Life Cycle Assessment and Forest Products: A White Paper

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Table of Contents

Executive Summary

In most industries worldwide, including the forest products sector, there is an increasing focus on the environmental, social and economic sustainability credentials of companies and products.

This has led to an increase in the application of life cycle thinking, which includes economic, environmental and social consequences of a product or process over its entire life cycle, from raw material extraction to manufacturing, packaging, distribution, use and end of life. Life cycle thinking has been developed into systematic approaches. The United Nations Environmental Programme (UNEP) has defined Life Cycle Management (LCM) as "an integrated concept for managing the total life cycle of products and services towards more sustainable consumption and production patterns." Under this approach, Life Cycle Assessment (LCA) is one of the specific analysis tools that can be used for products or services.

LCA is increasingly being used as an important and effective tool to support multiple types of sustainability goals. Its use has grown with the development and application of an internationally recognized standard by the International Organization for Standardization (ISO), the ISO 14040 series. Numerous life cycle assessments have been completed on wood, pulp and paper for a variety of purposes and several practical design tools and procurement tools have also been successfully developed based on LCAs.

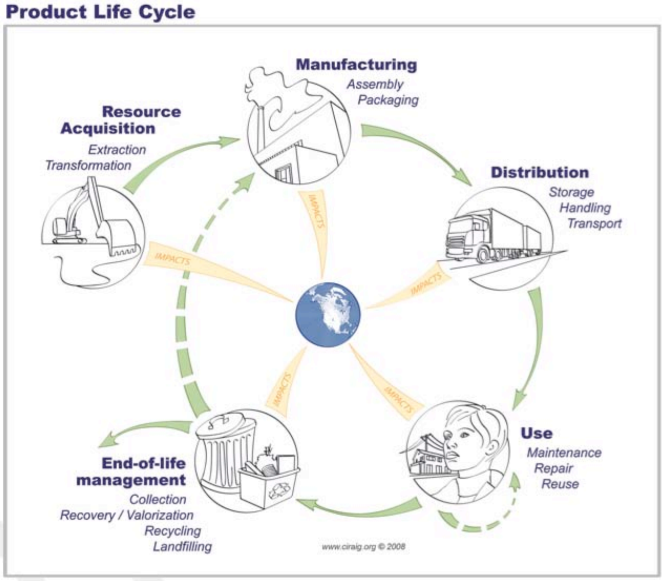
LCA's advantages are derived from the comprehensiveness of the approach. It is a sophisticated analysis tool that requires a strong understanding before being used effectively or interpreting results. In its definition of LCA, the International Organization for Standardization states that it is the "compilation and evaluation of the inputs and outputs and the potential impacts of a product system throughout its life cycle." For each life cycle stage (e.g. raw material extraction), all the processes are identified (e.g. transporting harvested fibre to the mill), and for each process, all the inputs (e.g. fossil fuel) and outputs (e.g. CO_2) are identified. Each of the inputs and outputs are then compiled and categorized into potential impacts on the environment (e.g. climate change). Once the impacts are calculated, the sum of the air, water and soil impacts are interpreted and considered together against the original goals of the LCA. LCAs are most useful when the goals of the assessment have been clearly defined in advance.

The Forest Products Association of Canada (FPAC) and PricewaterhouseCoopers (PwC) developed this white paper to provide information about LCA and to be a reference for those interested in learning how LCA can be applied in the forest products industry. This White Paper is intended for those new to LCA as well as those who are already familiar with the concept.

What is LCA?

Life cycle assessment (LCA) is a comprehensive environmental accounting tool with well-established procedures and methods that are governed by specific rules and standards, most notably those developed by the International Organization for Standardization (ISO). LCA's use continues to increase and there are now many experienced LCA practitioners world-wide who have successfully applied LCA across a broad range of industry sectors.

Product Life Cycle



As illustrated in this diagram from The Interuniversity Research Centre for the Life Cycle of Products, Processes and Services (CIRAIG), LCA is an approach that covers the whole life cycle of a product or a service, usually "from cradle-to-grave", i.e. from raw material extraction, to manufacturing, packaging, distribution, use and end of life. Process steps are identified for each stage in the life cycle. The inputs (materials and energy) and outputs (emissions and pollutants) are determined for each step. The inputs and outputs are then grouped into impact categories, which are categories of environmental problems. Typical impact indicators include abiotic depletion, acidification, climate change, human toxicity, ecological toxicity, eutrophication[1], fossil fuel depletion, photo-oxidant smog formation and stratospheric ozone depletion.

By examining the product or service over its entire life cycle, informed decisions can be made to avoid transferring pollution from one life stage to another or from one media (air/water/soil) to another. Although carbon emissions and carbon footprinting are very important aspects of life cycle studies, carbon is just one of many elements evaluated within an LCA.

> *"LCA is the compilation and evaluation of the inputs and outputs and the potential impacts of a product system throughout its life cycle".*
>
> Definition from the International Standards Organization (ISO).

[1] Eutrophication is the increase of nutrients discharged to water bodies which negatively impacts water quality and disrupts ecosystems.

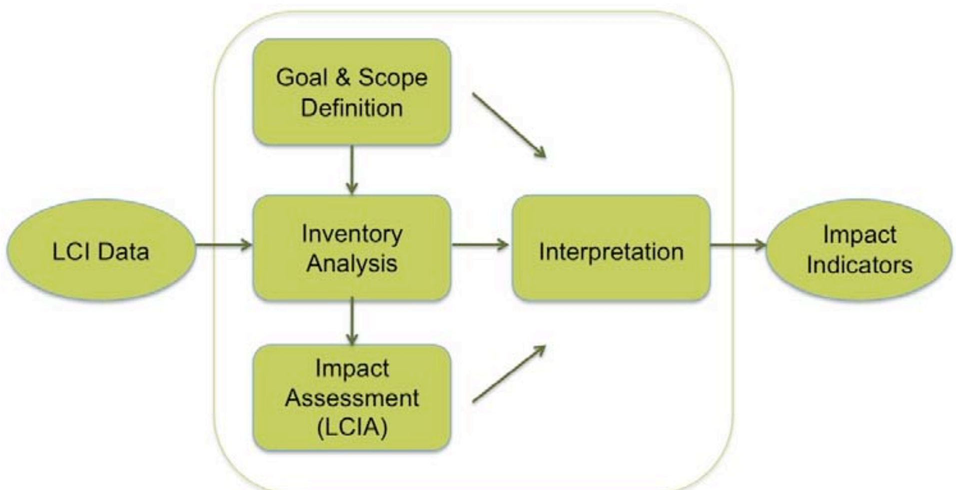
A Standardized, Transparent, Verifiable and Internationally Recognized Approach

ISO has developed standards for LCA under the ISO 14040 family of international standards, notably ISO 14040:2006: *Principles and framework of LCA* and ISO 14044:2006: *Requirements and guidelines for LCA standards*. These define the methods for developing and verifying LCAs. It is recommended that any LCA be performed according to ISO 14040 standards.

LCAs follow four fundamental steps. These steps, which are explained later in this document, are:

1) goal and scope definition;
2) inventory analysis;
3) impact assessment; and
4) interpretation.

These steps are linked in the LCA methodology diagram from the U.S. Life Cycle Inventory Database.



Source: http://www.nrel.gov/lci/assessments.html

There are also specific requirements for data quality and transparency, and requirements to ensure that the assessment is robust, for example:

- sensitivity analysis, to understand how sensitive the results are to the methods and data; and
- uncertainty analysis, to quantify the uncertainty introduced into the results due to the cumulative effects of model assumptions, input uncertainty and data variability.

The ISO Standards require third-party review by an independent expert panel (the "peer review" process) prior to any public communication of results. Because of the scientific rigour required, conducting an LCA is technically challenging and time-consuming. If it is well planned, its benefits can outweigh the costs.

What Are the Main Reasons for Carrying Out an LCA?

Driving Performance Improvements

LCA can enable companies to prioritize environmental investments. Companies can target investments more effectively, since LCA provides a detailed breakdown of the main contributors (materials, energy sources, step of the life cycle, etc.) to key environmental impacts. With data on which choice will lead to better environmental performance, companies can choose projects with superior improvement-to-cost ratios.

LCA supports companies by looking at processes and supply chains comprehensively, which in turn can spark significant overall performance improvements. It can be a major catalyst of innovation within a company because it brings people together from different functional departments and from different points in the supply chain, many of whom may never have collaborated before, to find new ways of managing the life cycle of products. In addition, adopting an LCA approach provides a unique opportunity to rethink relationships with suppliers, notably by developing concepts of mutual progress and through improved information exchange and transparency.

LCA can contribute to cost savings through more efficient use of resources or energy, or by identifying alternative processes that lower overall production costs.

LCA can also be used to identify improvements to products, processes and services. The basis for analysis in an LCA is the functional unit, which is a description of what the product does (e.g. a paper towel cleans up a spill). The analysis is set up to avoid “false savings,” such as using fewer resources for a product that requires more units to perform the same task (e.g. a smaller paper towel may not have a lighter environmental impact if two smaller paper towels are needed for the job compared to one larger one).

Software tools have been developed based on LCA in order to support life cycle based decisions. For example the Athena Institute’s EcoCalculator[2] for building assemblies and Impact Estimator for Buildings help designers choose building materials based on life cycle information.

LCA can be used to define key performance indicators (KPIs) to monitor progress and communicate relevant information to stakeholders, especially if the design/production process is linked to a company-wide Environmental Management System. This may also serve as the basis for new strategic positioning of products based on the integration of LCA in daily business practices, notably through eco-design, new markets or customer targets, marketing claims, etc.

[2] The Athena Institute Ecocalculator and Impact Estimator http://www.athenasmi.org

Effective Marketing Communications

Customers and consumers are increasingly aspiring towards healthier and more environmentally friendly consumption and greener procurement practices, and they want quality information to assist them in making choices. Marketing claims regarding the environmental aspects of products or services are most effective when the claims are substantiated by data. Because of a growing number of unsubstantiated environmental and green claims, customers and consumers have more confidence in claims that have been verified by an independent party. LCAs that follow an internationally recognized methodology and are verified by a panel of independent experts can provide credible information on which to base marketing communications.

LCAs provide the bases for developing Environmental Product Declarations (EPDs), which are used to communicate LCA results and other product and environmental performance information.

A key strength of LCA is the ability to communicate the multiple benefits of different initiatives a company has underway. Some companies may want to communicate only one or two elements, e.g. carbon footprint, water consumption or energy consumption. Others, however, may want to provide a more comprehensive picture and LCA can serve as a tool to support a broad range of communications.

Meeting Stakeholders' Expectations

Innovative and proactive companies, policy-makers and NGOs are also promoting life cycle thinking since it provides a holistic view of the environmental performance of products. For example, many governments around the world are factoring in environmental requirements and performance indicators when developing procurement criteria. Investors are increasingly looking for environmental performance indicators to support their valuations and to assess company risk.

Companies' industrial customers need to address their own customers' and stakeholders' expectations and will need data from upstream in their supply chain to do so. If they are carrying out LCAs, it is likely that they will need to work with their suppliers to obtain accurate and recent data. This raises such questions as: will the availability of an LCA carried out by a supplier be a decisive point in their choice of suppliers? Or, will the results of an LCA, and the demonstration of improvement over time, become a competitive advantage?

Retailers are beginning to launch initiatives themselves, and are pushing the need for information upstream. For example Walmart is effectively making carbon footprinting and emissions reduction actions a requirement for its suppliers for certain product categories. Tesco, a major retailer in the UK, introduced carbon labelling in stores in 2008 and is continually adding to the number of products labeled, which implies increasing cooperation with their suppliers.

Complying With and Anticipating Legislative Requirements

To date, using life cycle approaches has been voluntary, and used mainly by companies interested in improving and disclosing the environmental performance of their products.

However, there is a trend towards increasing legislation based on environmental accounting. For example, the first Canadian mandatory requirements for greenhouse gas (GHG) reporting/accounting and emissions caps and penalties for large emitters were introduced in 2007 in the province of Alberta. Many other provinces (e.g. British Columbia, Ontario and Quebec) are now implementing reporting and verification requirements for the purpose of calculating baseline emission levels starting in 2010. In Europe, several legislative requirements are directly based on LCA, such as the Energy-Using Products Eco-design Directive.

Many countries around the world are beginning to explore mandatory national, environmental labelling schemes. For example in France, under the Grenelle Law, the mass-market retail industry will most likely have to display environmental information based on national LCA guidelines by 2011. Currently environmental labelling regulations are not considered to be technical barriers to trade under the World Trade Organization (WTO) rules. This means that companies wishing to sell products in France and other countries that have implemented similar initiatives will have to perform LCA studies and produce the required environmental information. The cost of doing so may be very high unless companies are prepared and have already started down the LCA path. In North America, it is not known whether similar legislation will be enacted.

Understanding the Limitations of LCA

LCA provides many benefits, however it is important to understand its limitations if it is to be used effectively. Knowing these limitations is key to determining whether it is the most appropriate tool for a given situation.

- The results of an LCA are relevant for the geographic area where the data is collected. For example, an LCA conducted on an energy-intensive product in a region where electricity is mainly from hydroelectricity cannot be applied to the same product produced in another region where the electricity is mainly from fossil fuels, unless the LCA calculations are adjusted accordingly.

- Inventories of the inputs and outputs are collected based on where they occur, and then are translated into environmental impacts on a global or regional scale. The results from an LCA identify potential impacts on the environment and are not a calculation of actual impacts. Therefore LCA cannot replace local studies such as ecosystem-based studies of forest dynamics and biodiversity.

- LCA is a steady-state approach. It is a snapshot at a point in time and does not capture changes over time. However, LCA practitioners are actively studying ways to address this issue.

- LCA is quantitative and generates many numbers, all of which need to be interpreted. It does not provide a pass or fail result.

- LCA is a risk management tool that supports the identification of the largest impacts and can provide a basis of comparison over time. Improvements will result from the quality of the subsequent decisions.

- LCA is an environmental accounting tool with an inherent level of uncertainty and it should not be seen as having the same level of precision as financial accounting. LCA requires a very large amount of data, particularly to calculate all the inputs and outputs for every step. Databases are often used since it is impractical to collect all the necessary data from original sources (e.g. cannot get data from all the specific power plants from which electricity was sourced). Databases are improving, but practitioners need to understand all the assumptions, the age of the data, etc., and this may not be possible for every data point. There are numerous assumptions made during the assessment. For example, practitioners have to make assumptions about how to allocate electricity used in a plant which produces multiple products on the same equipment. Additionally, turning the inputs and outputs into their impacts on the environment is not an exact science and there are several credible methodologies that are used for impact assessment.

- The results of two LCAs on a same subject may differ according to the objectives, processes, quality of the data, assumptions and the impact assessment methods used. This makes transparency in LCA reporting a crucial element for communication and is the reason why ISO standards require it.

- Conducting an LCA is very resource-intensive, requiring personnel with the necessary expertise, access to data and databases as well as specialized software.

- LCA typically does not address the economic or social aspects of a product, however the life cycle approach and methodologies described in the ISO standards could be applied to these aspects.

Understanding LCA's limitations upfront during the planning phase will help to ensure that the goals of the assessment are achieved or determine whether other life cycle approaches would be more appropriate. Understanding LCA's limitations along with its benefits will also improve understanding of LCAs presented by others.

LCA 101

According to the ISO standards, there are four steps in an LCA:

- Goal and scope definition
- Inventory analysis
- Impact assessment
- Interpretation of the results

Goal and Scope Definition

The first question to consider is: why is the organization considering carrying out an LCA?

This question is not explicitly addressed in the Standards, but experience suggests that this will help define the level of assessment required. For example:

- A screening LCA can help identify the most significant contributors to environmental impacts, which can be then used to narrow the focus for further study.
- A full LCA can contribute to supporting marketing claims about a specific product or support an eco-design approach (e.g. supporting product development that aims to develop a new product that minimizes the environmental impacts).

Goal

In order to use LCA effectively, it is important to define the specific goals of the assessment.

For example*: "As part of the organization's continuous environmental performance improvement efforts, technical teams have developed new processes that should reduce the products' impacts on the environment. The organization now wishes to quantify the perceived potential improvement and establish whether there are still other opportunities that could be exploited to optimize the environmental performance of the product."*

Organizations also need to specify for whom the LCA results are intended and whether they intend to communicate the results publicly.

Functional unit

Once goals have been defined, the next step is to evaluate what the product does for the user. The objective is to define a "functional unit," or the service performed by the product. It must be measurable and in line with the objectives of the study. It should not be too specific to one product, but rather applicable to other products performing similar functions.

The choice of the functional unit is fundamental because it serves as the reference point against which all impacts will be assessed.

- If an LCA's goal is to input into an environmental improvement plan, and the functional unit is well defined, then the product or process can be redesigned to minimize the environmental impact while retaining the required performance.

- A comparative LCA can only be used to compare products that use the same definition of the functional unit.

Examples of functional units:

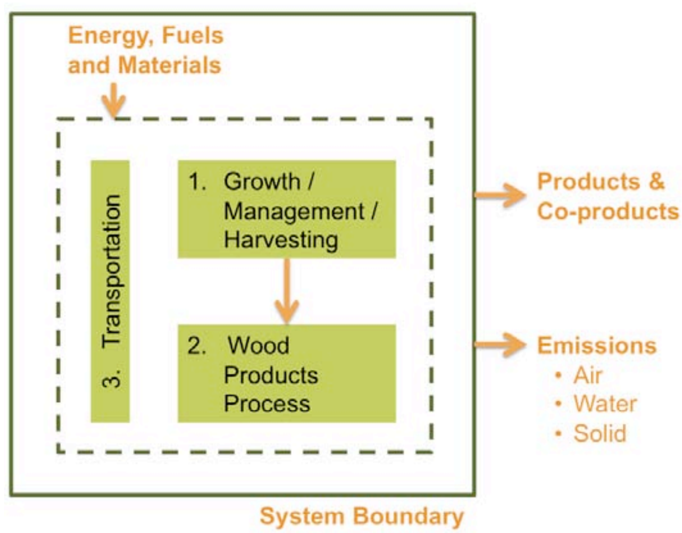
- An LCA was recently carried out to measure the potential environmental benefit of thin papers. The underlying premise is that thin papers provide a surface with certain properties for printing books, while requiring fewer resources than regular paper types. However, the processes and resources for producing thin papers differ from those used for traditional paper. Therefore the functional unit was defined as supplying 1 m^2 of a printed book (or a certain number of pages) with specified minimum paper properties.
- For a study that compares concrete and wood-framed buildings, the functional unit chosen would be the residential service provided by a multi-storey apartment building over its lifespan. It would not be appropriate to define the functional unit as a certain mass or volume of wood or concrete in this case since different amounts of each are required to fill the function of providing housing.

Scope

The boundary conditions describe the life cycle stages and processes within each that are included or excluded in the scope of the LCA. This means that the steps of the life cycle included must be listed, as well as how relevant upstream and downstream phases are taken into account. Life cycle stages and/or processes may be excluded because of a deliberate decision to narrow the focus on certain elements, a lack of relevance for the study goals, a lack of data, or because of other factors.

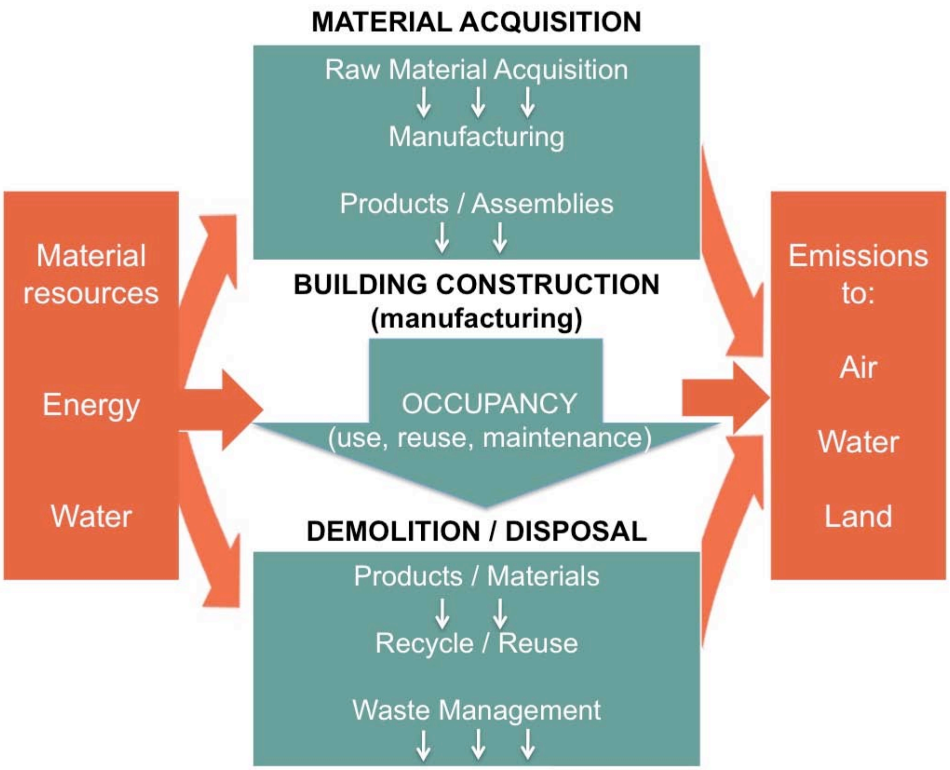
Studies with different boundaries cannot be compared unless the studies can be adjusted to match definitions of what is included and not included. For example, in most building or construction studies, the systems studied exclude the construction of the infrastructure (e.g. new roads), as well as the manufacturing of machines and tools.

This is a typical cradle-to-gate system boundary from a study by the Consortium for Resources on Renewable Industrial Materials (CORRIM) showing the three steps that were included.



Source: http://corrim.org/pubs/reports/2010/swst_vol42/15.pdf

Another example from the Athena Institute for a building shows that the scope includes the material manufacturing, construction, occupancy and demolition.



Source: http://www.athenasmi.org

Data Collection

LCA is an assessment tool that requires a large amount of data and data analysis. Wherever possible LCA practitioners use existing data contained in databases rather than create new data. There are public Life Cycle Inventory (LCI) databases, which are typically free, and private databases that typically charge fees. The quality of the data in the databases varies both within and between databases. The potential impact on the results is often studied by sensitivity analyses on the key inputs and outputs.

An organization may need to launch its own data collection process (primary data collection) and involve its suppliers, depending on the data availability, the level of detail required, how current and accurate existing data is and the sensitivity of the results to data variability.

For example, for paper produced in non-integrated mills (i.e. paper mills without pulping facilities), it is advisable to involve the mill's pulp suppliers in the data collection process, as this life cycle step will contribute significantly to environmental impacts.

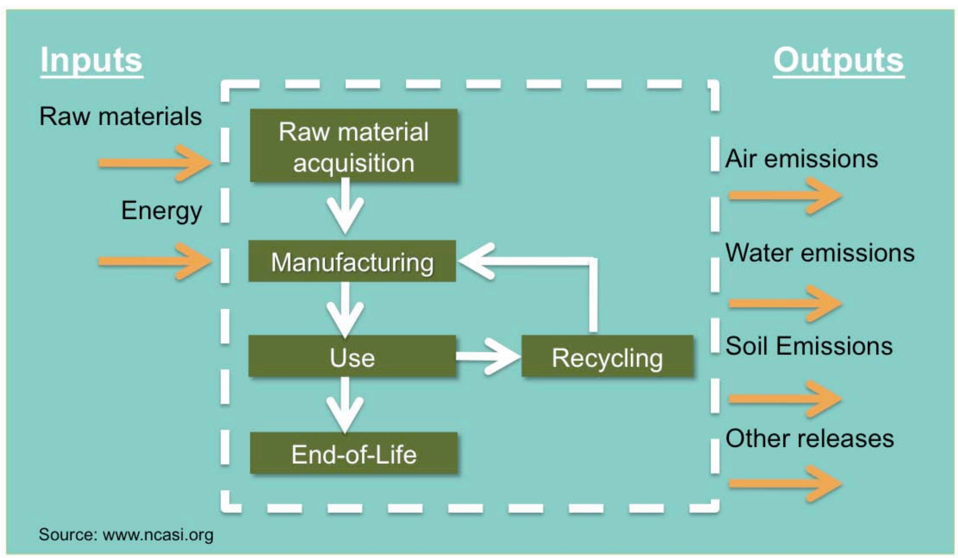
Data collection is an iterative process, which can take up to several months per project. It requires dedicated resources to prepare questionnaires, explain questions and send reminders to relevant contacts, etc. Additionally, consolidation and consistency checks of data are crucial to ensure data integrity and quality.

Modelling

Once all the data is collected for each process step, the data is entered into either dedicated LCA software packages (e.g. TEAM™, GaBi, SimaPro, etc.) or a simplified Excel sheet. The computer model is set up allow for the calculation of environmental flows of inputs and outputs and categorize them into impact categories.

Inventory Analysis

Inventory analysis is the compilation and quantification of all the inputs and outputs for the chosen system boundary as shown in the example below from the National Council for Air and Stream Improvement (NCASI). Inputs include all the raw materials and energy. Outputs include emissions to air (e.g. carbon dioxide), water (e.g. phosphates) and soil (e.g. heavy metals) and any other releases.



Impact Assessment

Knowing that there are certain amounts of pollutants discharged is not enough for an LCA. Once the environmental flows (from the input and output data) have been identified and measured, they are categorized into impact categories.

Typical impact indicators include abiotic depletion, acidification, climate change, human toxicity, ecological toxicity, eutrophication[3], fossil fuel depletion, photo-oxidant smog formation and stratospheric ozone depletion. LCA practitioners and

[3] Eutrophication is the increase of nutrients discharged to water bodies which negatively impacts water quality and disrupts ecosystems.

scientific experts, such as the Intergovernmental Panel on Climate Change (IPCC) or the World Health Organization (WHO), have developed methodologies to translate the inputs and outputs into these potential environmental impacts.

There are two types of Impact Categories: Endpoints and Midpoints. An endpoint category seeks to represent the resulting damage to the environment or human health. A midpoint category (e.g. smog formation) aims to cover an environmental problem that stands somewhere between the inventory (i.e. an emission) and an endpoint result. The evaluation of the impact follows a cause-effect chain from the inventory flows to at least midpoint indicators, and optionally continuing with further cause-effect modeling to assess endpoint results.

Impact categories that are not easily characterized in LCA include land use impacts and contained toxics (methods for assessing emitted toxics are still being developed). When relevant to the products studied, in addition to the impact indicator values, LCA reports may also highlight life cycle inventory (LCI) data, including consumption of water, wood, minerals, metals and energy.

Interpretation of Results

Once the impacts have been calculated, results can be interpreted in order to fulfill the study objectives. Overall assessment may include reviewing which life cycle stages contribute the most towards each impact category.

For example, if one of the goals was to improve the environmental performance of a product, and if a waste reduction method was chosen, the LCA results could be studied to identify the main sources of waste (e.g. waste generated during a certain step of the manufacturing process, or the production of a certain raw material, etc.) and help the organization design effective solutions to reduce these waste sources.

Issues Specific to the Forest Products Industry

The Wood, Pulp and Paper Industry – Environmental Flows and Impacts

The following criteria are usually used to characterize the environmental performance of forest products:

- Water releases: eutrophication (BOD, COD, Phosphorus, Sulphur), environmental effects monitoring, toxicity (notably for monitoring effects of chlorine and bleaching), etc.
- Air emissions: air acidification (emissions of NO_x and SO_x), greenhouse gases and particulate emissions
- Primary energy consumption, distinguishing renewable and non-renewable energy sources. This is increasingly important as a large number of Canadian forest products companies have converted to using renewable biomass for the majority of their energy needs, rather than fossil fuels.
- Resources depletion: including tracing of wood flows, depletion of non-renewable energy sources and, depending on the product studied, depletion of certain rare materials

For wood products, additional areas of interest include the use of surface treatments, VOC content and/or emissions in product and packaging use, recycling and waste phases, etc. However, the selection of indicators depends on the type of product studied. For example, if there is a printing phase, the emissions of photo-oxidants may be an additional impact to be studied.

The table below is a synthesis of several LCAs of paper products carried out by PricewaterhouseCoopers. It shows the different life cycle steps considered, from production of raw materials through to end of life. The level of contribution of each life cycle stage varies depending on the impact considered. Results can vary significantly depending on the specific attributes of the product and processes. For each step, the table charts the level of contribution to relevant environmental impacts (high, medium, minor and negligible):

		Life Cycle Stage						
Medium	**Indicator**	**Paper Production**	**Paper Printing**	**Lamination**	**Production of other raw materials**	**Manufacturing**	**Transport**	**End-of-life**
Energy	Total primary energy consumption	+++		+	++	++	++	
	Non renewable energy	++			++	++	++	
	Renewable energy	+++			+	+		
Air	Greenhouse gas emissions	+++			++	++	++	+
	Air acidification	+++			+	++	++	
	Chemical photo-oxidants	++	+++	+++	++	++	++	+
	Human toxicity	+++	+++	+++	+	++	++	
Water	Ecotoxicity	+++	++	++	+	+	+	
	Consumption	+++			+	++		
	Eutrophication	+++			++	++		
Resources	Non renewable resource depletion	++		+	++	++	++	
Waste	Non hazardous waste production	+++	++		+	++		++

Legend: high (+++); medium (++); low (+); negligible (blank)
Source: PricewaterhouseCoopers

Carbon

While there has been a growing focus on carbon as an indicator of environmental performance, carbon and greenhouses gases are only one subset of an LCA. A full LCA assesses additional relevant impacts on the environment.

Specific carbon methodologies and tools have been developed for the forest industry. The Forest Industry Carbon Assessment Tool (FICAT)[4], developed by the National Council for Air and Stream Improvement (NCASI) for the International Finance Corporation (IFC), is used to assess the overall life cycle greenhouse gas impact of forest industry manufacturing facilities or companies. The Confederation of European Paper Industries (CEPI) has developed a "Ten Toes" methodology for determining the carbon footprint of products[5]. Usually in LCA a difference is made between carbon emissions from biomass and from fossil origin.

Carbon accounting methodologies are still evolving, therefore it is important to ensure that the assumptions made are fully understood when interpreting or using LCA results.

Water — Used vs. Consumed

In LCA tables, the flow of "water used" usually considers the quantity of water withdrawn, but does not account for whether it is returned to its original natural source, e.g. river or lake. A better way would be to measure the quantity of "water consumed", which measures the quantity of water actually consumed in the process, or in other words, the amount of water that is not released back to its original source, thereby creating an impact on that source. The pulp and paper industry is generally perceived as water intensive. Water is important throughout pulp and paper mills for numerous processes including washing, rinsing or cooling raw materials and machines. Most of this water is reused several times before being treated and released back to its original source. Therefore a much smaller amount is actually consumed, e.g. water that evaporates from steam or leaves with the product, compared to water used. Assessments can track these different water flows and highlight the difference between water used and water consumed. Methods are being developed for LCAs to characterize the impacts of water use and consumption.

Recycled Content Paper — Understanding the Fibre Cycle[6]

Some customers and consumers focus on papers with high recycled content. This is based on the assumption that more recycled content is always better for the environment for every product. However, recycled content is only one attribute. A life cycle approach includes assessing a range of attributes across the entire life cycle. Recycling paper and wood products is definitely an important

[4] Forest Industry Carbon Assessment Tool www.ficatmodel.org

[5] CEPI Carbon Footprint Tool
http://www.cepi.org/docshare/docs/1/JJCKEHEBKLIPJFINFKKEHCHH59YA47FH4O1TQ7VPB6U3/CEPI/docs/DLS/CarbonFootprintmain-20071112-00003-01-E.pdf

[6] http://www.thepaperlifecycle.org/ is a resource for further information on the fibre cycle

component of the sustainability of forest products. Fresh fibre from third-party certified sources is also important. Not all paper is recyclable or recycled quickly (tissue, books, etc.) and fibres break down with each reuse, therefore fresh fibre is always required.

A life cycle approach can help determine which product application of recycled content, and at what level, can yield the most benefit. For any particular paper product, LCA can be used to account for impacts related to:

- Transportation, including waste collection and transport to recycling facilities
- Sorting and recycling processes
- Recycled fibre processing (e.g. de-inking, bleaching etc.) and fibre recovery rates from processing
- Alternative end-of-life options (e.g. energy production)
- Type of end product and product attributes

Biodiversity

Biodiversity refers to the diversity in plants and animals as well as diversity in ecosystems and landscapes. LCA focuses on quantifying inputs and outputs. So can biodiversity be modelled in a meaningful way for LCA purposes?

Some of the flows and traditional impacts considered in LCA, such as waste production or eutrophication, directly imply ecosystem modifications. However LCA does not yet comprehensively address biodiversity impacts.

Land use change can be used as an indicator to measure impacts on biodiversity and is relevant to the forest sector in terms of afforestation (e.g. conversion of agriculture lands to forest) and forest land loss due to agricultural, urban or infrastructure use, and the impacts of forest operations. However, methods are still under development and no agreement on a method to be commonly used in LCA has been reached.

There are other specific complementary methods already available or under development that may be a better fit for this purpose than LCA (e.g. monetization of biodiversity or of ecosystem services).

Environmental Communication

Many companies want to publicize certain environmental aspects of their products, particularly when they have invested in process changes or made new supply chain choices. Marketing communication is more effective when there is data and analysis to validate claims. LCA is well suited to provide validation for marketing claims. Following ISO 14040 LCA standards will allow others to understand the methodology used and provides assurance that a peer review process was followed.

ISO has established standards for communication of environmental labels and declarations:

- ISO 14020:2000: General Principles for Environmental Labels and Declarations

- ISO 14024:1999 Type I: This standard defines ecolabelling requirements. Ecolabels define relevant impact categories and corresponding thresholds, with the goal that only the top 10–20% of a product category can achieve these thresholds. The whole life cycle is taken into account, with third-party verification.

- ISO 14021:1999 Type II: This standard is for self-declarations, which usually focus on a single criterion at a specific stage in the life cycle. There is no third-party review involved.

- ISO 14025:2006 Type III: This standard is for labelling and environmental declarations that disclose information about the environmental performance of products and services over their life cycle, for example an Environmental Product Declaration (EPD). Third-party verification can be part of the process.

LCAs can be used in marketing claims to compare products with similar functions. However, attention to detail and transparency is critical, particularly for comparative assertions. System boundaries, functional units and other key parameters and assumptions need to be reviewed for consistency before comparing LCA results. LCA results are usually relative to specific products and it is not possible to extrapolate specific product results to general statements about product categories (or vice versa).

LCA's advantages stem from its comprehensive technical methodology — but this level of detail can make communication of LCA results very challenging. When communicating marketing claims based on LCA, the claims should be clear and simple, mentioning only relevant elements supported by the results and refer to a more complete study verified by an independent expert panel. It is advisable to provide two levels of information:

1. A very simplified level, which highlights the key figures in a clear and relevant manner:
    - Do not make a claim without backing it up with data.
    - Do not focus on small improvements of a few percentage points since LCA has an inherent level of uncertainty.
    - Do not promote improvements that were required by legislation unless that is clearly explained.

2. An expert level, which provides more detailed information:
    - It is advisable to have a synthesis of the LCA study performed, preferably in the form of a communication brochure that is publicly available, which briefly sums up the main hypotheses and the results, as well as the sources of data and key assumptions.
    - The full LCA report should be made available to stakeholders upon request.

Resources

The Athena Institute
http://www.athenasmi.org

The Interuniversity Research Centre for the Life Cycle of Products, Processes and Services (CIRAIG)
http://www.ciraig.org

Consortium for Resources on Renewable Industrial Materials (CORRIM)
http://www.corrim.org/

FPInnovations - Wood Products
http://www.forintek.ca

International Organization for Standardization
http://www.iso.org

The Life Cycle Initiative: International partnership between United Nations Environment Programme (UNEP) and the Society of Environmental Toxicology and Chemistry (SETAC)
http://lcinitiative.unep.fr

National Council for Air and Stream Improvement
http://www.ncasi.org

U.S. Government LCI database
http://www.nrel.gov/lci

About FPAC

The Forest Products Association of Canada (FPAC) is the voice of Canada's wood, pulp, and paper producers nationally and internationally in government, trade, and environmental affairs. FPAC represents the largest Canadian producers of forest products. Our members are responsible for 66% of certified forest lands in Canada. Third-party certification of member companies' forest practices is a condition of membership in the Association — a world first.

FPAC Sustainability Statement

The Canadian forest products industry contributes to society's well-being through its products and activities — from forest to market. FPAC members are committed to a sustainable development path built on a profitable and competitive industry and to grow business and the industry's share of the global markets in a manner that meets the growing demand for sustainably produced products. Our members pride themselves on regenerating harvested areas, a commitment to legal logging and the enforcement of tough regulations, welcoming outside scrutiny of their practices, participating in recovery and recycling, and promoting carbon neutrality across the value chain. FPAC members will operate in a manner that is environmentally responsible, socially desirable, and economically viable.

About PwC

PricewaterhouseCoopers Advisory France is a member firm of the PricewaterhouseCoopers Network (www.pwc.fr). Globally, PricewaterhouseCoopers provides industry-focused assurance, tax and advisory services to build public trust and enhance value for its clients and their stakeholders. More than 146,000 people in 150 countries across our network share their thinking, experience and solutions to develop fresh perspectives and practical advice. PwC has been advising policy makers and business on climate change since 1997, helping them to analyse issues and develop practical solutions to the challenges they face. With a global network of over 700 Sustainability and Climate Change professionals (www.pwc.com/sustainability), PwC offers a broad range of advisory, assurance and tax services that guide clients through the complexities of adapting to a low-carbon economy and a resource constrained world (www.pwc.fr/dd).

Industry specialists in our Global Forest, Paper & Packaging practice offer a broad range of innovative, cost-effective solutions that respond to both local and global business issues. For details visit: www.pwc.com/fpp.

References to "PricewaterhouseCoopers Advisory France" should be read as referring to the French company PricewaterhouseCoopers Advisory, member firm of the PricewaterhouseCoopers Network. The registered office of PricewaterhouseCoopers Advisory is 63, rue de Villiers, 92 200 Neuilly sur Seine (France).

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