ARE YOU CLEAR ABOUT **Embedded Carbon and Product Carbon Footprints**

EMBEDDED CARBON:

Embedded carbon is a generic term used to describe the range of greenhouse gas (GHG) emissions associated with the production of a product.

The development of a product carbon footprint provides an opportunity to understand in detail the embedded carbon of a product and in particular the stages of the product lifecycle that cause the most GHG emissions.

PRODUCT CARBON FOOTPRINT:

A product carbon footprint measures the GHG emissions at each stage of a product's life and includes:

- Extraction, production and transportation of raw materials,
- Processing of raw materials,
- Manufacture or service provision, assembly and packaging,
- Distribution (transport, storage and handling),
- Consumer use,
- End of life treatment and disposal of a product.

At each stage GHG emissions can result from sources such as energy use, transportation fuel, refrigerant losses from air conditioning units and waste treatment and decomposition.

Clear About Carbon
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PRODUCT CARBON FOOTPRINTS – CONSIDERING THE PRODUCT LIFE CYCLE STAGES:

Activities to be considered when identifying relevant carbon emissions:

Raw Materials

- Includes all inputs used at any stage in the life cycle.
- Includes processes related to raw materials such as mining/extraction, farming, forestry, pre-processing, packaging, storage and transport.
- Accounts for the impact of raw materials such as fertilisers (in their production, transport and application) and land use change.

Manufacture

- Includes all activities from the collection of raw materials to distribution such as production processes, transport/storage, packaging and site-related emissions such as lighting, ventilation and temperature.
- All materials produced need to be accounted for including the product, waste, co-products (useful by-products) and direct emissions.

Distribution/retail

- Includes all steps in transport and related storage, retail storage and display and temperature controlled storage

Consumer Use

- Includes energy required during the use phase such as storage, preparation, application and maintenance/repair.

Disposal/recycling

- Includes all steps in disposal such as transport, storage and processing.
- Also includes energy required in the disposal/recycling process, and direct emissions due to disposal/recycling such as carbon decay, methane release and incineration.

LIFE CYLE ASSESSMENT – PAS 2050:

PAS 2050 takes a process life cycle assessment (LCA) approach to evaluating the GHG emissions associated with goods or services, enabling companies to identify ways to minimise emissions across the entire product system.

PAS 2050 follows 5 core principles:

Relevance	Select sources, data and methods appropriate to assessing the chosen product's life cycle GHG emissions.
Completeness	Include all GHG emissions that provide a 'material' contribution to a product's life cycle emissions (including storage).
Consistency	Enable meaningful comparisons in GHG-related information.
Accuracy	Reduce bias and uncertainty as much as is practically possible.
Transparency	When communicating, disclose enough information to allow third parties to make decisions with confidence.

The PAS 2050 methodology is also used to determine the carbon footprint of products which receive the Carbon Trust Label.

Measuring a product carbon footprint using the PAS 2050 methodology consists of 5 basic steps. All steps must be completed to achieve a footprint.

Step 1 Step 1 requires the development of a process map of the product's life cycle, from raw materials to disposal, including all material, energy and waste flows.

When producing a process map, the following issues need to be considered:

- All raw materials should be taken into account. Inputs and outputs, waste processes and transport must be considered for each stage,
- Different methodologies of customer use,
- In many cases recycling should be considered alongside landfill.

Different types of process map can be developed which include the 'business to consumer' model and the 'business to business' model.

The Business to Consumer model involves taking into account the entire lifecycle of the product in question. This will include the consumer's use of the product and any disposal that is required.

The Business to Business model involves measuring the carbon from source to the stage at which the product is distributed to the customer. This method may prove more viable for complex items and allow for a chain of Business to Business models to be created.

Step 2 Step 2 requires the confirmation of boundaries and the development of a high-level footprint calculation to help prioritise efforts. Without appropriate and consistent boundaries, it is difficult to make meaningful comparisons between products.

The key principle for setting system boundaries is to include the most significant emissions. Following this process, it may be necessary to re-visit step 1.

Step 3 Step 3 requires the collection of data on material amounts, activities and emissions factors across all life cycle stages.

Data collection can be the most challenging part of establishing a robust product carbon footprint. Availability of data from organisations in the supply chain may be limited depending on the relationship with them and the level of influence that can be exerted.

The best data to use is primary data collected from actual operations, however this may not be available for all aspects or stages and therefore it is acceptable to utilise secondary data which has been collected in similar situations.

Step 4 Step 4 involves the calculation of the product carbon footprint. GHG emissions factors are used with the collated data to calculate the carbon emissions at each stage of the process map. These emissions figures can then be added together to produce an overall carbon footprint for the product.

A review of the calculations is required to ensure that the proportions of emissions from different stages of the process map are in line with expectations and, where available, comparable product footprints.

Step 5 Step 5 requires an assessment of the accuracy of the footprint analysis. The objective of this step is to identify any areas of uncertainty in the footprint and the extent of that uncertainty

Where uncertainty exists efforts should be made to reduce this. Where this is not possible, the nature and extent of any uncertainty should be explained in any footprint report.

This stage is important because it:

- Enables greater confidence in comparisons between products and in decision making,
- Identifies where to focus data collection efforts,
- Contributes to better understanding of the footprinting model itself (how it works, how to improve it and when it is robust enough),
- Indicates how reliable the footprint is for internal and external users of the information.

Stage 5 is vital to transparency, one of the fundamental principles of a PAS 2050 analysis.

USING PRODUCT CARBON FOOTPRINTS

Product carbon footprints can be used in a number of different ways by organisations.

Informing process and product improvement

Identifying 'carbon hotspots' enables organisations to identify which parts of their processes are most carbon intensive and present the greatest opportunity for improvement. This is also known as 'hot-spotting'.

Hot-spotting can inform emissions reduction activity, which may be achieved through reducing the materials and energy used in production, substituting materials for ones with less embedded carbon, improving the energy efficiency of the product in use, reducing transport and packaging requirements, or making the product easier to remanufacture or recycle.

Examples of organisations that have used product carbon footprints to inform process and product improvement can be found on page 6.

Tracking product related emissions over time

If seeking to track reductions of GHG emissions associated with a product over time it is necessary to establish the carbon footprint of the product at the outset. This initial carbon footprint is often referred to as a 'baseline' carbon footprint against which future carbon footprinting exercises can be compared

In tracking emissions over time it is important to understand the boundaries that have been applied to the initial 'baseline' study and to try and ensure that these are consistent for future carbon footprinting exercises.

In addition some consideration should also be given to the uncertainties surrounding the data. It is likely that some data will become more accurate as experience and understanding of the data measurement and collection processes improve.

Sometimes a recalculation of the initial baseline carbon footprint may be necessary if improvements in data accuracy significantly affect findings.

Using carbon footprints to compare products

One of the main long term aims of using product footprints is to be able to compare one product against another.

Product comparisons may inform a procurement decision or be used as part of a capital investment or project options appraisal. As with organisational carbon footprints, it is important to understand the boundaries that have been applied to any carbon footprint study (what is included and what is not).

In addition some consideration should also be given to the uncertainties surrounding the data.

Carbon Labels

A carbon label is often shown on a product's packaging as a consumer-facing representation of carbon dioxide (CO_2) emissions that are either embodied in a product or released during its lifetime. The first carbon label was introduced in the UK in 2006 by the Carbon Trust.

The use of carbon labels is increasing, especially on consumer goods, although it is still not widespread thus making product comparison difficult.

As demonstrated by the PAS 2050 approach, the development of product carbon footprints and labelling of products can be complex and costly.

INFORMING PROCESS AND PRODUCT IMPROVEMENT:

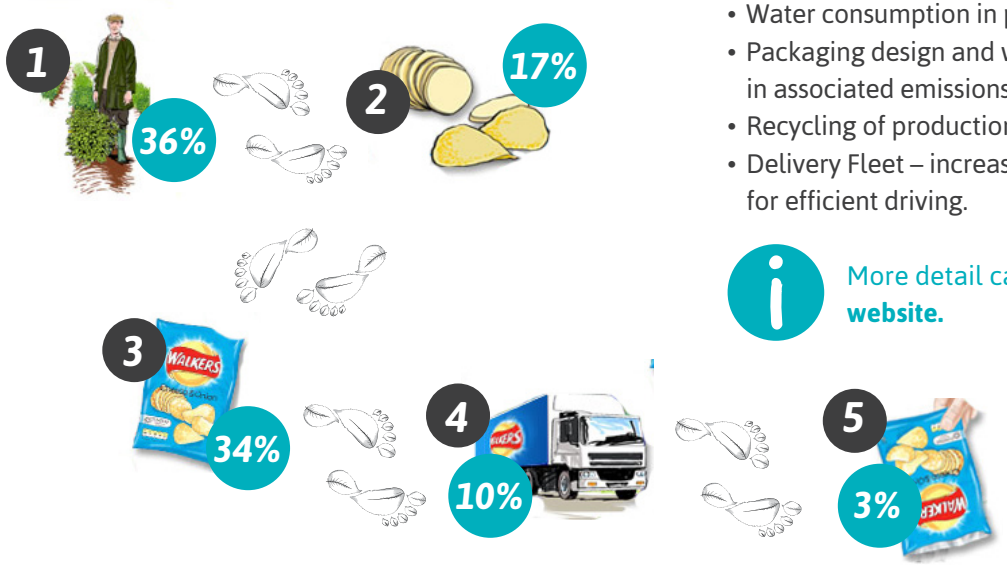
Examples of product carbon footprints

Walkers Crisps

Walkers are one of the companies that have achieved the Carbon Trust Label across much of their product range.

The flow-chart shows exactly what percentage of their carbon footprint is expended at each stage:

1. The raw materials: potatoes, sunflowers and seasoning
2. Manufacture: producing crisps from potatoes
3. Packaging the crisps
4. Distribution: bringing the crisps to point of sale
5. Disposal of the empty crisp packets



In 2009 Walkers reduced their carbon footprint by 7% representing an overall saving of 4,800 tonnes of CO_2 compared to 2007. On a standard bag of Walkers Crisps the saving is equal to 6g of CO_2.

Walkers achieved this reduction by working closely with staff and suppliers to reduce carbon emissions associated with:

- Transportation of potatoes (only using British potatoes),
- Gas and Electricity used in production processes,
- Water consumption in production processes,
- Packaging design and weight - making a 4.5% reduction in associated emissions,
- Recycling of production waste – increased to over 90%,
- Delivery Fleet – increased use of biodiesel and training for efficient driving.

More detail can be found on the **Walkers website.**

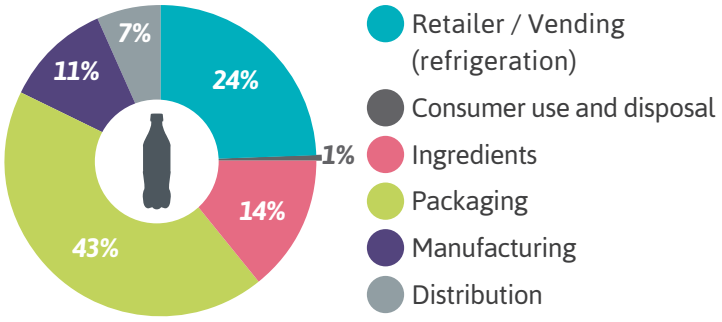
Coca-Cola

Below is the breakdown of the carbon footprint of a bottle of Coca-Cola over the stages of its lifetime.

24.5% of the carbon footprint is as a result of refrigeration at the point of sale. Here, behaviour change has a significant role to play. When we buy a cold drink do we always drink it straight away? Does it need to be sold to us cold?

It is also important to remember that this 24.5% has a direct impact on the energy bills within an organisation. Improving the efficiency of vending machines can reduce both electricity usage and the embodied carbon in the products.

For a 500ml PET bottle of Coke, the carbon footprint for each step looked like this:



Note: figures have been rounded

More information can be found on the **Coca Cola website.**