# Making sustainable consumption and production a reality

A guide for business and policy makers to Life Cycle Thinking and Assessment

EUROPEAN COMMISSION

JRC
EUROPEAN COMMISSION

environment

Europe Direct is a service to help you find answers

to your questions about the European Union

Freephone number (*):

00 800 6 7 8 9 10 11

(*)Certain mobile telephone operators do not allow access
to 00 800 numbers or these calls may be billed.

*Printed in Belgium*

Printed on recycled paper that has been awarded the EU Ecolabel for graphic paper

(http://www.ecolabel.eu/)

EU
Ecolabel
www.ecolabel.eu

# Table of contents

3

©Photodisc

# Introduction

The many products we buy and use every day contribute to our comfort and well-being. However, awareness of the unsustainable levels of resource consumption and the significant impacts of these products on the environment is growing among consumers, policy makers and business.

Consumers want to make the right environmental choices when buying products. Policy makers want to promote sustainable consumption and production to respond to national and international environmental challenges. And businesses want to improve efficiency to boost margins and competitiveness, while contributing to a sustainable society.

This guide has been developed to help address these issues. The case studies highlighted offer an ideal starting point in understanding the full environmental implications of products.

The availability of information about various environmental pressures is increasing. However, it is not always clear what this information means, how important it is, and how it can best be related to products. What businesses and policy makers need to know is how to attribute environmental pressures to specific products, how to obtain this information and how to present it in a way that is easy to understand.

This guide shows how a life cycle approach can be used to identify and reduce the environmental and health impacts of the products we use. It underlines the importance of considering these issues across the entire life cycle of a product and sets them within the context of policy development, business design and innovation.

The information in this brochure is aimed at helping both the public and private sectors make more informed decisions to achieve better environmental outcomes. This in turn contributes to delivering our common environmental objectives through better policies, business strategies, product design and better customer choice.

*"The way we produce and consume contributes to global warming, pollution, material use, and natural resource depletion. The impacts of consumption in the EU are felt globally, as the EU is dependent on the imports of energy and natural resources."*

*Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan, 2008.*
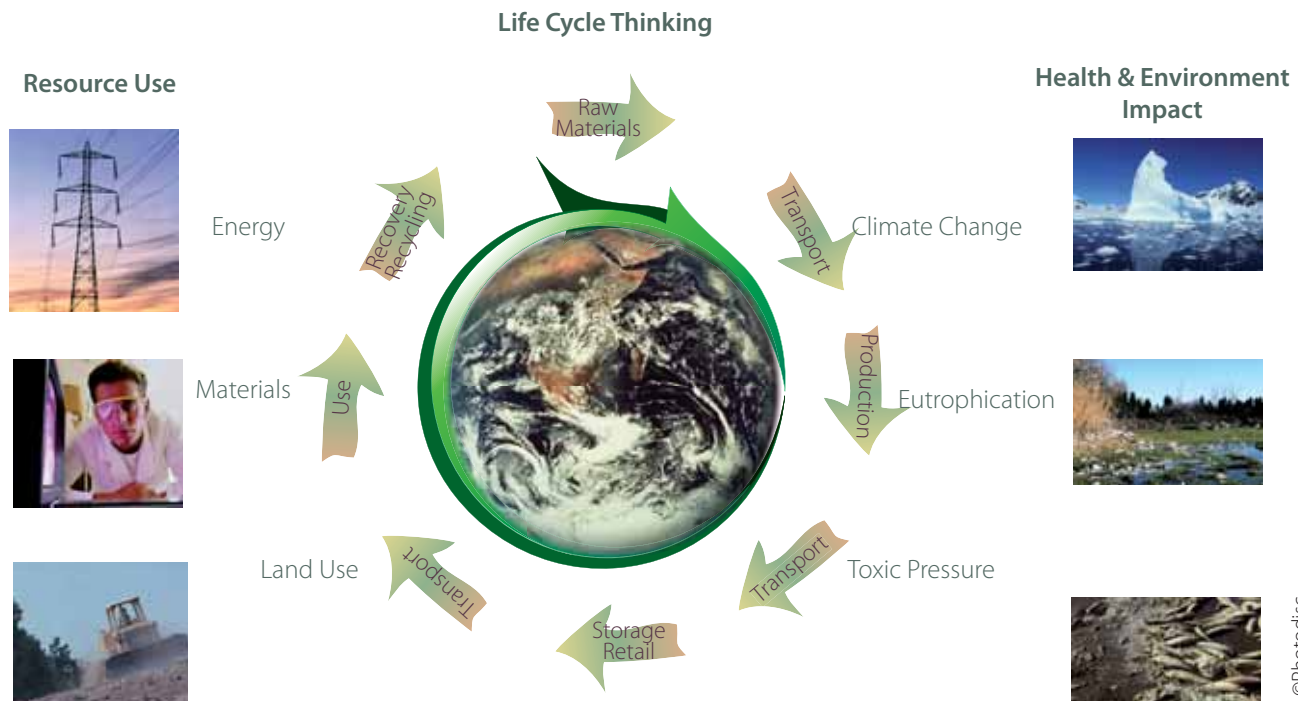
# What is Life Cycle Thinking?

Until recently, actions for environmental improvement focused on minimising pollution from single sources such as discharges into rivers and emissions from factories.

Life Cycle Thinking (LCT) seeks to identify possible improvements to goods and services in the form of lower environmental impacts and reduced use of resources across all life cycle stages. This begins with raw material extraction and conversion, then manufacture and distribution, through to use and/or consumption. It ends with re-use, recycling of materials, energy recovery and ultimate disposal.

The key aim of Life Cycle Thinking is to avoid burden shifting.

This means minimising impacts at one stage of the life cycle, or in a geographic region, or in a particular impact category, while helping to avoid increases elsewhere. For example, saving energy during the use phase of a product, while not increasing the amount of material needed to make it.

Taking a life cycle perspective requires a policy developer, environmental manager or product designer to look beyond their own knowledge and in-house data. It requires cooperation up and down the supply chain. At the same time, it also provides an opportunity to use the knowledge that has been gathered to gain significant economic advantages.

## Life Cycle Thinking

### Resource Use

Energy

Materials

Land Use

Raw Materials

Recovery Recycling

Use

Transport

Transport

Storage Retail

Transport

Production

### Health & Environment Impact

Climate Change

Eutrophication

Toxic Pressure

©Photodisc

## A brief history of Life Cycle Thinking

Many people are aware that products result in environmental impacts and resource consumption. However, understanding and quantifying these over the entire life cycle of a product is a relatively new concept.

The precursors of Life Cycle Thinking emerged in the late 1960s and early 1970s from concerns about limited natural resources, particularly oil. They came in the form of global modelling studies and energy audits. They were referred to as Resource and Environmental Profile Analyses (REPA) and Net Energy Analyses.

Since the 1970s, needs have changed and techniques have improved. Life Cycle Thinking has become a key complementary tool in policy and decision making, both in government and business.

### Life Cycle Thinking TIMELINE

**1963**:  Early studies known as Resource and Environmental Profile Analyses (REPA).

**1969**: First comparative multi- criteria environmental study for Coca Cola - became basis for the current method for life cycle studies.

**1991**: The Society of Environmental Toxicology and Chemistry (SETAC) develops the Impact Assessment method for LCA.

**1992**: First European scheme on Ecolabels, established by the European Commission; World Business Council for Sustainable Development (WBCSD) founded by industry to address sustainability.

**1995**: SETAC develops  Code of Practice for Life Cycle Assessment; first Life Cycle Assessment on a car – VW Golf.

**1996**: International Organization for Standardization (ISO) launches first standards on Life Cycle Assessment.

**2001**: European Commission releases Green Paper on Integrated Product Policy (IPP) building on Life Cycle Thinking.

**2002**: United Nations Environment Programme (UNEP) / SETAC Life Cycle Initiative launched.

**2003**: European Commission Communication on Integrated Product Policy

**2005**: European Platform on Life Cycle Assessment established at the European Commission; EU Thematic Strategies on the prevention and recycling of waste and the sustainable use of natural resources published.

**2006**: First version of the Commission's European Reference Life Cycle Database (ELCD) goes online.

**2007**: Start of development of International Reference Life Cycle Data System (ILCD) Handbook.

**2008:** European Commission launches Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan.

First public specification for carbon footprinting published (British PAS2050).

**2009**: ISO initiates development of first international standard for product carbon footprinting; the World Business Council for Sutainable Development (WBCSD) and the World Resources Institute (WRI) start drafting a Green House Gas (GHG) Protocol Product / Supply Chain Standard and life cycle based Scope 3 Corporate Standard.

**2010**: Launch of the ILCD Handbook by the European Commission.

# Why take a life cycle approach?

*To initiate and drive forward environmental improvements and economic gains, you need to approach environmental issues from a life cycle perspective.*

With the consequences of human activities on the environment becoming ever more apparent, leading businesses and governments need to be fully informed of the impacts associated with goods and services and play their part in reducing them.

For many years, reducing environmental impacts focused on production processes, treatment of waste and effluent streams. This remains important. These actions help, for example, to successfully address the issues of reducing air and water pollution from a specific operation. However, this does not necessarily reduce the negative environmental impacts related to the consumption of materials and resources. It also does not account for the shifting of burdens – solving one problem while creating another. Solutions therefore may not be optimal and may even be counter-productive.

Businesses have not always considered the supply chains or the use and end-of-life processes associated with their products. Government actions often focus on a specific country or region, and not on the impacts or benefits that would occur in other regions or that are attributable to their consumption.

In both cases, without attention to the full life cycle of goods and services (supply/use/end-of-life), the environment suffers further, as we use more resources – resulting in poorer financial performance and higher potential for reputation damage.

Life Cycle Thinking adopts a broader perspective. As well as considering the environmental impacts of the processes within our direct control, attention is also given to the raw materials used, supply chains, product use, and finally the effects of disposal and possibilities for re-use or recycling.

Life Cycle Thinking can help identify opportunities and lead to decisions that help improve environmental performance, image, and bring economic benefits. This approach demonstrates to customers that responsibility for reducing environmental impacts is being taken.

*"The need to move towards more sustainable patterns of consumption is more pressing than ever.....the challenge is to create a virtuous circle: improving the overall environmental performance of products throughout their life cycle."*

*Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan, 2008.*

*Companies are increasingly ensuring that the overall environmental performance of their products, from the choice of raw materials to the manner of disposal, is continually improved without compromising quality.*

©Shutterstock

**Life Cycle Thinking in practice**

**Case study: Materials in products – wind turbines**

Wind power, one of the most familiar forms of renewable energy, is helping us meet our demand for energy from a sustainable source and tackle climate change. Stable structures made of a number of materials (including steel, polyesters and epoxies) are required to harvest this abundant source of energy. These materials give the turbines their strength, durability and lightness. They also enable the development of taller turbines that reach higher, faster winds and are therefore more efficient in converting wind into electricity.

As a wind turbine itself emits no $CO_2$ while in use, the only carbon dioxide created is in the manufacture of the materials and the maintenance and disposal stages. Emissions may be further reduced through the use of recycled materials.

Steel manufacturers in particular recognise that it is vital to understand the environmental issues in the various stages of a turbine's life. A life cycle approach is used to calculate the 'carbon payback' period. As a result, the energy consumption in manufacture, operation and end-of-life processes is recovered from the wind energy produced usually within six to nine months of operation. Product design and innovation have reduced the weight of some steel turbine towers by 50% over the last ten years, often reducing the associated energy consumption. In this case, Life Cycle Thinking has been crucial in determining the choice of materials in order to reduce emissions that contribute to climate change and the consumption of natural resources.

©Shutterstock

# Life Cycle Thinking for policy and business

10

*Why carry out an investigation into life cycle impacts? Is it relevant? The simple answer is yes.*

This section delves deeper into some of the main drivers, benefits and positive outcomes of using Life Cycle Thinking in government and business.

Although the worlds of policy and business may appear to have separate motives and goals, they share a common, underlying need to have the right information available to make informed decisions.

For those working in the field of policy development, taking a life cycle approach is beneficial for a number of reasons:

- Gathering baseline environmental impact information for market-orientated policies and the promotion of innovative product design;
- Understanding trends in product supply chains and where to best influence the chain;
- Developing resource strategies, such as optimal waste management;
- Better informing consumers through the use of labelling schemes and the use of Green Public Procurement (GPP).

*"It is necessary to develop means to identify the negative environmental impacts of the use of materials and energy throughout life cycles (often referred to as the cradle to grave approach) and to determine their respective significance. This understanding of global and cumulative impacts along a causal chain is needed in order to target policy measures so that they can be most effective for the environment and more cost-efficient for public authorities and economic operators."*

*Thematic Strategy on the sustainable use of natural resources, 2005, European Commission.*

*"Life Cycle Assessments provide the best framework for assessing the potential environmental impacts of products currently available."*

*European Commission Communication on Integrated Product Policy, 2003.*

*A number of companies are using this approach to improve product models over their entire life cycle.*

In business, there may be different drivers based on the same set of information. This can help to:

- Understand which parts of a product's life cycle have the greatest environmental impacts to promote material and economic efficiency;
- Create an improved market position and customer image through ecolabels, Environmental Product Declarations (EPD) and carbon labels;
- Achieve closer cooperation with suppliers and customers regarding product risks, development and marketing;
- Foster better relations with authorities, environmental groups and with other collaborative partners;
- Improve the company's image to shareholders and customers.

Template2.inddja.indd   10     8/02/2010   17:48:14

## Applications in policy

Life Cycle Thinking is increasingly fundamental in the development of key environmental policies around the world. In the European Union, Life Cycle Thinking is at the heart of a growing number of policies and instruments in areas such as:

- Integrated Product Policy, the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan, Green Public Procurement, EU Ecolabel, EU Eco-Management and Audit Scheme, Ecodesign, Retail Forum)

- Waste – Life Cycle Thinking is now a term in the Waste Framework Directive, used to help determine the benefits of different prevention or management options. Life Cycle Thinking is also central to the Thematic Strategy on the prevention and recycling of waste, and the Thematic Strategy on the sustainable use of natural resources.

- Eco-innovation and the EU Environmental Technologies Action Plan (ETAP).

Outside of the European Union, Canada is among the growing number of countries that has also applied this approach where Life Cycle Thinking has helped develop policies on ecolabelling, packaging, waste reduction and toxic substance management. It has also been used in both New Zealand and Japan, including for ecolabelling and in Australia for public procurement. In the United States, the Low-Carbon Fuel Standard of California and the Environmental Protection Agency's Regulation of Fuels and Fuel Additives build on Life Cycle Assessment. The Norwegian Ministry of the Environment has used Life Cycle Thinking in setting up Green in Practice (GRIP), a foundation promoting sustainable consumption and production.

## Applications in business

The diagram below illustrates the use of life cycle information to inform an array of decision making processes in business. Life Cycle Thinking is at the core, with many spin-off applications.

For example, product differentiation is a key aim of marketing. Companies want their products to stand out from those of their competitors. Special offers, cheaper prices and stylised packaging are some of the ways of achieving this. Differentiation based on the product's environmental characteristics is an increasingly powerful tool, often achieved by an environmental claim or label.

To make such an environmental claim, businesses must gather credible and robust evidence that a product's environmental performance has been quantified and, where relevant, meets



Lower ecological impact

Greener manufacture of products

Business marketing & efficiency

Legislation

Product ecodesign

Life Cycle Thinking

Carbon Reduction

Waste management

Green Procurement

Ecolabels, carbon footprints

Greater resource efficientcy

Greater consumer awareness, confidence & green consumption

©Shutterstock

strict environmental criteria. Businesses may also wish to publicise the fact that they have quantified the environmental performance of their product and are working to improve it.

There may be other drivers, such as a manufacturer wishing to develop a new product to achieve a market advantage. The development of hybrid cars is an example where a life cycle approach and ecodesign have been applied to understand the relative impacts of these new engine types compared to conventional ones.

**Further information on related EU policies and instruments:**

**The Thematic Strategy on the prevention and recycling of waste:**
**http://ec.europa.eu/environment/waste/strategy.htm**

**The Thematic Strategy on the sustainable use of natural resources:**
**http://ec.europa.eu/environment/natres/index.htm**

**Integrated Product Policy (IPP): http://ec.europa.eu/environment/ipp/**

**The EU Environmental Technologies Action Plan (ETAP)**
**http://ec.europa.eu/environment/etap/**

**The Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan (SCP/SIP):**
**http://ec.europa.eu/environment/eussd/escp_en.htm**

**The Ecodesign Directive: http://ec.europa.eu/enterprise/eco_design**

**Green Public Procurement (GPP): http://ec.europa.eu/environment/gpp**

**EU Ecolabel: http://www.ecolabel.eu/**

**Eco-Management and Audit Scheme (EMAS):**
**http://ec.europa.eu/environment/emas/about/summary_en.htm**

**Waste Framework Directive: http://ec.europa.eu/environment/waste/framework/index.htm**

**Retail Forum: http://ec.europa.eu/environment/industry/retail/index_en.htm**

# Quantifying Life Cycle Thinking with Life Cycle Assessment

A Life Cycle Assessment (LCA) quantifies and assesses the emissions, resources consumed, and pressures on health and the environment that can be attributed to different goods or services over their entire life cycle. It seeks to quantify all physical exchanges with the environment, whether these are inputs in the form of natural resources, land use and energy, or outputs in the form of emissions to air, water and soil.

The inputs and outputs associated with a product's life cycle are collated in a 'balance sheet', or life cycle 'inventory'. For example, the production of a plastic bottle might consume x grams of extracted crude oil and y m$^3$ of natural gas during production, resulting in z grams of $CO_2$ emissions.
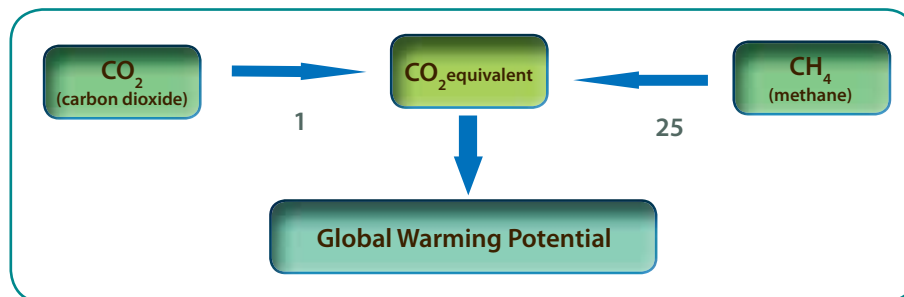
When an inventory of all the inputs and outputs has been made, they are grouped into impact categories such as 'human toxicity' or 'climate change'. The inputs and outputs are then converted into indicators for each impact category using models and scientific knowledge.

For example, all greenhouse gases are grouped under the 'climate change' impact category.  In order to compare these and illustrate the contribution to climate change in the form of a single indicator (often known as the carbon footprint), all inputs are harmonised to an equivalent and then added together – in this case, as 'kg of $CO_2$ equivalents'.

To further illustrate this, let us consider the example of methane gas. Methane is 25 times more potent a greenhouse gas than carbon dioxide. Emissions of methane are therefore multiplied by 25 to get their global warming potential in carbon dioxide ($CO_2$) equivalents. The environmental performance of the product considering climate change is then presented as the global warming potential in the form of a total amount of $CO_2$ equivalents.

Some impact categories may have greater relevance than others. It is possible to give the indicators a weighting depending on their relative importance. For example, is climate change more, or less important than resource depletion? This can then be used in an assessment to derive a single indicator. However, such a process inevitably introduces a level of subjectivity.

| Examples of environmental impact categories | |
|---|---|
| **Impact Category** | **Description** |
| **Climate change** | Carbon dioxide, methane and other greenhouse gases released into the environment allow sunlight to pass through the earth's atmosphere, but absorb the infrared rays that reflect off land and water. This inhibits their escape and therefore heats up the atmosphere. |
| **Ozone depletion** | The release of substances, such as CFCs, HCFCs, halons, methyl bromide, carbon tetrachloride and methyl chloroform, contribute to stratospheric ozone depletion and increased ultra violet radiation to the earth's surface. |
| **Acidification** | Emissions of chemicals such as sulphur dioxide, nitrogen oxides, ammonia and hydrochloric acid directly, or through conversion to other substances, lower the pH of soil and water bodies, affecting animal and plant life. |
| **Eutrophication** | The release of nutrients, mainly nitrogen and phosphorus, from sewage outlets and fertilised farmland causes nutrient enrichment. This results in changed species composition in nutrient-poor habitats and in algal blooms in water bodies, causing a lack of oxygen and fish death. |
| **Photochemical ozone creation** | Ground-level ozone, which has impacts on animal and plant life, is produced by reactions of hydrocarbons and nitrogen oxides to light ('summer smog'). |
| **Human toxicity** | Exposure to a chemical substance over a designated time period can cause adverse health effects to humans. |
| **Ecotoxicity** | Emissions of substances (residues, leachate, or volatile gases) that disrupt the natural biochemistry, physiology, behaviour and interactions of the living organisms that make up ecosystems.  A distinction is made between different ecosystems, such as freshwater and terrestrial. |
| **Ionizing radiation** | Impacts as a result of radioactive substances in the environment and/or other sources of radiation. |
| **Land use** | The use (occupation) and conversion (transformation) of land area by product-related activities such as agriculture, roads, housing, mining etc. |
| **Resource depletion** | The consumption of non-renewable resources such as water and crude oil, limiting their availability for future generations and affecting the areas they are taken from. |

**Life Cycle Thinking in Business**

**Case study: Washing clothes without wasting energy**

Life Cycle Assessment has been used since the late 1980s to analyse products, identify product innovation opportunities and guide decision-making on laundry detergents. Studies have shown that energy consumption in the home is by far the most substantial use of energy across a washing machine's lifetime. With this knowledge, detergents have been developed by several companies for washing clothes at lower temperatures.

To quantify the benefit of using lower temperatures, the energy savings of the 'use phase' in the home were measured. Life Cycle Assessments were conducted to compare low temperature products with normal variants. Further evaluations were carried out to determine whether the ingredients in certain low temperature detergents caused any negative impacts, for example, via emissions to water.

Findings showed that cold water detergents can lead to significant savings in energy consumption and improvements across a range of environmental indicators such as climate change, acidification and photochemical ozone creation. Developing these detergents reduced the environmental impact through lower energy consumption, brought financial benefit to the consumer through lower electricity bills, and provided leading industries in this sector with a substantial business opportunity.

©iStock

# Different types of assessment

*There are several ways to assess the life cycle impacts of products. Some are more complex than others – all have their merits.*

Different approaches demand different requirements in terms of data collection and quality assurance, resulting in varying levels of robustness. They also have different intended users – from consumers and small and medium sized enterprises to product designers and experienced life cycle experts.

## ISO Life Cycle Assessment (LCA)

These assessments comply with the principles and requirements of the international standards on LCA (ISO 14040 and 14044). The term 'ISO LCA' (or process-LCA) is often used to describe an assessment that includes considerable data collection related to the product's supply chain, use, and end-of-life. An ISO LCA is generally carried out, for example, when no other studies have been conducted for a given product or product group. This helps identify what is important in the product's life cycle and, therefore, where to focus. Such full LCAs are often pre-requisites for other Life Cycle Thinking support tools and instruments.

An ISO LCA requires extensive data collection and expertise to model the product's life cycle, either in-house or via external experts. For these types of assessments, dedicated LCA software tools and databases are generally used. The European Commission has developed a Life Cycle Assessment system fully compatible with ISO standards. This is outlined on page 24.

## Other Life Cycle-based approaches

### Streamlined LCA, ecolabel and ecodesign

In a streamlined LCA, a simplified approach is deliberately adopted, generally by limiting data collection and using generic data where appropriate. The focus can be guided by, or based on, more complete ISO LCA studies.

One example of a streamlined approach is ecodesign. Ecodesign draws on a subset of so-called Key Environmental Performance Indicators (KEPIs). These KEPIs are identified through a more detailed ISO LCA and reflect the main considerations or 'hot spots'. This method of developing a simplified set of criteria based on more robust LCAs and other information is increasingly used to develop ecolabels.

Nevertheless, while attractive for a number of everyday applications, care is needed when undertaking a streamlined LCA. Without some baseline knowledge about the product's life cycle impacts, results may be misleading and might inadvertently lead to burden shifting. Also, effort could be spent on life cycle stages that do not have the greatest opportunity for environmental improvement. It is best, therefore, to use streamlined approaches only where solid experience from using ISO LCAs has already been gained.

### Carbon Footprinting

In recent years, the carbon footprint has gained recognition as an indicator of the contribution of goods and services to climate change. It is often based on a life cycle approach, but focuses only on the emissions linked to a product that contribute to climate change.

Data are generally collected throughout the entire life cycle at a consistent level of detail as in an ISO LCA, although not all emissions, resources consumed, and impact categories are evaluated. This limitation in scope raises the prospect of burden shifting – solving one problem while creating another. This can unfairly promote products that do not necessarily have a better overall environmental performance, or environmental footprint.

## Ecological Footprinting

This life cycle approach considers some of the impacts of human activities on the Earth's natural environment. The technique helps to compare the demand placed on eco-systems – the land and the sea that we use and the resources we extract from them – against the earth's capacity to meet this demand (such as through regeneration of resources and assimilation of waste). Results are presented in planet equivalents , that is, how many planets we would need if the same level of consumption of resources was replicated world-wide. This can build on ISO LCAs, but does not consider all impact categories.

©Photodisc

## Environmental Input-Output Analysis

An economic Input-Output (I-O) Analysis describes the financial inputs and outputs (transactions of goods and services) between given business sectors of the economy within a prescribed geographical area, region, country or continent. When combined with environmental data for these sectors, an estimate of the environmental impact per unit value of a sector (for example per euro) can be made.  This is often called environmental I-O analysis or I-O LCA.  An  environmental I-O analysis  can help to estimate the impacts of one sector relative to another and highlight significant sectors in terms of their environmental impacts.

## Material Flow Analysis (MFA)

A Material Flow Analysis examines the movements of materials through, for example, an industry sector and its supply chain, or a given region. MFAs are used to identify key environmental issues related to the resource efficiency of systems and develop strategies to improve them.

## Life Cycle Costing (LCC)

Similar to Life Cycle Assessment, Life Cycle Costing (sometimes called 'Whole Life Costing') is an economic application based on Life Cycle Thinking. This technique takes into account all the costs across the lifetime of a product, including purchase, operation, maintenance and disposal. This information is valuable in understanding the total cost of an investment or ownership. For example, while upfront  costs may be greater for an eco model, the overall lifetime cost is lower due to cheaper running costs. Similar approaches are also emerging to estimate social impacts and benefits associated with a product's life cycle.

**Life Cycle Thinking in Business**

**Carbon Footprinting**

**Case study: Retailer action to lower our carbon footprint**

Retailers are becoming increasingly aware of the opportunities to improve the environmental performance of products and influence purchasing decisions. There are currently various activities to capture and record life cycle data on a range of household products and pass this information on to customers. This offers consumers a better understanding of the environmental impacts of their purchasing choices. Some initiatives display carbon footprinting information on a wide range of products from potatoes to lightbulbs. Retailers are beginning to present this kind of information on product labels. Some carbon labels are directly linked to the commitment of actively working to reduce greenhouse gas emissions. In addition to reducing their own carbon footprint, the benefit to retailers is that they are being seen as national and international leaders in engaging consumers on climate issues and helping them reduce their carbon footprint. In the case of one multi-national retailer, more than 500 product lines have been, or are in the process of being footprinted.

**Life Cycle Costing**

**Case study: Compact fluorescent Vs tungsten filament light bulbs**

Compact Fluorescent (CFL) light bulbs have been available for several years. It is generally accepted that they are more efficient and better value for money than the traditional filament (GLS) light bulbs.

A 60W GLS (filament) bulb and an 11W CFL bulb give similar light outputs. While CFLs generally have a higher purchase cost, they benefit from lower running costs. A CFL bulb will typically last 10,000 hours; a GLS lasts for only a tenth of that. Assuming a purchase price of €3 for the CFL, €0.50 for the GLS and €0.10 per kWh for the electricity, the total cost of buying and running the GLS for its whole lifetime would be €6.50, whereas it would be €14 for the CFL. However, you would need ten GLS bulbs to provide the same amount of lighting time as one CFL. Therefore, the real comparative costs are €65 for the GLS bulbs and €14 for the CFL – almost five times less.

Data from UK Defra Market Transformation Programme Briefing Note on Domestic Lighting BNDL01 www.mtprog.com



©Image Source

## Other environmental assessments

In contrast to the life cycle approaches described earlier that focus on a product, other environmental assessments concentrate on a specific site, organisation or chemical substance. However, Life Cycle Thinking and Assessment can be used in these to provide complementary information.

### Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA)

Environmental Impact Assessment is a technique for estimating the potential impacts a project may have which offers credible information to decision makers. It is defined by the International Association for Impact Assessment (IAIA) as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made". It is applicable to any scale of project, but is mostly used for large scale works, such as infrastructure construction, roads, airports, town enlargements and so on.

Strategic Environmental Assessment is a similar technique, but more appropriate for assessing the impacts of new or changing polices and strategies.

In both EIA and SEA, Life Cycle Thinking and Assessment can provide complementary information. They can be used to help assess the different options for the goods and services that are associated with plans, policies, and strategies. Both EIA and SEA are required under EU legislation for certain projects and programmes likely to have significant impact on the environment.

http://ec.europa.eu/environment/eia/home.htm

### Environmental Management Systems (EMS)

Organisations use Environmental Management Systems to continually monitor and assess their environmental performance, and subsequently put in place plans to improve it. This information can be publicised through company environmental and corporate social responsibility (CSR) reporting. The two best known EMS schemes are the ISO 14001 and the European Eco-Management and Audit Scheme (EMAS).

EMAS is widely known for focusing on the direct impacts that organisations have and for continual improvement of these impacts. These can include energy used in heating and lighting buildings, fuel used in transport and logistics or waste produced in a manufacturing process. EMAS also requires the organisation to assess and address its indirect impacts through the goods and services it consumes. Once data have been gathered, a course of action can be drawn up to reduce, monitor and review these impacts and, generally save costs. The indirect impacts are best addressed using information based on life cycle assessments for the goods and services consumed and produced.

http://www.iso.org/iso/iso_14000_essentials
http://ec.europa.eu/environment/emas/about/summary_en.htm

### Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

REACH is the European Union's chemicals policy. The purpose of REACH is to reduce the impact of chemicals on human health and the environment through a better understanding of the properties and effects of chemicals. It also demands the substitution of the most toxic chemicals with safer alternatives, as and when they become available. Life Cycle Assessments could be used effectively to support the comparison of different alternatives that serve the same functional purpose.

http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

19

# Getting started

*This section looks at the steps involved in putting Life Cycle Thinking into practice.*

Typical first steps for businesses can include:

- Conducting a screening of the company's product portfolio to identify those goods and services that contribute most to environmental burdens. This will depend on both the emissions per product over the entire life cycle , the resources consumed and the number of products sold;

- Identifying which life cycle stages contribute most to the overall environmental impact of a particular products. For this, it is necessary to break down the results into relevant stages along the supply chain as well as to consider product use, re-use, recycling and ultimate disposal;

- Identifying options for improvement, as well as possible "win-win" situations where reducing the environmental impact of products can come with cost saving opportunities (identification of "low hanging fruit"). Complementing environmental information with cost data often delivers a double benefit. Using an environmental profile as the baseline for comparisons, companies can, for example, introduce changes in production processes or substitute material or energy sources and look at how this affects the environmental performance over the life cycle.

In public administrations, similar steps will be required, such as:

- Establishing environmental criteria in public procurement procedures. This requires an analysis of the main goods and services purchased by public authorities, including an evaluation of the key environmental impacts throughout the life cycle of the product options. Policy makers can build on work carried out by the European Commission on the EU Ecolabel scheme and Green Public Procurement;

- Defining criteria for processes and services eligible for environmental state aid. In this case a Life Cycle Assessment may be beneficial in evaluating environmental performance of options, for example in the area of eco-innovation and waste management;

- Carrying out life cycle-based studies as part of environmental impact assessments can be an essential step in the policy development process. Life cycle-based studies can be particularly helpful in guiding decisions where it is necessary to evaluate various options.

For all these steps, appropriate resources and expertise are essential. Life Cycle Assessment is a multidisciplinary approach requiring skills in different areas, such as knowledge of industrial processes and engineering approaches, technology assessment techniques, and environmental impact assessment.

To get businesses and policy makers started, the Resource Directory of the European Platform on Life Cycle Assessment offers support with the implementation of Life Cycle Thinking and Assessment by providing:

- References and contacts of service providers in the fields of: Life Cycle Assessment, Carbon Footprinting, Environmental Product Declarations (EPDs), Design for Environment (DfE), Design for Recycling (DfR), ecodesign (Ecodesign Directive), environmental labels (EU Ecolabel, Nordic Swan, Blue Angel etc.), Green Public Procurement (GPP), supply chain management and other topics;

- Lists of commercial and free-of-charge life cycle-related databases;

- Lists of commercial and free-of-charge life-cycle-related software tools;

- Life Cycle Assessment results from published studies, including ecodesign and ecolabel criteria.

Businesses and policy makers can also consult the International Reference Life Cycle Data System (ILCD Data Network) and the European Reference Life Cycle Database (ELCD) for emissions and resource consumption data for products and processes. Guidance on methodological issues can be found in the ILCD Handbook.

For more details on these resources, visit: http://lct.jrc.ec.europa.eu

Other useful links:

EU Ecolabel: http://www.ecolabel.eu/

Green Public Procurement : http://ec.europa.eu/environment/gpp/index_en.htm

EU guidelines on state aid for environmental protection:

http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:082:0001:0033:EN:PDF

## Life Cycle Thinking in Business – different levels of ambition

### Increasing levels of ambition →

| | Internal environmental commitment and readiness | Environmental profile for a greener product | Marketing a greener product |
|---|---|---|---|
| Goals | Select initial areas for environmental improvements | Implement the most obvious environmental improvements | Documentation of most important environmental impacts |
| Survey & Analysis | Overview of life cycle phases, legal requirements, etc | Simplified environmental assessment and user survey | ISO LCA or product-specific ecodesign and market survey |
| Cooperation | Contact with relevant partners | Cooperation with suppliers on documentation and environmental improvements | Common routines for exchange of experience in the product chain |
| Results | Respond to enquiries about a product's environmental profile | Conform to environmental criteria, for example public procurement guidelines | Marketing of the product's environmental characteristics |

### Life Cycle Thinking in Business. Case study: Making cars more sustainable

Over the past two decades, car manufacturers have become more concerned about the environmental impacts of their products. There is a growing desire to understand and reduce impacts for financial, environmental, and reputation reasons. Some manufacturers have developed their own indicators as internal management tools for assessing the sustainability of operations and vehicles.

Various manufacturers evaluate how their vehicles can be improved at the design stage to meet targets on environmental, social and economic impacts, using a life cycle approach. The parameters used include climate change, safety and life cycle costing. These can be evaluated against each other in a spider graph format, which shows the evaluation for different models. This has resulted in a more holistic approach to vehicle design and an improved capacity to report environmental performance to consumers and government taking into account their full life cycle.

©Shutterstock
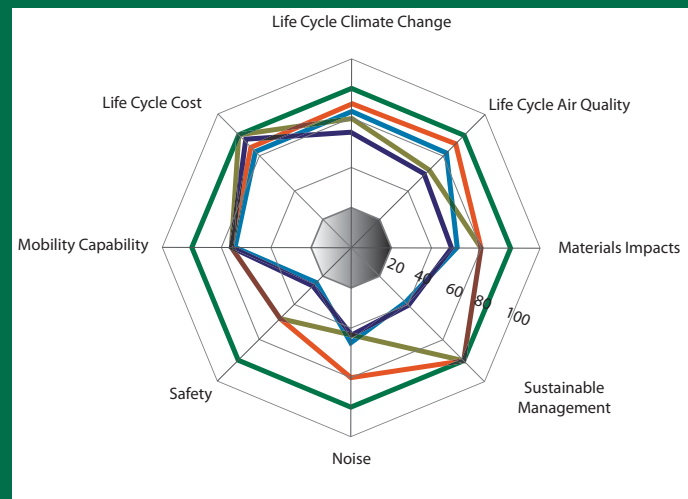
**Life Cycle Thinking in policy-making**

**Case study: Life Cycle Assessment of nappies, UK Environment Agency**

With the increasing profile of municipal waste management in the UK, and the need to reduce landfilling, attention has been drawn to the use of disposable nappies and their presence in the municipal waste stream. This awareness has led a number of local authorities and Non Governmental Organisations (NGOs) to promote the use of cloth nappies, with the objective of reducing municipal solid waste. In response to this, the UK Environment Agency commissioned a peer-reviewed Life Cycle Assessment of the use of nappies in the United Kingdom.

The assessment was conducted with the support of an advisory board, including representatives from government, industry and NGOs. The assessment highlighted that the environmental impacts of both disposable and reusable nappies are largely equal, although the impacts of the latter are highly dependent on the way they are laundered (washing temperature and use or not of tumble drying). Moreover, the environmental impact of nappy use is relatively small when compared to other household activities.

# Ensuring quality and consistency: recommended methods and data

*To undertake a life cycle assessment you need methods and data.*

## ISO standards

The general principles and requirements for conducting a Life Cycle Assessment are set out in the ISO standards 14040 and 14044. These describe the four phases of a Life Cycle Assessment and outline the elements that need to be considered for each phase. They also specify the reporting and verification needs to facilitate understanding and enhance the credibility of the assessment. This ensures that the reader of the final report is provided with enough information to make sound decisions.

It is important to keep in mind that the ISO standards are built on international agreements but they do not go into every technical detail and are not very prescriptive. They provide a general framework which can sometimes result in two ISO compliant LCAs giving different results. For this reason, a number of guidance documents and handbooks have been published to provide additional guidance for quality assurance and coherence.

## International Reference Life Cycle Data System (ILCD)

The International Reference Life Cycle Data System (ILCD) has been developed based on existing practice and through broad consultation between several partners and is coordinated by the Joint Research Centre of the European Commission. The ILCD, which is fully compatible with ISO standards, principles and guidelines consists primarily of a Data Network and a Handbook. The European Commission has developed the ILCD to provide an authoritative basis to support the increased availability of coherent and quality-assured Life Cycle Assessments, methods, and data.

## ILCD Handbook

As part of this system, the ILCD Handbook is also in line with the ISO standards, principles and guidelines. It consists of a set of documents, including:

- General technical guidance on Life Cycle Assessment;
- Guidance for generic and average Life Cycle Inventory (LCI) data sets;
- Guidance for the framework and requirements of Life Cycle Impact Assessment (LCIA);
- Guidance for reviews in Life Cycle Assessment.

## ILCD Data Network

The ILCD Data Network is a non-centralised and web-based network that brings together consistent and quality-assured life cycle emission and resource consumption data from different sources. These data sets comply with requirements related to the ILCD Handbook. All data providers can join this network free of charge and give access to data under their own terms (for free, fee, members, etc). Consistency and quality assurance enables data from different sources to be used in one study without creating discrepancies and helps to reduce costs for users.

## European Reference Life Cycle Database (ELCD)

The European Reference Life Cycle Database (ELCD) provides life cycle emissions and resource consumption data from EU business associations and other sources for selected key materials (such as plastics, metals and chemicals), energy carriers, transport, and waste management services. These ELCD datasets are available free of charge. Data from the ELCD will be an input to the ILCD Data Network.

http://lct.jrc.ec.europa.eu

**European Platform on Life Cycle Assessment**

The ILCD Handbook, Data Network and the ELCD have been developed under the European Platform on Life Cycle Assessment (LCA). This Platform was established by the European Commission to support Life Cycle Thinking and Assessment in business and policy. The Platform includes a Forum for discussion and a Resource Directory. This Directory provides comprehensive information on LCA services, tools, databases and providers on a global scale, as well as on existing assessments and related ecodesign and labelling criteria.

25

# Making sustainable consumption and production a reality

In summary, the way we currently produce and consume goods and services is unsustainable and contributes significantly to many of today's environmental problems.

The Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan aims to improve overall environmental performance throughout a product's life-cycle, promote and stimulate demand for better products and production technologies, and help consumers make better choices through effective labelling.

To implement this policy effectively, consistent and reliable data and methods are needed to assess the overall environmental performance of products. Such methods must be cost-effective and easy to apply for both public administrations and businesses. As described in this brochure, this is where Life Cycle Thinking and Assessment can play an increasingly important role.

### Better Products

The Ecodesign Directive ensures that manufacturers consider energy use and other environmental impacts during the conception and design phase of a product. It lays down a method for setting ecodesign requirements based on the life cycle of a product. The Directive has been extended to include energy-related products. This now covers products which do not necessarily consume energy during use but which have an indirect impact on energy consumption, such as water-using devices or windows. Life Cycle Thinking and Life Cycle Assessment provide the framework and methods to investigate energy and environmental impacts that help define the implementing measures for ecodesign.

### Leaner production

Businesses can make more sustainable products by using less material resources and by encouraging the use of recycled materials. Life Cycle Thinking and Assessment can help trigger innovation in processes and technologies that will lead to less resource use and lower environmental impacts. Life Cycle Thinking can also help point to those natural resources which could be used as substitutes and what the resulting environmental improvements would be.

The EU Eco-Management and Audit Scheme (EMAS) is an essential tool for making more effective use of resources and reducing environmental impacts of businesses and organisations. Life Cycle Thinking and Life Cycle Assessment help address these aspects in a systematic and scientifically robust manner, taking into account the environmental impacts associated with goods and services consumed, as well as produced, by an organisation.

### Smarter Consumption

Consumers can play an important role in protecting the environment through the choices they make when buying products. However, if they are to make the best environmental choices, they need to be well-informed. Life Cycle Thinking and Life Cycle Assessment are at the heart of the EU Ecolabel; the criteria which products have to meet typically cover the entire life cycle. By considering consumption needs and choosing EU ecolabelled products, consumers are contributing to sustainable consumption.

Public authorities also have a key role to play as one of the most significant consumer groups. Green Public Procurement (GPP) requires the introduction of environmental criteria in the tendering procedures for goods and services. Life Cycle Thinking and Life Cycle Assessment can play an important role in this decision making process.

In conclusion, Life Cycle Thinking and Life Cycle Assessment are already playing a key role in EU policies on sustainable consumption and production and will continue to be an essential factor in policy making in the future.

# Some important terms

**Life Cycle Thinking (LCT)** is the consideration of the potential environmental impacts that a product can have during its life cycle; from extraction and processing of raw materials, through manufacturing, distribution and use, to recovery or recycling and disposal of any remaining waste.

**Life Cycle Assessment (LCA)** is the process of quantitatively evaluating the environmental impacts of a product over its entire life period.

**Cradle to Grave** covers the complete life cycle, from the initial extraction of raw materials to final disposal.

**Farm to Fork, Gate to Plate** (from agricultural production to consumption), **Well to Wheel, and Tank to Wheel** (from fuel extraction to combustion in vehicles), similarly conjure up an image of what stages of the life cycle are being presented.

**Environmental impacts, burdens, or pressures** broadly refer to the consequences that may be caused by emissions, discharges and releases to the environment as well as the resources consumed over a product's life cycle. There are many categories of environmental impacts to consider, such as impacts on the climate from greenhouse gas emissions (GHG); contributions to pressures on aquatic ecosystems from chemical emissions; and the availability of natural resources both now and for future generations.

A **Carbon Footprint** is the result of a life cycle assessment that is focused on climate change impacts only.

Avoiding **burden shifting** is a key aim of Life Cycle Thinking. This is where the impact on one life cycle stage such as manufacturing or use is reduced by some means, only to be increased or shifted to another category, stage or area. Burden shifting can partially or entirely cancel out a benefit.

To be able to compare products, it is necessary to ensure that the function the products are designed for is comparable. Quantity, quality and timescale need to be considered. For example, when comparing light bulbs, the comparable function, known as the **functional unit** could be the environmental impacts for a bulb, with a given light output in lumens over an agreed period of time. Just comparing bulb A with B can be misleading.

The term **products** includes both goods and services.

# References and further sources of information

**Standards & specifications**

**ISO 14040:2006** Environmental management – Life cycle assessment – Principles and framework

**ISO 14044:2006** Environmental management – Life cycle assessment – Requirements and guidelines

**ISO/TR 14047:2003** Environmental management – Life cycle assessment – Examples of application of ISO 14042

**ISO/TR 14049:2000** Environmental management – Life cycle assessment – Examples of application of ISO 14041 to goal and scope definition and inventory analysis

**ISO/TR 14062**: Eco Design - organisation, planning, tools and the design development scheme for the integration of environmental aspects into the product design and development process.

**ISO 14063**: Environmental Communication – guidance on general principles, policy, strategy and activities relating to both internal and external environmental communication

**PAS2050:2008** Specification for the assessment of the life cycle greenhouse gas emissions of goods and services

**LCA resources and networks**

European Platform on LCA

**http://lct.jrc.ec.europa.eu.** The site includes links to the ILCD Handbook, ILCD Data Network, life cycle related policy activities, the LCA Resources Directory and ELCD database:

UNEP / SETAC Life Cycle Initiative **http://lcinitiative.unep.fr.**

Danish LCA Centre **http://www.lca-center.dk**

German Network on LCI Data : **http://www.lci-network.de**

Australian Life Cycle Assessment Society and National LCA database **http://www.alcas.asn.au/**

American Center for LCA; US EPA Life Cycle Assessment Research; NREL US LCI database

**http://www.lcacenter.org  http://www.epa.gov/nrmrl/lcaccess/index.html**

**http://www.nrel.gov/lci/database/**

Japan Environmental Management Association for Industry (JEMAI) and National LCA database **http://www.jemai.or.jp/english/index.cfm;**

China National Institute for Standardisation (CNIS) and National LCA database:

**http://www.sac.gov.cn/templet/english/ShowArticle.jsp?id=2789**

Brazilian Institute of Information in Science and Technology (IBICT) and National LCA database **http://www.ibict.br**

Thai National Metals and Materials Technology Centre and National LCA database **http://www.mtec.or.th/th/index.asp**

Malaysian National LCA database project : **http://www.lcamalaysia.com/**

**Journals**

International Journal of LCA **http://www.scientificjournals.com/sj/lca/startseite**

Journal of Industrial Ecology : **http://www3.interscience.wiley.com/journal/118902538/home**

Journal of Cleaner Production

**http://www.elsevier.com/wps/find/journaldescription.cws_home/30440/description#description**

*The Europeans Commission takes no responsibility for the content, reliability or credibility of the non-EU websites listed above.*

# Abbreviations

| | |
|---|---|
| **BSI** | UK National Standards Body |
| **CBA** | Cost Benefit Analysis |
| **CFC** | Chlorofluorocarbons |
| **CSR** | Corporate Social Responsibility |
| **EIA** | Environmental Impact Assessment |
| **EMS** | Environmental Management System |
| **ELCD** | European Reference Life Cycle Database |
| **EPD** | Environmental Product Declaration |
| **EuP** | Energy-using Product |
| **GHG** | Greenhouse Gas |
| **GPP** | Green Public Procurement |
| **HCFC** | Hydrochlorofluorcarbons |
| **ILCD** | International Reference Life Cycle Data System |
| **IPP** | Integrated Product Policy |
| **ISO** | International Organization for Standardization |
| **KEPI** | Key Environmental Performance Indicator |
| **LCA** | Life Cycle Assessment |
| **LCC** | Life Cycle Costing |
| **LCI** | Life Cycle Inventory |
| **LCIA** | Life Cycle Impact Assessment |
| **LCT** | Life Cycle Thinking |
| **REPA** | Resource and Environmental Profile Analyses |
| **SEA** | Strategic Environmental Assessment |
| **SETAC** | Society of Environmental Toxicology and Chemistry |
| **SCP/ SIP** | Sustainable Consumption and Production and Sustainable Industry Policy Action Plan |
| **UNEP** | United Nations Environment Programme |
| **WBCSD** | World Business Council for Sustainable Development |
| **WRI** | World Resources Institute |

Copies of this publication are available free of charge from:

European Commission
Directorate-General for the Environment
Information Centre (BU-9 0/11)
B-1049 Brussels

http://bookshop.europa.eu

Photo credits:

Cover page: Photodisc , Shutterstock

Publications Office