



Product carbon footprinting – How to stay ahead in a carbon-constrained world

Peter J. Nieuwenhuizen, Philip W. Beall and Davide Vassallo

The climate debate has moved beyond the question of whether climate change is happening. The issue is no longer whether there should be limitations on carbon emissions, but when and how these limitations should be imposed. Do you know how much carbon dioxide your company emits to make its products or provide its services? In this article the authors spell out a practical way for companies to respond to all these pressing questions.

The heat is on. The climate debate has now well and truly moved beyond the question of whether climate change is happening or not. Science continues to address the inherent uncertainties of the field and challenge the limits of our knowledge, but societal opinion and perceptions have firmly shifted. No longer are we asking whether there should be limitations on emissions, but when and how. Such limitations, whatever form they take, will affect business by imposing costs or necessitating emission reductions. Climate change, in short, has become a business reality to which companies must react.

As a consequence, business executives are asking themselves questions such as: How should my company prepare for a carbon-constrained world? Do I know how much CO₂¹ my company emits to make the products it depends upon? Do I know how much CO₂ was emitted to produce the raw materials I buy? What is my total financial exposure once CO₂ is fully priced in? And how does my company stack up against others, fulfilling customer demands and requirements?

To help you answer these questions, in this article we will explain:

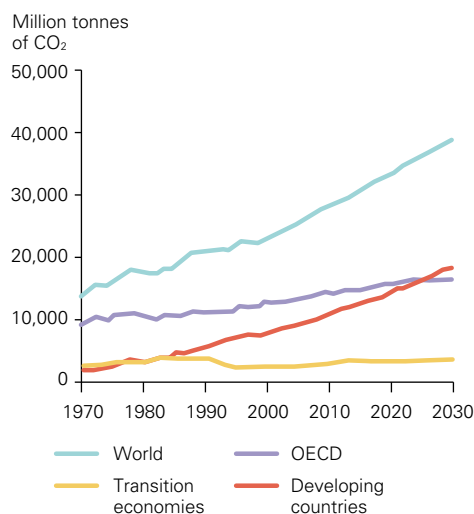
- What is at stake in an era in which carbon emissions are no longer free
- Why companies need to look beyond their own operations to determine their carbon exposure
- What a product carbon footprint looks like, and what is driving its emergence
- How companies can prepare to do business in a carbon-constrained world.

¹ Carbon dioxide, the main greenhouse gas. Whenever we refer to CO₂, we mean "carbon dioxide equivalents" or CO₂e, including the other main greenhouse gases methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons and perfluorocarbons.

What is at stake

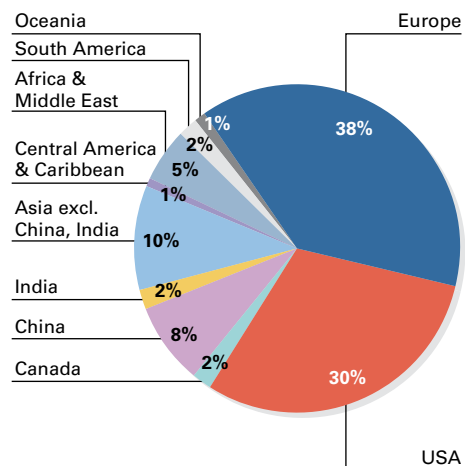
Without action, global emissions are forecast to double by 2030 (Table 1). The Intergovernmental Panel on Climate Change, the advisory body to world leaders, concluded last year that global carbon dioxide emissions would need to fall by 50-85 % by 2050 to prevent average global temperatures rising by more than 2°C. In the short and medium term, much of the emphasis to act will be on the developed economies of Europe, North America, Japan and Oceania. These OECD countries, home to just a fifth of the world's population, are responsible for nearly half of the world's annual CO₂ emissions. Significantly, since 1900 they have caused over 70 % of all CO₂ emitted into the atmosphere (Table 2). Since OECD economies generate nearly 60 % of the world's GDP, it is not difficult to understand why developing economies, even though their emissions are growing rapidly, expect OECD economies to reduce emissions sharply. To "make room" for developing economies and give them their fair share of emissions as they develop their economies, the OECD economies should mathematically reduce theirs by as much as 80-90 %.

Table 1 **CO₂ emissions forecast**



Source: International Energy Agency

Table 2 **Origin of global stock of CO₂ in the atmosphere, emitted between 1900 and 2002**



Source: World Resources Institute

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Indeed, the developed world is taking up the challenge. The EU Emission Trading Scheme (ETS), developed in 2005, is today the world's largest single carbon market. Japan and Australia are looking to implement a similar scheme, and even in the US, where the federal government has been dragging its feet, eight Northeastern states have formed the Regional Greenhouse Gas Initiative, while California is partnering with ten other US and Canadian states in the Western Climate Initiative. All initiatives work to implement a cap-and-trade programme, which will impose a price on carbon emissions.

Estimates about the future price of carbon vary from as low as €25 (\$38) up to €150 (\$220) a tonne, with the consensus on the higher end of the scale. According to the International Energy Agency the cost of carbon dioxide emissions would need to be at least \$200 a tonne, many times today's level of €28 (\$42) a tonne, to deliver the cuts proposed by scientists to avert the threat of global warming. Another trigger for a rise is the €100-per-tonne fine that comes into force this year with phase two of the European Union's Emissions Trading Scheme. It will be imposed on companies that breach their ETS emissions limits, and the companies will have to purchase enough allowances to bring them back into line.

Wherever the price settles, the impact will be substantial. We stand on the brink of a new era in which carbon emissions are no longer free. Given their wealth and emissions, OECD countries are first in line to put a true cost on carbon. At €28 per tonne, Europe's total emissions – 2 billion tonnes in 2008 – are costing some €56 billion, or roughly 0.5 % of GDP (€12.7 trillion in 2008). This will have an impact on every company and consumer in these economies. As the costs for CO₂ emission cascade down the supply chain, there will be winners and losers. Products, processes and services that require few emissions will gain a cost and image advantage over those that require more. Industries will scramble for access to scarce low-carbon resources, driving their price up.

Looking beyond your own company's operations

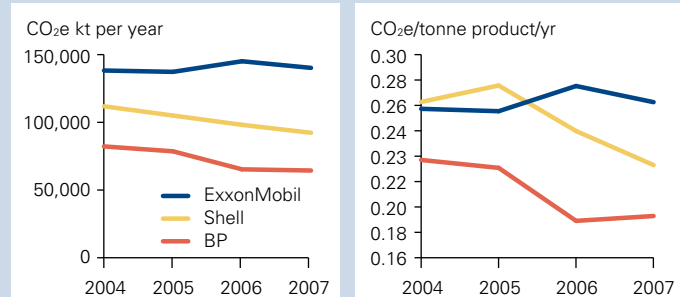
To understand their exposure, companies need first and foremost to know how much carbon is emitted to produce their products or services. The good news is that many companies have already started doing so. Unfortunately, what is best practice today is only the beginning of what is needed to prosper in a carbon-constrained world.

Today, companies typically measure and report carbon emissions on an absolute basis, e.g. by production location, combined by region and eventually by company. This is then reported, for example in company annual reports, or through dedicated initiatives. The not-for-profit Carbon Disclosure Project is the largest such initiative. Besides acting as a repository for company carbon emission information, it provides information to institutional investors with combined assets of over \$57 trillion under management. Thus it is a force to be reckoned with.

To provide additional insight, total company emissions may be divided by total production or sales, to obtain a CO₂ productivity ratio. This type of reporting is becoming more prevalent as companies set CO₂ reduction targets using total production to normalize the ratios. An example is shown in Table 3 for three international oil and gas companies.

The emission reporting initiatives have been developed as a result of joint efforts by business, governments and independent stakeholders, including NGOs. They exist partly

Table 3 **Absolute and relative carbon emissions for three international oil & gas companies**



Source: Annual company sustainability reports

to enable emissions trading and partly to create greater transparency so that companies, as a first step to emissions control, can be benchmarked against each other. The reporting should comply with harmonized standards, the most influential of which are the Greenhouse Gas Protocol, pulled together by the World Resources Institute (set up by the World Business Council for Sustainable Development), and the ISO 14064 standard, compiled by the International Organization for Standardization. The standards are basically equivalent. Both have been set up to create a global, harmonized standard to account for CO₂ emissions. They divide company emissions into three scopes, as shown in Table 4:

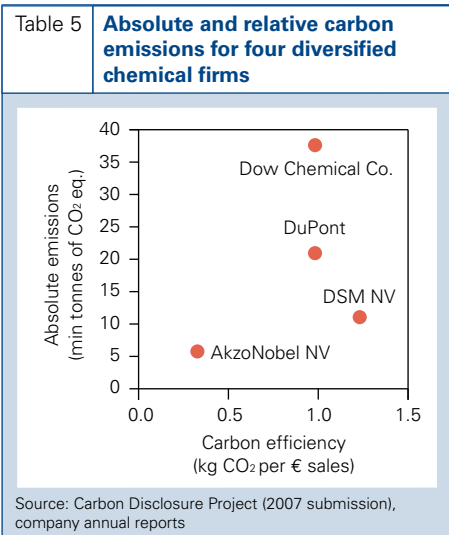
Table 4	Carbon emission scopes according to ISO14064/GHG Protocol definitions
<p>Source: The Greenhouse Gas Protocol: A corporate accounting and reporting standard (revised edition), World Resources Institute, World Business Council for Sustainable Development</p>	

Scopes 1 and 2 broadly correspond to emissions from energy use controlled by the company. Scope 1 concerns direct emissions, e.g. a furnace that a company is operating. Scope 2 relates to indirect emissions, predominantly those from the electricity that is purchased and that has been generated by the combustion of primary fuels like coal, oil or gas. Until very recently, Scopes 1 and 2 were regarded as being the most relevant, and all other emissions were lumped together as Scope 3 and not widely considered.

While it is certainly good to report and minimize Scope 1 and 2 emissions, it has two important disadvantages. First, it does not take into account the emissions related to raw materials that a company procures. Thus, a supermarket chain may try to reduce emissions from its stores and

transport. However, the majority of “carbon” that it sells to customers has actually been emitted before the products even arrive in its warehouses. For example, a can of soda requires CO₂ emissions to make the aluminum can, purify water and produce the flavors. Wal-Mart in the US has recognized that this is the case. Realizing that carbon equals energy, and energy equals cost, it is seeking low-carbon suppliers to get the twin benefits of cost and emission reduction.

Secondly, total company emissions don't convey how emissions relate to the different products or services a company provides. For example, a company producing basic chemicals will find that some chemicals require a lot of energy – and hence CO₂ – to produce, and others much less. Similarly, a furniture retailer will realize that a wooden table will have very different emissions from a plastic table. Scope 1 and 2 emission reporting does not provide such information.

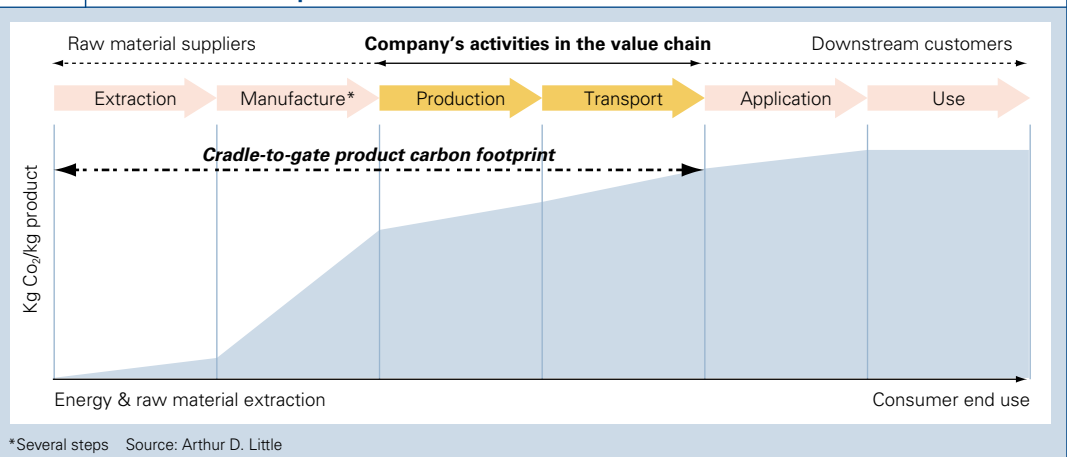


As a result, the current system of emission reporting makes it nearly impossible to correctly benchmark companies about their ability to manage emissions. For example, if we compare four global, diversified chemical companies, all leaders in the Dow Jones Sustainability Index, we find a significant spread in both total emissions and carbon efficiency (Table 5). Is Dow Chemical worse than the others because it emits so much carbon, or is it simply a much larger company? Is AkzoNobel better than the others because its carbon efficiencies are comparatively low? We couldn't tell because the product portfolio of these companies is so different. Some companies may produce a high proportion of basic chemicals that simply require a lot of energy (as is the case for Dow). Others may be active further downstream and require much less energy to generate the same sales (as is the case for AkzoNobel). Comparing companies based on their aggregate Scope 1 and 2 emissions works only in isolated cases when companies are homogeneous in their make-up. We need to consider Scope 3 emissions and get to a greater level of granularity, and compare emissions for products, not companies.

Determining your product carbon footprint

To help reduce carbon emissions, Scope 1 and 2 emission reporting can only be seen as a first step towards a more sophisticated system of carbon reporting. Indeed more and more companies focus on product carbon footprint, or PCF, instead. PCF is the cumulative CO₂ that is emitted along the value chain to make a particular product and deliver it to the customer (Table 6). It is obtained by calculating all the emissions related to the raw materials and ingredients that make up a company's product. To this is added the energy the company needs to manufacture the product and get it to the customer.

Table 6 **Product carbon footprint**



PCF is being evaluated by a number of leading firms, often in collaboration with NGOs (see box). In the past year, Arthur D. Little has worked with a number of such pioneering companies to determine the carbon footprint of their products. For example, for a blue-chip chemicals company, we helped develop a product carbon footprint measurement system for all the company's products. An inventory of emission reduction projects subsequently showed that the company could reduce emissions by as much as 10 %, meeting company profit targets. A reduction of a further 20 % could be achieved with positive internal rate of return (IRR). For a leading European energy supplier we helped to improve the measurement of CO₂ emissions. This allowed the company to develop strategies to invest in clean technology and engage in carbon trading. And with one of

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the leading global beverage companies, we investigated CO₂ emissions from raw materials to waste disposal, assessed the specific emissions per liter and quantified CO₂ reductions, in order to improve the green image of the brand. Each of these companies realized that, as the world gets more serious and more sophisticated about managing carbon emissions, the only useful measure for comparing companies is the total carbon footprint of the products they supply.

Putting product carbon footprinting into practice

A host of leading companies are currently experimenting with product carbon footprint (PCF), believing this to be the appropriate measure for comparing suppliers and manufacturing methods, and stimulating emission reductions for their products. As these companies ask their raw material suppliers to give them the necessary data, they drive the demand for a reliable PCF up the value chain, stimulating competition between their suppliers.

Tesco: CEO Sir Terry Leahy has stated that as a company "...we must help to stimulate the development of low-carbon technology, and work with our suppliers and others to deliver significant CO₂ reductions throughout our supply chain end to end..." The company is leading by example by providing carbon footprints for a number of its products.

Wal-Mart: In September 2007, Wal-Mart announced that it will begin asking its suppliers to measure their carbon footprint and find ways to reduce it, part of an effort by the world's largest retailer to transform itself into a more environmentally friendly company. Wal-Mart started by looking at seven categories that are ubiquitous in its shoppers' lives: DVDs, toothpaste, soap, milk, beer, vacuum cleaners and soda.

PepsiCo: PepsiCo's Walkers brand is the first major food brand in the world to display a carbon footprint/reduction logo on its packs. The label was developed by the Carbon Trust, a UK government-funded independent organization that works to accelerate the move to a low-carbon economy. Walkers has reduced energy use per pack by a

third and water use by almost half. One step in reducing carbon was sourcing potatoes domestically to reduce transport miles. PepsiCo is also the No. 1 green power purchaser in the US. PepsiCo and its three major bottling companies in the US purchased enough Renewable Energy Certificates to match 100 % of their 2007 purchases of electricity load in the US.

Timberland: Timberland now includes a label with its footwear that details the energy used in making the shoes, the portion that is renewable and the factory's labor record. As Timberland found out, such measurements are complicated. To measure the true environmental costs of Timberland's products, you have to go back to the cow that supplied the leather. In fact, the vast majority of Timberland's carbon footprint comes from activities preceding the production of its shoes.

PepsiCo, Tesco and Wal-Mart are also part of the Supply Chain Leadership Collaboration, together with leading companies Cadbury Schweppes, Hewlett-Packard, Imperial Tobacco, L'Oreal, Nestlé, Procter & Gamble, Reckitt Benckiser and Unilever. The collaboration wants to create a single standardized approach to measuring the carbon footprint of supply chains. Each member of the Supply Chain Leadership Collaboration has selected up to 50 suppliers to work with them. "Working within supply chains to innovate and reduce CO₂, as well as other environmental impacts, will be a key part of this work," said Dr Peter White, Director, Global Sustainability, Procter & Gamble.

How is a PCF obtained? The basic approach is:

1. Determine the ingredients (or raw materials) for each product or service, and how much of them is needed
2. For each ingredient, determine how much CO₂ was emitted to manufacture and transport it to the customer. These values can be obtained from available databases, can be calculated or can sometimes be provided directly by the supplier

3. Determine the proportion of the company's Scope 1 and 2 emissions that each product requires, including transport
4. Add each element in the appropriate ratio, to obtain the final value.

All this should be captured in an easy-to-maintain database, so companies can update their carbon footprint as they reduce their in-house energy use, or as suppliers improve the emissions of their products, by changing to more efficient technologies, or changing their raw materials. While conceptually quickly visualized, actual implementation requires serious work to gather data, as well as decisions about the required accuracy of the data.

We are a long way from an ideal world in which each company can expect to receive from its suppliers an accurate measure of the carbon content of the products it buys. For the time being, those companies leading the way are required to do some serious data evaluation to reliably inform their customers of how much carbon they are buying.

PCF then is the cradle-to-gate emission value of a product: total emissions from the extraction and growing of the basic raw materials, their transport and conversion into intermediates, etc., all the way to each company's gate, where the product is handed to the customer. As the value chain extends, each company adds its own carbon emissions to those obtained from its suppliers. In its ultimate, most ideal form, it is a cascading value much like a value-added tax (VAT) system, in which companies work together to provide their customers with the carbon emissions total up to that point, all the way to the end consumers, who can then compare the carbon footprint of comparable products and then make their buying decisions.

How PCF can affect your business

We are a long way from an ideal world in which each company can expect to receive from its suppliers an accurate measure of the carbon content of the products it buys. For the time being, those companies leading the way are required to do some serious data evaluation to reliably inform their customers of how much carbon they are buying. Not only do they have to determine how their own carbon emission relates to the products they sell, but they also need to do so for most of their suppliers, and their suppliers' suppliers, which have not reached the same level of sophistication.

At this time it is too early to tell whether product carbon footprinting will gain widespread acceptance among businesses, and to what extent it will be taken up by end-consumers (see box). But, besides the fact that leading consumer companies are driving the approach in their supply chain, there are some powerful drivers pushing business in that direction, some altruistic and some self-interested.

First of all, understanding the carbon content of their raw materials allows companies to become better at sourcing raw materials. Thus, Wal-Mart explicitly equates carbon to

Will consumers buy it?

As companies like Tesco and PepsiCo are experimenting with the addition of carbon labels to their packaging to inform consumers of the climate impact of their purchases, one may wonder whether this is temporary hype or a more permanent feature in retail.

Certainly, the carbon footprint of a product is a measure that is easy to grasp for consumers. It is one, simple, apparently unambiguous number, where less is better. In this sense it compares favorably to, for example, the health and environmental impact of ingredients or product components, which are often open to interpretation. As such, the carbon footprint label should go down very well with consumers, who are already used to comparing caloric value of the products they buy.

On the other hand, calculating footprints and updating them as new, better information becomes available or producers change the way they work, is not without effort. It is not proven that this effort is offset by additional sales. And, while one may conceive that, given the choice between similar products, consumers will prefer a lower-carbon alternative, in reality such like-for-like buying decisions are very rare. Products vary in more than one dimension, and consumers have a number of buying criteria to consider, including taste and brand loyalty. At best the product carbon footprint may be one additional factor they take into consideration.

But what will not go away is that carbon emissions equal cost. Every product is ultimately the manifestation of energy, obtained in a low- or high-carbon fashion. The product carbon footprint is a transparent way for companies to understand how they can influence the cost structure of the product, and to what extent they depend on fossil resources, which are by their nature limited and hence susceptible to long- and short-term price increases.

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energy, and sees it as a proxy for cost. In this time of energy cost hikes, knowing the carbon content allows you to distinguish real energy-related price inflation from claimed hikes in the supply chain. Furthermore, when comparing suppliers it will enable you to partner with the ones that are most efficient or have certain natural advantages in terms of carbon.

Secondly, product carbon footprinting can play a key role in the standardization initiative pursued by organizations such as the World Resources Institute, the World Business Council for Sustainable Development and the International Organization for Standardization, the originators of the traditional scope emission reporting initiative. These organizations have embarked on a two-year process to develop industry-overarching standards for product and supply chain greenhouse gas emissions, enabling companies to quantify their Scope 3 emissions. Businesses can expect that, in two years' time, Scope 3 quantification will be actively promoted, for example by the Carbon Disclosure Project, which has signed up as many as 3,000 leading companies around the world. Also, companies may be required to provide such information to receive high rankings in company benchmarking initiatives like the Dow Jones Sustainability Index or FTSE4Good.

Thirdly, stimulating PCF as a requirement to do business can be quite beneficial for incumbent, sophisticated companies that are competing with less well-run businesses. PCF requires cooperation along the supply chain, a good understanding of manufacturing processes and an ability to position and brand products. PCF will increase the complexity of doing business and, as it does so, well-run multinationals should expect to have an edge over their less able competitors, at home and abroad.

Fourthly, PCF can help companies carve out valuable positions in marketing their products. A well-conceived "green" marketing and product strategy can be very lucrative indeed, and can provide a lasting edge over competition. As a green first mover, Toyota's "zero footprint" approach, demonstrated by the introduction of the Prius, has given the company a huge boost in sales and standing. This is despite the fact that, for example, Europe's PSA Peugeot

Citroën fleet has better average mileage. But, as a close follower, PSA Peugeot Citroën could not reap similar benefits and now trails Toyota in customer perceptions. From experience we know that companies can improve their competitive position by repositioning towards CO₂-sensitive customers.

Finally, PCF may help industry and governments deal with the thorny problem of “carbon leakage.” Carbon leakage occurs when companies, to escape potentially debilitating carbon costs, relocate their manufacturing operations from carbon-regulated OECD economies to others that do not (yet) impose a cost on carbon.

Finally, PCF may help industry and governments deal with the thorny problem of “carbon leakage.” Carbon leakage occurs when companies, to escape potentially debilitating carbon costs, relocate their manufacturing operations from carbon-regulated OECD economies to others that do not (yet) impose a cost on carbon. The net effect is a loss of employment in the country of origin and an increase in overall carbon emissions, since many developing countries employ less efficient and/or more carbon-intensive methods of energy generation. However, broad uptake of product carbon footprinting may allow governments to set maximum PCF values for products that are imported into their areas, comparable with standards of, for example, collision safety of vehicles or product safety of small-scale electronics. This would in effect export carbon emission regulation to non-regulated economies. Of course, such regulation would not sit well with trade liberalization efforts, and would put a considerable administrative burden on business. However, just the threat of it might help combat carbon leakage by stimulating developing economies to adopt similar PCF standards, and thus minimize the competitive disadvantage of production in carbon-regulated economies.

Insights for the Executive

We are moving towards a world where carbon is constrained, and in which a price will be put on carbon emissions. This is set to be implemented first in the developed economies, as developing nations argue that they have the moral right to increase their emissions to enable them to continue on their current growth path. Already, many companies are measuring and/or reporting their carbon emissions. However, the traditional “scope-based” framework is giving way to a value-chain approach that is more sophisticated and considerably more insightful. Along the supply chain, companies will add up the carbon emissions

specifically related to their products and services, thus providing a product carbon footprint, or PCF, which is a total of all upstream carbon emissions. This shift is being driven by some of the best-known brands, is supported by NGOs, and will ultimately allow the comparison of the carbon efficiency of competing technologies, companies and whole value chains.

How should forward-thinking executives prepare their companies? We suggest three key actions:

1. Determine the product carbon footprint for your products and services. As a first step this can be done pragmatically, in an 80-20 fashion, with a plan to work out the details over time. It is better to have a rudimentary system that gives guidance than the perfect system that is not yet operational.
2. Appropriately the first-mover advantage, if still possible. Find out whether you can position your company as a leader in low-carbon products and services. Strike long-term supply deals with your most proactive or best-positioned suppliers to make sure their carbon advantage is pulled into your supply chain, not your competitors'. Find out which of your customers are seeking to market low-carbon products and services, and offer to join forces.
3. Start reducing carbon. With the knowledge obtained through the actions set out above, reduce carbon in your company and your value chain. Whenever we have helped companies to do so, not only have we found technical and practical solutions for the majority of their emissions, but a large proportion of the initiatives have also added straight to the bottom line. This makes carbon footprint programs self-funding or even profitable, right from the start.

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