then be interpreted through the same powerful Life Cycle Impact Assessment methods used for LCA and shown in Figure 2.

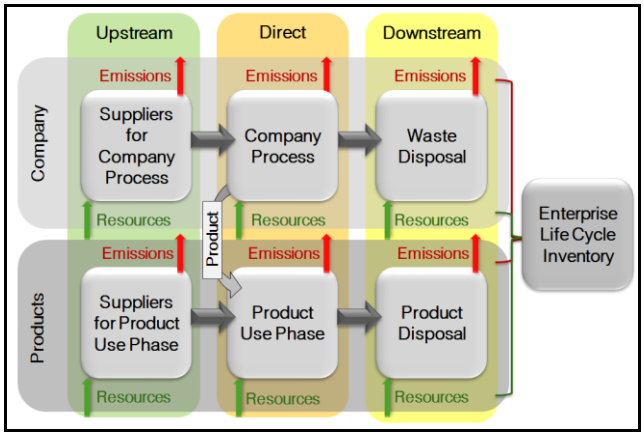

Figure 3: Overview of the methodology for creating an Enterprise Life Cycle Inventory.

The method deviates from the *Functional Unit* approach of traditional LCA and replaces it with a structural approach where the entity (or certain divisions) are the unit of study, so that results are reported on the basis of impacts occurring during a certain time of operation (e.g., company-wide climate change impacts for 2007). The result is a stronger ability to compare within the system (i.e., the company) for planning, prioritization and tracking.

The results enable companies to quantify their environmental impacts based on their inputs—both material and financial—and their outputs. The strong scientific basis of the methodology allows consistent comparisons to be made among diverse portions of the company's operation. For instance, the environmental impact of transportation can be compared with that of the supply chain materials or electricity consumption. A broad view of the enterprise is provided to identify the main sources of impacts. The method provides a consistent framework for tracking progress by evaluating the changes in environmental metrics over time and for quantifying the efficiency of actions taken. Finally, the results can show the relationship between cost and environmental impacts, which is essential for identifying the best environmental investment opportunities.

3 EXAMPLE: SWISS TELECOM PROVIDER

The approach described above has been used to evaluate the environmental performance of a telecom provider. Annual flows of materials and energy were analyzed to create an energy consumption and climate change impact profile. Compared to the scope of the company's previous environmental report, the study scope was a significant expansion and included employee commuting travel, advertising, infrastructure, and more.

3.1 The Results

Figure 4 shows the contributions to the primary energy consumption among all aspect of company operation. 56% of the overall impacts are directly related to the company activities and 44% linked to the use of the services they provide. For the direct company component, electricity is the most important contributor to total energy use (25% of the grand total). On the other hand, climate change impacts due to electricity are only to 2%. This is because the electricity source is the Swiss electrical grid, comprised mainly of hydropower and nuclear sources. The other important contributors to the company's energy consumption are the production of the network infrastructure (23%) and advertising (14%).

The use of services by customers also causes a significant portion of the impacts: 44% of primary energy consumption and 39% of climate change impacts. Among the customer impacts, the main contributor is internet use (including computer equipment), followed by the production and use of mobile phones and finally the use of fixed phones.

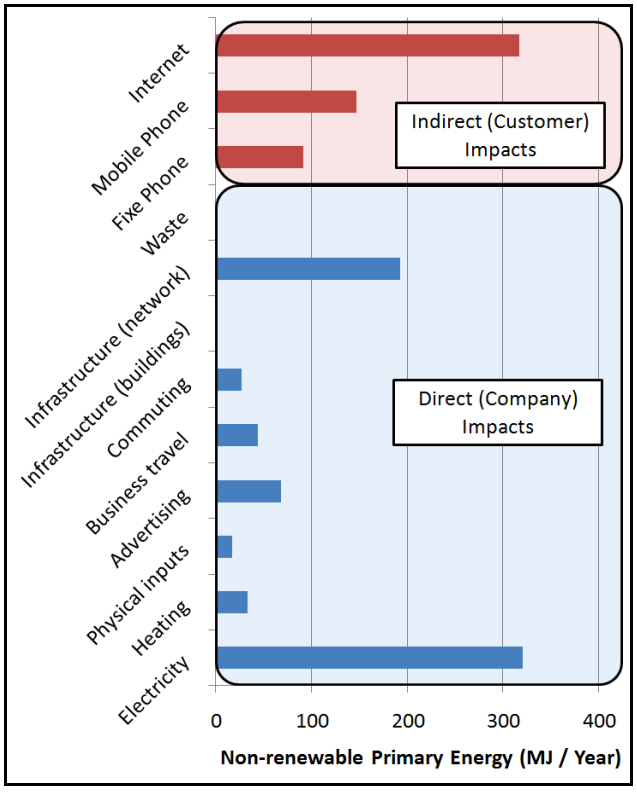

Figure 4: Annual energy consumption for a telecom provider

Compared to the direct CO_2 emissions in the company's 2003 environmental report, the study resulted in

Clean Technology 2008, www.ct-si.org, ISBN 978-1-4200-8502-0

a 12-fold greater total CO_2 sum. This difference demonstrates the importance of taking a broad view of all company activities; the company was able to identify and implement several effective actions based on this 12-fold larger set of opportunities.

3.2 The Actions

Among the major actions identified and implemented by the company following the study were: revisions to its purchasing criteria for terminal equipment and infrastructure; an educational campaign to provide customers with information on indirect impacts and ways to reduce electricity consumption; promoting more efficient commuting means for employees; and promoting new technologies, such as low energy cordless phones and high efficiency modems. All of these actions were successfully implemented and in total are expected to result in a cost savings in addition to improving environmental performance.

None of these actions would have been identified as actions based on the company's prior inventories of energy use and climate change impacts. Furthermore, even if identified, the prior accounting system would not have provided room for these successes to be reflected. The result of the broader view taken by such an approach is a much greater range of viable opportunities for sustainability actions.

4 EXAMPLE: PHARMACEUTICAL COMPANY

The method has been applied to a pharmaceutical company and the results again illustrate the importance of taking a broad view of company activities and also illustrate the potential importance of considering costs to identify the most feasible actions. The results are show in Figure 5.

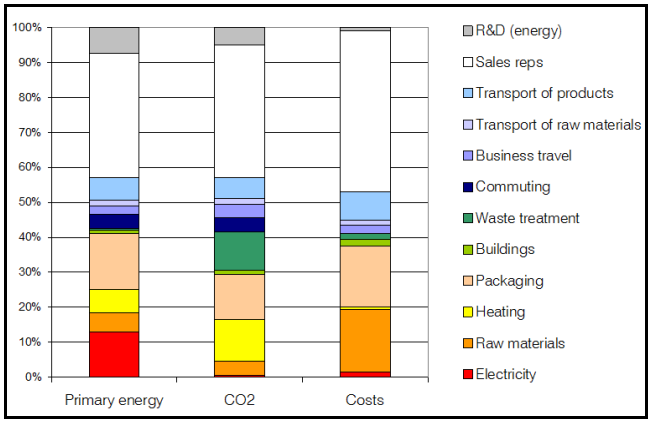

Figure 5: Energy consumption, CO_2 and costs for activities of a pharmaceutical company

The activity of the company's sales force results in the largest portion of energy use, CO_2 and costs. Because the sales reps travel in their own vehicles and are reimbursed for mileage—rather than traveling in company-owned vehicles—this aspect of the company's operation would likely fall outside of nearly all other impact assessment methods. The results clearly show the importance of including it, and the result is an obvious action item; an initiative to improve the efficiency of the sales force vehicle fleet became an immediate priority, with a savings of both costs and impacts.

Other categories of company activity also illustrate the important of the impact-cost comparison. In looking for areas to focus on energy reductions, packaging and electricity stand out along with sales reps as potential priority areas. However, also viewing the costs suggests that there are likely to be more cost savings in reducing packaging than in reducing electrical use. This is vital information in identifying viable action areas. Further, viewing the CO_2 emissions suggest that electrical use is not a substantial contributor in this category, whereas packaging is (again, the Swiss grid). The ability of the method presented here to present a large information base in a simple and understandable format greatly facilitates interpretation and identification of priority actions.

5 CONCLUSION

Gaining a broad and quantitative view of environmental impact is becoming increasingly important for companies as they progress in forming and implementing sustainability programs. It will soon be essential, as customers, shareholders and governments are placing ever-growing emphasis on this information and as robust sustainability programs increasingly become an important competitive advantage among the world's leading companies.

In particular, the method presented here provides quantitative and scientifically-valid information regarding broadly-defined environmental sustainability metrics of a company. This information is an indispensible tool for:

- Identifying priority actions for achieving corporation sustainability goals and ensuring resources are focused on the most efficient areas.
- Providing a framework for setting goals and tracking progress in corporate sustainability.
- Providing a context for interpreting product sustainability programs, such as traditional LCA.
- Providing accurate and understandable information on corporate sustainability successes to employees, shareholders, customers and the public.
- Enabling evaluation of the influence of future internal or external factors on sustainability performance and related costs.