FACT SHEETS

Carbon Footprinting & LCA

The Industry Council for Packaging and the Environment

Introduction

Lifecycle assessment (LCA) quantifies the environmental burdens associated with a product, process or activity over its entire lifecycle, from production of the raw materials to disposal at end of life. It generates a series of lists of materials and energy, and environmental impacts. These cannot be added together into a single number because they are measures of very different things .

"Carbon footprinting" is a newer, measurement system of a small selection of parts of a complete LCA. Whereas LCA covers all quantifiable environmental impacts associated with the product, a carbon footprint covers just greenhouse gas emissions. A single unit of measurement is used, carbon dioxide equivalent, and a single value obtained.

This makes carbon footprint results much easier to communicate than LCAs, but the results are not as clear cut as they seem. Many assumptions have to be made in making an LCA or a carbon footprint calculation, and the results are never precise or consistent enough to enable fair comparisons to be made between alternative products.

Carbon footprinting does help companies identify "hot-spots" where emissions are highest, but carbon isn't the only sustainability indicator – water consumption, efficient land use, animal welfare and resource conservation can be at least, and in some circumstances, more important.

Neither LCA nor carbon footprinting produce truth, but they do provide insight, and can be used as part of "lifecycle thinking". Lifecycle thinking isn't a measurement procedure, it's a state of mind, to help companies operate as sustainably as they can.

What is a carbon footprint?

A carbon footprint represents the total emissions of carbon dioxide (CO2) equivalents from whatever source is being measured, within a defined system boundary.

Everything has a carbon footprint, and the "system boundary" describes the scope of what is being measured. For example, a carbon footprint may be assigned to

- **a person or household** – emissions associated with the energy they use to heat their home, to power their appliances and drive their cars, the emissions involved in producing all the products they use and getting them to the point of sale, the emissions associated with the waste they produce, and their share of the emissions from the public transport and other services they use [see for example the INCPEN publication ***Toward Greener Households*** which looks at the energy cost of packaging in the context of other household purchases and activities]
- **a product** – emissions associated with the entire lifecycle, from mining raw materials or raising animals for food, through the various stages of processing to the packaging and transport involved in getting the finished product to the point of sale, and then on to final use and disposal

- **a production plant** – emissions associated with all of the plant's operations
- **a business or organisation** – the emissions associated with everything it does, from producing products or services to heating and lighting its offices and its business travel.

Although we talk about "carbon footprint" it is actually the emissions of all the gases, including carbon dioxide, but also nitrous oxides and methane that have a Global Warming Potential (GWP).

These are added together and expressed as CO2 equivalents (CO2e). As part of its scientific assessments of climate change, the Intergovernmental Panel of Climate Change has published reference values for GWPs of several greenhouse gases, which measure their relative ability to trap heat in the atmosphere. For instance, methane has a GWP 25 times greater than that of CO2.

Why calculate carbon footprint?

With growing concern about the sustainability of modern lifestyles, there has come a demand for companies to measure and disclose the environmental impact of what they do. The two fundamental environmental issues are climate change and greenhouse gas emissions, and depletion of the earth's resources. Carbon footprinting addresses the first of these.

A number of companies have experimented with carbon labelling some of their products, and in France it is proposed that carbon labelling or some other form of carbon declaration should become mandatory. However, an on-pack carbon footprint value may not help the consumer because:

- There is little point in looking at the carbon label on shampoos and presumably choosing the lowest, because more than 90% of the carbon emissions depend on how much hot water is used to wash your hair.
- Some products' carbon value is constantly changing. Foodstuffs may be brought in from different places according to the season, and computers may be assembled from components bought in from different parts of the world as costs or exchange rates fluctuate.
- For raw materials bought in by suppliers (or by suppliers' suppliers), the only practicable option may be to use published secondary data and industry averages. But you can't compare alternative products if most of the data comes from industry averages. In any case, different data sources will yield different numbers. The carbon footprints of polyethylene range between 1kg and 3kg of CO2e per kg of polyethylene, depending on the efficiency of production plant.
- A carbon label can't be used to compare alternative products of the same type, because different ways of calculating the data yield very different results – for example, companies make different decisions on how to divide their total emissions between the various items in their product range. See ***Environmental Labelling***
- The results will be greatly distorted by the nature of the energy supply in the producing country. Anything produced in France, where more than 75% of electricity is generated from nuclear power, will have a much lower carbon footprint than an equivalent product from the UK, where nuclear energy accounts for less than 15%.

Carbon footprinting is much more useful as a way of helping companies identify "hot-spots" where emissions are highest and where attention needs to be focused.

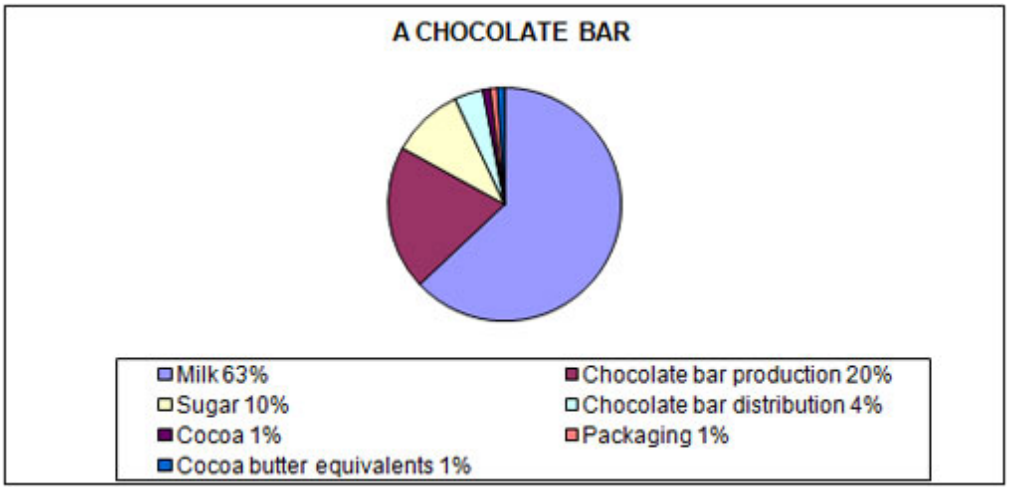
This can be done by measuring the footprints of their own operations, where they can be sure of the comparability of the data. Which factories, processes and products have the lowest carbon footprint, and why? What can be done to bring everything up to the level of the best?

They can also use their own data and secondary data from published sources to work out what stage or stages in the lifecycle are responsible for the majority of emissions. This calculation doesn't need to be precise, as the orders of magnitude will usually be clear.

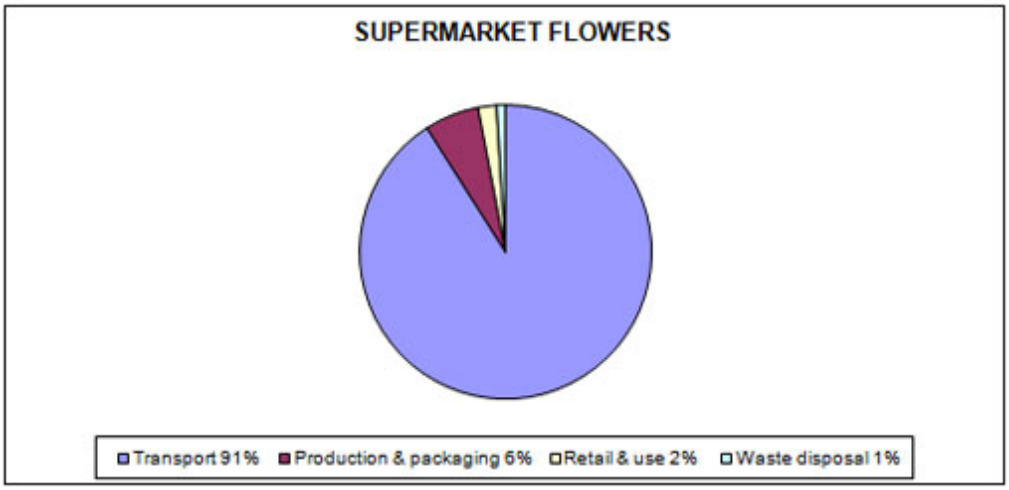
But since carbon footprinting only tells part of the story as regards corporate social responsibility, environmental impact and sustainability, a company practising "lifecycle thinking" may find that it is better to make changes that raise its carbon footprint. Intensive rearing of poultry and livestock is far more carbon-efficient than more humane methods of animal husbandry.

Carbon footprinting and lifecycle thinking

Companies may find it easier to drive carbon out of the system by working with suppliers than by making changes in their own operations. They need to ask which stage is most carbon-intensive, where are the opportunities for change, and where can savings be made most cost-effectively? To take two published examples:



The chocolate bar manufacturer's own operations account for 24% of the carbon footprint. In total, 61% of the carbon impact comes from agriculture, 31% from manufacturing the chocolate and its ingredients, and 8% from transport (only half of which came from importing ingredients from across the world). So it makes sense for the chocolate manufacturer to look first at ways of helping to promote sustainable agriculture.



In the case of supermarket flowers, a relatively small improvement in the transport arrangements would make far more difference to the carbon footprint than anything that could be done at the retail stage.

Lifecycle assessment

Carbon footprinting is a sub-set of a full lifecycle assessment (LCA). LCA, which has been around for about 30 years, is a method of systematically assessing the environmental burdens associated with a product, process or activity over its entire lifecycle.

An ISO standard (ISO 14040) defines the various stages involved in carrying out an LCA:

- First, the purpose of the study and the systems to be studied have to be identified. That includes setting the system boundaries – for example, will the study cover every part of the supply chain, or only those under the direct control of the company commissioning the study?
- Then an inventory analysis has to be conducted. All materials and energy used and all emissions and wastes released to the environment are identified and quantified over the whole life cycle of the product (from raw material extraction and processing, through manufacture, use and end of life).
- An impact assessment analyses the environmental significance of the inputs and outputs identified in the inventory analysis.
- Finally, in the interpretation stage, results are analysed, limitations explained, conclusions made and recommendations provided.

Although LCA is at first sight a robust form of environmental accountancy in which the main difficulty is interpreting complex findings, in reality there is a high level of subjectivity. Subjective decisions have to be made on:

- system boundaries – which operations or impacts are to be covered by the study and which should be excluded? A

more comprehensive study may be less robust if it incorporates issues where the data is uncertain. Also, the more parameters covered, the more difficult it is to interpret the results
- allocation of inputs and outputs between the product studied and other products made in the same place or used at the same time. If allocation is based on cost, and the product studied represents 60% of total costs, then it could be allocated 60% of the relevant impacts. If allocation is based on weight, and the product studied represents 40% of total weight, then it could be allocated just 40% of the impacts
- the functional unit, the basic unit of measurement. It could, for example, be 1kg of milk from the farm, 1litre of milk from the supermarket or a typical consumer's daily intake.
- which sources of secondary data to use.
- the assumptions to be made on issues such as transport distances, how the electricity used has been generated and how recycling is credited against production impacts
- how the various impacts should be weighted (the relative importance given to water and energy use, resource conservation versus pollution avoidance, etc).

There are also high levels of inherent uncertainty with environmental impacts such as toxicity, resource use, acidification and eutrophication, and LCA cannot cover unquantifiable impacts such as biodiversity.

LCAs are time-consuming and expensive, but comprehensive carbon footprinting may not be much cheaper.

The European Commission's Joint Research Centre (JRC) recommends that if organisations are developing carbon data, it makes sense to evaluate non-greenhouse gas emissions at the same time. The in-house effort is only slightly higher.

Uses of lifecycle assessment

Manufacturers can use LCA to model the impacts of a change in production methods or packaging materials. What effects would a new packaging format have on energy consumption in production and distribution, material consumption, air and water pollution and waste generation?

This can be a very complex issue, but with narrow system boundaries LCA can answer very simple and straightforward questions. For example, it has been used to determine whether there were better alternatives for supermarkets than the four-pack trays of apples (expanded polystyrene trays with a outer layer of clingfilm) often used.

The study found that selling apples loose resulted in over 25% more overall waste, because the fruit was much more likely to be damaged without the protection provided by the packaging. On the other hand, selling apples loose generated less non-biodegradable waste.

More problematic is the use of LCA to compare alternative products. These may be commissioned by interested parties or by policymakers. Because of all the decisions and assumptions that have to be made, different studies rarely produce genuinely comparable data, and the results are almost invariably contestable.

Sources

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Summer 2010