Counting the Cost of Carbon

Applying practical accounting principles for product carbon footprints

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Introduction

There are many different aspects to building a successful and sustainable carbon management strategy for an organisation. The first step involves creating awareness; individually and as an organisation.

Everything has either a negative or positive impact on the environment. This impact is often referred to as a carbon footprint. Awareness of the size of an organisation’s carbon footprint and the changes that can be made to reduce this impact (through logistics, purchasing options and general operational procedures) are fundamental in developing a sustainable carbon management strategy.

A carbon footprint within the operational boundary (an organisation’s ‘four walls’) is only a small part of the overall carbon management strategy; an organisational carbon footprint needs to progress and include the extended supply chain to encompass products and services offered throughout the organisation. This is a vital step in becoming a carbon neutral organisation.

Engaging in a detailed product footprint analysis is one of the most tangible tasks within a carbon management strategy. It has direct value to the end user, providing valuable information on associated carbon emissions that are released from the direct manufacturing and supply of a product or service.

Many environmentally conscious customers today are looking at minimising their personal carbon footprint through their purchasing decisions. Organisations are seeking to measure, understand and improve their product carbon footprints using life cycle analysis (LCA) methodologies. This is ultimately to gain an edge within a competitive market or industry by gaining visibility of carbon inventory associated with greenhouse gas (GHG) emissions.

An alternative approach is to use accounting principles such as activity based costing (ABC) and economic input output (EIO) to account for carbon. Supply Chain Consulting has incorporated these principles and developed a new methodology to allocating carbon emissions to processes and products, the Carbon Allocation Process (CAP) methodology.

This document describes the concepts of traditional life cycle assessments and its pros and cons. It will also discuss the new developed carbon allocation process and the benefits of this approach.

**Counting the cost of carbon emissions – The Takeaway:**

- Measurement and awareness of a carbon footprint is fundamental to developing a sustainable carbon management strategy
- Environmentally conscious customers are minimising their personal carbon footprint through purchasing decisions
- As yet, there is no internationally accepted standard for defining the extent of a product or service’s life-cycle
- For a full carbon footprint to be measured, emissions must be calibrated for each stage of a product or service’s life-cycle
- With businesses outsourcing manufacturing operations it is likely that the extended supply chain emissions will account for the majority of total carbon footprints
- Visibility of carbon inventory enables organisations to understand how and where product and service activities generate GHG in order to minimise emissions in an ongoing and financially sustainable way
- Counting the cost of carbon emissions identifies the most effective GHG reduction opportunities. This drives improved asset utilisation, increased materials and energy efficiency, as well as the development of new products and services that reduce the GHG impacts of customers or suppliers.
The premise of a traditional Greenhouse Gas - Life Cycle Assessment (GHG-LCA) is to detail the associated emission activities from a service or product in order to either work on mitigating emissions or establishing a strong environmental profile within a sector.

A product carbon footprint following the life cycle concept means that it is all-encompassing and includes all possible causes that give rise to carbon emissions. Simply, a GHG-LCA includes all GHG protocol scope 1, scope 2 and 3, indirect emissions from all product-associated materials, processes, services and facilities required to manufacture and/or deliver a product or service (Figure 1)³.

In the past, due to the time-consuming and costly efforts to collect the direct and indirect emissions, businesses have been reluctant to perform GHG-LCAs. However, due to new legislation, emission trading schemes and the change in purchasing habits by consumers and suppliers, organisations are realising the need to use GHG-LCA as part of their product positioning within a more competitive – and ‘greener’ – market.

Product carbon footprints provide a variety of potential benefits to organisations that engage in a GHG-LCA. They:

- provide a comparison among products
- improve overall environmental performance
- justify environmental marketing claims
- develop strategic or tactical goals
- enhance brand positioning
- provide a competitive advantage through ‘green labelling’
- identify potential cost savings
- help plan for product or service consumer offsetting options (offset the carbon the cost).

A carbon footprint is expressed as a CO2 equivalent (CO2-e), which accounts for the global warming potential of the six Kyoto greenhouse gases. Carbon footprints can be calculated using a variety of GHG methodologies¹-³.

There are challenges in performing any carbon product or service footprint as there is, as yet, no internationally accepted standard for defining the life-cycle ‘boundary’. However the ISO 14040/14044 and BSI PAS 2050 offer guidance on moving beyond immediate organisational boundaries and into the extended supply chain to account for a product or service carbon footprint ¹, ⁴, ⁵.
Overview of the traditional GHG-LCA approach

There are four major steps when performing a GHG-LCA:

1. Defining the scope and goals
2. Conducting a life cycle inventory
3. Performing a general impact assessment
4. Providing an opportunity evaluation

**Step 1 – Defining the scope and goals**

The most critical component to define when performing any LCA, establishing a clear and concise scope and goal, involves defining and describing the product or process activities being investigated as well as the aims and context in which the GHG-LCA is to be controlled. This ‘planning phase’ identifies the boundary and stages of the product or service activities which is examined.

A well defined boundary is critical in obtaining meaningful results as it forms the basis from which the LCA is carried out and provides a framework for comparison between similar products and measurement indicators. For the purposes of this paper, the CO2-e per product is the key indicator being measured; however this can be broken down against the six GHG Kyoto gases if required.

It is important to establish the scope and goal of the GHG-LCA for a pre-defined product functional unit. A poorly defined goal or scope will directly affect the value and quality of information obtained in product or process carbon footprint and can greatly affect the carbon value associated to the functional unit.

**Defining the goal involves identifying the intended application and reasons for the GHG-LCA:**

- For whom is the product or process footprint intended?
- Is the study to be comparative or disclosed?

**Scope determines:**

- what product or product system is being analysed
- what environmental impact categories are considered
- what function of the product and what other assumptions are being made.

**There are four major boundaries (scope settings conventionally used (Figure 2) 4, 8:**

a. **Cradle-to-grave.** Also known as a full GHG-LCA, a cradle-to-grave GHG-LCA is the assessment from raw materials (cradle) to use phase and disposal (grave). A typical cradle-to-grave GHG-LCA incorporates raw materials, manufacturing process, distribution and recycling of the product, all the way through to final disposal to landfill or incineration.

b. **Cradle-to-gate.** Cradle-to-gate GHG-LCA is a partial assessment GHG-LCA. The analysis typically includes sourcing of raw materials (cradle) and manufacturing process but excludes all activity outside of the manufacturing factory (gate (1)) or sale of goods (gate (2)).

c. **Cradle-to-cradle.** Cradle-to-cradle is a specific full GHG-LCA. It incorporates the full GHG-LCA approach for one product only. Typically the point of recycling into a secondary product is not included.

d. **Well-to-wheel.** Incorporates all the transport emissions associated with the distribution of goods, it includes the emissions from fuel supply (well) through to consumption (wheel).
Step 2 – Conducting a life cycle inventory

Taking a life cycle inventory (Figure 3) requires all the GHG emission inputs and outputs for a product or service to be identified, as well as identifying all the internal activities that are directly associated to the product or service. The inventory requires identification and assignment of emissions for each stage of the product or service; from resource collection, transportation and assembly to use and disposal. Within each stage, the relevant life-cycle carbon emission data must be found within GHG-LCA databases or emission workbooks. These are the process steps that go into the creation of the individual product or service.

Step 3 – General impact assessment

Once all of these data points are collected a product footprint is able to be calculated and a general impact assessment of the product can be made. Data output and assumptions are examined. The trade-offs among different environmental factors, if more than one is modelled within the scope, are then identified and understood.

The data is assessed against the initial goals and scope to establish if the objectives have been met. If not, additional work will need to be done which could include more data collection or, more likely, a modification to the scope and goals that better narrows what exactly is being assessed.

Step 4 – Opportunity evaluation

Once the goals and scope are satisfied, the product or process carbon footprint can then be evaluated to highlight opportunities to reduce or mitigate the environmental impact of the product or service (functional unit). The areas with the highest emissions within the inventory indicate opportunities for significant overall reductions.

Pros and cons of traditional GHG-LCA

Pros
- Information from GHG-LCA can be used as part of a larger decision making process
- Ideal for modelling single products
- Many databases of information are available with environmental indicators

Cons
- One GHG-LCA can only be compared to another GHG-LCA if there are consistent assumptions and context between them
- Typically does not address economic/social impacts of products
- No accepted methodologies for consistently and accurately associating inventory data with specific environmental impacts
- The data for each of the outputs related to each part of the system boundary is generated from scientific assessments for the general materials and processes being used and not for the specific product being built
- Any change in the product’s materials or processes will require a new GHG-LCA to be conducted to capture this information in the footprint (i.e. a Traditional GHG LCA is static)
- Generally considered expensive and time consuming.

Figure 3. Typical life cycle inventory map
Introduction

Traditional accounting principles of activity-based costing (ABC) or economic input-output (EIO) can be applied to carbon emissions to calculate a product or process footprint. ABC and EIO are well-defined methods that have been modified to account for GHG in GHG-LCA projects. These are both methods that, traditionally, have been used to assign the organisation’s resource costs through activities to produce the products and services provided to its end customers.

They are generally used as a tool for understanding product and customer costs and profitability. As such, this same method can be applied for organisations where cost is equated to carbon equivalence and can be used to support strategic decisions such as carbon abatement, offsets, identification and measurement of process improvement initiatives.

Supply Chain Consulting has applied these principles to a top-down carbon allocation method, as opposed to a conventional bottom-up GHG-LCA approach. This is the Carbon Allocation Process (CAP).

Starting with a company footprint

Where does CAP get the information on emissions? To begin, the carbon emission data comes from the development of a company footprint. A company-level facility carbon footprint gathers the direct and indirect emissions associated within the ‘four walls’ of an organisation. Utility bills for natural gas and electricity use, fuel consumption or miles/kilometres driven for company owned vehicles are among some of the data that is collected and converted using international or regional carbon emission factors. The continued collection and expansion beyond the four walls of an organisation forms the backbone of the emissions data needed to ultimately build an accurate product or service carbon footprint.

Extending boundaries to cover end-to-end supply chain and concept of process carbon footprint

Processes that build a product or provide a service occur not only within the operational boundaries of an organisation but extend across a supply chain. The processes from the supply chain and any external facilities contribute to the overall carbon footprint of an organisation (this is the process carbon footprint within the organisation). Examples of processes are the total transportation of parts to a facility from a vendor or the manufacturing of the cardboard box packaging.

The processes occurring within the operational boundary of a facility are captured via the corporate carbon footprint. However, as part of a successful carbon management strategy, there is a need to go beyond that and start assessing the emissions of the extended supply chain. The supply chain consists of the vendors that are providing services and materials – parts and packaging, storage operations, transportation and logistics services, as well as recycling and waste operations. Each of these organisations has their own GHG emissions which are part of the overall indirect emissions contributing to a carbon footprint for the defined functional unit.

With businesses outsourcing manufacturing operations (outside the four walls of the organisation boundary) it is very likely that the extended supply chain emissions will account for the majority of the total carbon footprint of company products and services. They must therefore be measured to make a complete assessment of a product or service carbon footprint.

To determine the product or service carbon footprint, the facility and process carbon emissions are first captured. Then these emissions must be allocated to specific products or services.
Concept of product carbon footprint through the CAP

**Step 1** – Select a service or product for GHG assessment.
What is the carbon footprint (CO2-e) of a product (per unit qty)?

**Step 2** – Define the extended supply chain for the product or service
What are all the inputs and outputs for the product or service being assessed?

**Step 3** – Calculate company footprint
What are all the inputs and outputs for the product or service being assessed?

**Step 4** – Determine the processes for the product or service and allocate an emission source
Identify all the processes within the facility company and allocate the emissions source data per product or per service such as electricity, water treatment, distribution, stationary fuel consumption.

**Step 5** – Calculate the CO2-e per emissions source per product or per service

**Step 6** – Repeat steps 4 and 5
For each emission source within the facility company footprint, add all the allocated emissions together.

**Step 7** – Repeat steps 4 -6
For each facility/company across the supply chain per unit qty.

**Step 8** – Add all carbon emissions across the extended supply chain to obtain the total carbon emission per product or service.

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Example

The arrival of a single shipment of parts at a factory would have a carbon emission allocation due to the transportation ‘activity’. There would also be a manufacturing ‘activity’ for each specific part. The percentages would correspond to how much of each resource is used by each activity for what is being modeled – the number of parts being transported or the amount of electricity used by a particular manufacturing line are examples.

Each of these activities would consist of functional carbon units (carbon per cost, quantity, volume or distance) and form part of the total product footprint as determined by adding up the emissions associated with each activity performed to produce the product or service.

Depending on the boundary, GHG emission activities associated with the production, sale, use and disposal of the product throughout the product or service life are captured.

The GHG Carbon Dioxide equivalent (CO2-e) impact of any product can be determined by collecting the emissions associated with the direct and indirect activities involved with the product. This CAP model provides a top-down insight into the processes behind the creation of the product and therefore an accurate assessment of the choices in creating the product.

Benefits of the CAP-LCA approach

- Provides visibility of each carbon emission activity which allows for carbon abatement at each emission source (facilities, processes, raw materials used etc.) contributing to the product/service footprint.
- Product footprints can be evaluated based on real-time dynamics in a supply chain and requirements of fluctuating consumer demand.
- Product footprints can be evaluated in mass on a regular basis, rather than statically assessing one product at a time.
- As emissions associated with activities are analysed, changes in the captured emission ‘overhead cost’ will quickly be visible in the product footprint without having to go back through the allocation process.
- Visibility of operational (as opposed to static) process/product carbon reduction opportunities promotes positive environmental reputation and delivers competitive advantage.
- Streamlining the GHG emission process/product reporting process:
  - sets up an auditable reporting mechanism according to local, regional, national or international legislation and/or standards to authenticate process/product labelling.
  - ensures consistent reporting across all facilities/locations both internal and externally with trading partners (i.e. central visibility and reporting platform).
  - reduces the labour cost of greenhouse gas process/product data collection.
  - provides auditable results that enable participation in emission reduction and trading schemes.
- Provides a financially sustainable platform to encourage collaboration between trading partners in establishing true end to end GHG-LCAs.
Conclusion

Gaining visibility of carbon inventory enables organisations to understand how and where product and service activities generate GHG. This provides information that assists them to minimise emissions in an ongoing and financially sustainable way. It extends from both internal activities to the consumption of an organisation's products or services. It is ultimately about incorporating an understanding of carbon data into strategic corporate decision making.

Compiling a comprehensive carbon inventory improves a corporation's understanding of its emissions profile and any potential GHG liability or 'exposure'. A corporation's GHG exposure is increasingly becoming a management issue in light of heightened scrutiny driven by corporate social responsibility agendas and the emergence of government regulations and trading schemes designed to reduce GHG emissions.

Counting the cost of carbon emission identifies the most effective GHG reduction opportunities. This drives improved asset utilisation, increased materials and energy efficiency as well as the development of new products and services that reduce the GHG impacts of customers or suppliers. This then has the potential to reduce operational cost and differentiates the corporation in an increasingly environmentally conscious global society.

About Supply Chain Consulting

Supply Chain Consulting is a global provider of enterprise and environmental software solutions and services. Founded in Sydney, Australia in 1998, Supply Chain Consulting has grown organically and through acquisition, and today has over 400 customers, 500 employees and offices located around the globe.

Supply Chain Consulting delivers innovative business software solutions to meet the needs of today’s enterprises. Supply Chain Consulting’s product portfolio includes SLIM™ mid-market ERP solutions, Viewlocity™ supply chain visibility and optimisation software and CarbonView™, the world’s leading proactive Carbon Management solution.

About CarbonView™

CarbonView™ enables organisations to be socially responsible with an edge in the new carbon economy; an end-to-end solution for proactive carbon management.

CarbonView™ is the only software solution in the world that enables organisations to calculate their carbon footprint, monitor their footprint in real time and use intelligent algorithms to optimise financial objectives with ecological objectives. It follows a world’s first 5-step model for achieving bottom line benefits in a carbon constrained economy, the so-called Carbon Management Maturity Model.
References

9. The Climate Conservancy (TCC), Methodology Summary of the Climate Conscious Assessment, October 2007

Abbreviations

ABC Activity Based Costing
CAP Carbon Allocation Process
CM3 Carbon Management Maturity Model
CO2-e Carbon Dioxide equivalent
EIO Economic Input Output (method)
GHG Greenhouse Gases
LCA Life Cycle Assessment
LCI Life Cycle Inventory

Definitions

Operational boundary – an organisation’s ‘four walls’

Activity based costing (ABC) – a system for assigning costs to products based on the activities they require. In this case, activities are those regular actions performed by a company. Creating, placing and receiving a purchase order is an example of an activity performed inside most companies.