

Carbon Labelling and Low-income Country Exports: A Review of the Development Issues

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This article discusses the carbon accounting and carbon-labelling schemes being developed to address growing concerns over climate change. Its particular concern is their impact on small stakeholders, especially low-income countries. The popular belief that trade is by definition problematic is not true; carbon efficiencies elsewhere in the supply chain may more than offset emissions from transportation. Indeed, low-income countries may offer important opportunities for carbon emission reductions because of their favourable climatic conditions and use of low energy-intensive production techniques. However, their effective inclusion in labelling schemes will require innovative solutions to provide low-cost data collection and certification.

Key words: Carbon footprint, carbon labelling, low-income countries, exports, standards, certification

1 Introduction

In response to growing anxiety about climate change, policy-makers, firms and consumers are considering ways in which to reduce greenhouse gas emissions. A possible mitigation mechanism undergoing rapid development is carbon¹ labelling. This involves measuring greenhouse gas emissions from the production of products or services and conveying that information to consumers and those making sourcing decisions within companies. Well-designed schemes will create incentives for production of different parts of the supply chain to move to lower emission locations. Thus, carbon labelling enables consumers to join the battle against climate change by using their shopping trolley.

Firms are eager to cater to consumers' demands and to reduce their own carbon footprints. Global retail giants are developing carbon measurement and labelling

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1. We follow common usage here and use carbon to refer to all greenhouse gases. Appendix 1 provides a brief overview of the relevant terminology.

schemes and major manufacturers are following suit. However, the strong desire to act on carbon labelling has been running ahead of the challenges of measurement and the problems of effective communication through labelling that must be addressed for schemes to be successful. As a result, a growing number of standards are being developed with little effort to co-ordinate and generally little or no voice given to small players, such as low-income countries (LICs).

This article aims to draw attention to the potential impact of carbon measurement, footprinting and labelling schemes on the exports of LICs in a context in which such schemes are actually being developed and applied. To date, the major practical initiatives in this area have been led by retailers, and as a result are product-focused. There are at least three potential ways in which a product-focused approach can be operationalised. First, through a consumer-facing carbon label. Second, through the provision of product information via other means, for example, on a website. Thirdly, producers could offer to reduce their greenhouse gas (GHG) emissions related to their products through some form of social contract. Such commitments by producers are part of the methodologies of both the Carbon Trust in the UK and of *carboNZero* in New Zealand. Because such organisations are already implementing schemes, a discussion of the likely impacts of these approaches is pertinent. However, we do not seek to provide here a discussion of carbon labelling in the context of identifying optimal policies to mitigate climate change. In the future there will probably be a mix of policy responses using a range of complementary instruments, which may include market-based mechanisms such as carbon taxes, but these instruments are not yet operational, whereas carbon footprinting and labelling are.

Fears have been raised that low-income countries will face greater difficulties in exporting in a climate-constrained world where carbon emissions need to be measured and certification obtained to enable participation in carbon labelled trade. This discussion centres on *transportation* and the common presumption that products produced locally will have an advantage in terms of carbon emissions, and on the effects of *size*. Exports from LICs typically depend on long-distance transportation and are produced by relatively small firms and tiny farms which will find it difficult to participate in complex carbon-labelling schemes. However, the scientific evidence shows that carbon efficiencies elsewhere in the supply chain of a product may more than offset the emissions associated with transportation, while the disadvantages of small size can be accommodated by innovative solutions to low-cost data collection and certification.

Carbon labelling needs to be based on a sound, well-developed and independent scientific base. At present the available scientific evidence is small, but growing. It is too early to make specific predictions of how the exports of LICs will be affected, but it is timely to identify the major issues. This article starts by providing a brief overview of the intersection between carbon labelling and international trade. It then proceeds with two empirical sections. Section 3 presents the main conclusions and key issues raised by studies that have sought to measure carbon emissions or energy used along international supply chains, while Section 4 gives an overview of the emerging carbon-labelling initiatives. Both sections identify the key characteristics from a low-income country perspective. Section 5 is more analytical and discusses how LICs' export interests interact with the ongoing process of designing carbon-labelling schemes and how the

schemes that emerge create challenges and opportunities for future trade. Conclusions are offered in Section 6.

2 Carbon labelling and trade

The role of carbon labelling is to provide information to consumers and purchasers who are concerned about the impact of their choices on global warming. It is one instrument available to mitigate climate change that includes other trade measures, such as carbon taxes and countervailing duties, and specific regulatory requirements. The purpose here is not to compare and judge carbon labelling relative to other instruments but rather to investigate the key implications of emerging labelling schemes for a particular constituency: low-income countries.

An important aspect of carbon accounting and labelling is that schemes are actually being developed *and* implemented. As will be discussed in more detail in Section 4, there is a strong momentum within the corporate sector towards labelling initiatives. At present it is unclear if and when carbon taxes will be applied. While a tax on fossil fuels, in proportion to the carbon emitted in their use, would be relatively straightforward to apply, it would not address a number of important issues related to global warming. First, such a tax would only target emissions of CO₂ and not other greenhouse gases such as nitrous oxide and methane. Second, and related, a carbon tax would not deal with emissions due to changes in land use, such as deforestation. These two points are particularly important when considering agriculture, as typically the greatest impact on climate change from this sector arises from nitrous oxide from soils and methane from ruminants (Edwards-Jones et al., 2008). Finally, without global agreement on a carbon tax it appears that countries applying such a tax would seek to impose import taxes on products from countries that do not participate. Given the nature of globalisation and cross-border production networks in which a finished product typically contains components from an array of countries, there would need to be some form of carbon accounting to implement such an approach. Labelling schemes can therefore complement the more traditional approaches of taxation and regulation. For example, carbon labelling is an integral part of the proposed EU regulation on biofuels, discussed in more detail below.

The development of carbon labelling was predated by discussions of ‘food miles’. While food miles have been discredited as an accurate measure of the impact of food products on climate change,² discussions of how carbon labelling can attain the necessary precision to be effective are still ongoing. That is the scientific side of the discussion. The economics is complex and involves: consideration of how labels may bring down transaction costs in a supply chain by increasing transparency with regard to relevant product attributes (in this case emission efficiency); the costs of providing and verifying the necessary information; and how labelling will change consumer and producer behaviour.

2. Food miles, a metaphor for the evolution of the global food industry, are difficult to apply. Calculations show that transporting apples by sea, for example, causes less than 1% of the carbon dioxide emissions if they are flown; but the food miles concept tells us nothing about how the apples are transported.

The way in which information on carbon emissions is presented is a key issue on which consensus is far from achieved. Exploratory schemes giving detailed numerical information similar to nutritional information, have not proved successful. Simple labels can be misleading and inconsistent with the policy objective of reducing emissions. Alternatives being investigated include labels signifying that some minimum achievement has been attained (or a commitment to do so), or labels that certify observance of an appropriately defined 'good environmental practice'. At the same time, companies are exploring ways of distributing information internally so as to achieve objectives regarding their carbon footprint.

Measurement costs are a critical issue for small stakeholders. Low-income countries have predominantly small firms and tiny farms, hence any size bias in the carbon-labelling schemes, in terms of the costs of measuring emissions and of verifying those measurements, will translate into a heavy burden on the competitiveness of such small players. A feature of the last two decades of development in agro-food industries has been the implementation of strict trade standards, like the imposition of the GlobalGAP standard by a group of primarily UK and Dutch retailers. The cost of this standard is generally thought to be a major reason behind the marginalisation of small farmers from horticultural export markets (Dolan and Humphrey, 2000; Gibbon, 2003; Graffham et al., 2006; Graffham and MacGregor, 2006).

The provision of credible information is essential if a carbon-labelling scheme is to serve as a guideline for buyers and consumers when choosing emission-efficient products. Certification is one way to target this problem. Given that costs must be incurred by firms in certifying their emissions, the success of carbon labelling requires that consumers are willing to pay a premium to protect the global environment. Further, by allowing consumers and company purchasers to demonstrate their willingness to pay to reduce their carbon footprints, labelling may initiate a process by which firms in the production chain innovate so to acquire or maintain an existing advantage in terms of carbon emissions.

In principle, such labelling schemes could play an important role in achieving emission reductions and be a useful complement to other environmental policies. However, as with other eco-labels, there is concern that such schemes may, in practice, unfairly restrict trade, especially with LICs. This may arise if the labelling criteria reflect local technologies and tend to exclude 'acceptable products' produced with different processes in overseas locations, as might occur if the process of developing the labelling scheme is liable to capture by domestic interests.³ Similarly, there may be discrimination against imported products if the carbon emissions of particular products are indirectly derived using parameters based on data in the importing country and which may overestimate the emissions in the producing country (Deere, 1999). Both these concerns are likely to impact most heavily on LICs, where production processes tend to differ from those in rich countries and for which parameters derived in rich countries will be most inappropriate. In addition, as noted above, the costs of

3. Here we can make an analogy to the rules of origin that industrial countries have applied to determine eligibility for trade preferences. In the past, the specification of these rules has been far from transparent, has excluded key stakeholders and been strongly influenced by domestic industry, resulting in excessively restrictive rules limiting the value of preferences and constraining the degree of new competition faced by domestic producers.

certification are likely to impinge especially heavily on producers in LICs and if these costs lead to the exclusion of low emission producers from developed-country markets, then the whole labelling scheme would be undermined.

3 Carbon emissions throughout an international supply chain

Concern about climate change has stimulated interest in estimating the total amount of carbon emitted during the production, processing and distribution of a product. The final outcome of this exercise is called the product's 'carbon footprint' and the exercise itself is known as 'carbon accounting'.⁴ A product's carbon footprint is different from a company's as the former includes the carbon emitted by consumption (and disposal) of the product itself as well as of all inputs necessary to produce it. It is therefore called an embedded (or embodied) footprint.

Methods are already established for measuring, reporting and verifying carbon emitted during production.⁵ One scientific method typically applied is Life Cycle Analysis (LCA).⁶ In principle, this should imply adding up all carbon emissions throughout a product's life from the production of inputs to final consumption and disposal of waste. The methodological difficulties of putting this intuitively appealing idea into practice are, however, immense and the lack of standardised methods heavily influences the usefulness and comparability of existing studies.

Nevertheless, a small but rapidly growing literature analyses product-level carbon footprints. Needless to say, carbon accounting is becoming increasingly difficult in today's globalised world where supply chains grow longer and ever more complex.

There is little doubt that this complexity accounts for the dominance of agricultural supply chains in the scientific literature since many foods are subject to little processing and pass through relatively simple supply chains. Other products that have been subject to carbon measurement studies include transport fuels and forestry products, where again the supply chains are relatively straightforward. Nevertheless, carbon accounting may also be implemented for more complex products such as industrial products, although studies are still rare.

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4. Carbon footprints are expressed in units of CO₂ equivalents (CO₂e). This is because different GHGs have different impacts on the atmosphere – so-called radiative forcing. The most important GHGs in agriculture are carbon dioxide (CO₂), nitrous oxide (N₂O) and methane (CH₄). Currently it is estimated that 1kg of CH₄ is equivalent to 25kg of CO₂, and 1kg of N₂O equivalent to 298kg CO₂ over a 100-year time horizon (IPCC, 2007). However, as scientific knowledge on global warming has progressed so these conversion factors have been amended over time. Previously the Intergovernmental Panel on Climate Change (IPCC) had suggested that 1kg of CH₄ was equivalent to 23kg of CO₂, and 1kg of N₂O was equivalent to 296kg CO₂ (IPCC 2001), while before that IPCC (1995) had suggested GWP conversion factors of 21 for CH₄ and 310kg for N₂O. This is not a problem from a scientific point of view; however, some legislation and treaties may have adopted earlier IPCC conversion factors, and care should be taken to ensure equivalence in any calculations. The degree of radiative forcing of a GHG depends on several factors including how long they survive in the atmosphere, their current concentration in the atmosphere and their ability to capture infrared radiation.
 5. Defined in the World Business Council for Sustainable Development/World Resource Institute GHG Protocol and ISO 14064 on GHG quantification and reporting.
 6. LCA is defined in ISO 14040-44 standards and associated guidelines. Its methodology should not be used for regulatory purposes.

Table 1: Lifecycle analyses relevant to low-income country exports

Study	Case	Outcome	Comments
Williams (2007)	Kenyan and Dutch roses consumed in UK	Air freight-related emissions counteracted by higher energy use by Dutch greenhouses	Comparison of one Dutch with one Kenyan farm. Comparison may not be typical. Data not verified independently
Jones (2006)	Kenyan and UK beans consumed in UK	Kenyan and European on-farm energy consumption similar. Kenyan 12 times higher than UK due to air freight	No UK primary data, so basis for comparison is questionable.
Sim et al. (2007)	Kenyan, Guatemalan and UK runner beans consumed in UK	Kenyan and Guatemalan global warming potential 20-26 times higher than UK due to airfreight	As no UK primary data were collected it is hard to compare overall emissions
Fogelberg & Carlsson-Kanyama (2006)	Frozen South and Central America broccoli compared with fresh Swedish broccoli consumed in Sweden	Transportation-related emissions counteracted by lower use of fossil fuels in South and Central America production systems. In terms of carbon emissions, no substantive differences between the two origins	Only aggregated data presented in graphs, so hard to understand data collection and manipulation methods. Attempts made to normalise results to account for nutritional differences – a non-standard approach.
Fogelberg & Carlsson-Kanyama (2006)	Brazilian and Swedish chicken consumed in Sweden	Analyses trade-off between shipping feed from Brazil to produce chicken in Sweden and producing both in Brazil and shipping chicken to Sweden. Differences in emissions small	Only aggregated data presented in graphs, so hard to understand data collection and manipulation methods
Blanke & Burdick (2005)	German and Southern hemisphere apples consumed in Germany	Energy needed to store Northern apples almost as great as that needed to transport from overseas	Relies on modelling supply chains rather than primary data collection. Studies one month only, and only energy use (correlated with but not identical to carbon emissions)

Mila i Canals et al. (2007a)	EU and Southern hemisphere apples consumed in EU	Southern hemisphere apples as energy efficient as EU apples during EU Spring and Summer due to energy needed for storage counteracting that needed for transportation by ship	Considers whole calendar year. Only studies energy use (correlated with but not identical to carbon emissions). Incorporates variation in energy use in supply chains to present a more realistic range of energy use than normal LCA approach of one figure per supply chain
Mila i Canals et al. (2007b)	UK and Spanish lettuce consumed in UK	Spanish Winter production plus refrigerated road transport more 'carbon efficient' than UK Winter greenhouse production. Fertilisers important source of emissions in all systems	Primary data collected through field surveys on farms. However, sample size still too small to claim that results are statistically representative. Highlights variation between farms in emissions/kg lettuce produced
Schlich & Fleissner (2005)	German, Brazilian and New Zealand fruit juices and lamb consumed in Germany	Large global companies better able to exploit opportunities for reducing energy inputs from greater scale. Outweighs transportation-related emissions	
Saunders et al. (2006)	New Zealand and UK lamb consumed in UK	New Zealand's more extensive farming systems outweigh transportation-related emissions	Methodologically flawed in many ways: analysed 7 NZ farms as compared with standard data for one UK farm-type; did not consider all GHGs. NZ source found to be 4 times more 'carbon efficient' than UK production
Barrett et al. (2002)	Food consumed in York (UK)	Meat and dairy products have highest carbon emissions, horticultural products 3 to 5 times lower (per kg basis)	Ecological Footprinting used as methodological basis; specifically used Energy Analysis Program (EAP) to model carbon emissions
Wallén et al. (2004)	Food consumed in Sweden	Cheese, coffee, frozen fish and meat have highest carbon emissions, horticultural products 3 to 12 times lower (per kg basis)	Data taken from secondary sources, including suppliers. In absence of some data a series of assumptions made
Kramer et al. (1999)	Food consumed in the Netherlands	Meat and dairy products account for 50% of food-related carbon emissions, fruit and vegetables account for 15% of emissions	

Relatively few complete LCAs or carbon footprints for entire supply chains are published in the peer reviewed literature, with even fewer covering activities in a developing country. Similarly, studies that consider alternative supply chains for the same good, namely, a good supplied to the same market place via different supply chains, are very scarce. A larger grey literature is often produced by parties with commercial interests. To make things even more difficult, studies differ in their methodologies, making comparison difficult. Table 1 presents an overview of the main studies. With these caveats in mind, the rest of this section will present the available evidence and distil the lessons for LIC export opportunities.

3.1 Carbon emission patterns are highly complex

The literature illustrates a number of ways in which different carbon-emitting activities interact to provide an overall carbon footprint. An important implication of this is that geographical location alone is a poor proxy for overall emissions; favourable production conditions may more than offset a disadvantage in transport.

Williams (2007) estimated the carbon footprint of cut roses supplied to the UK market from companies in Kenya and the Netherlands and found that, even after taking into account the emissions from air transport, the Kenyan roses produced considerably lower emissions than Dutch glasshouse production, owing to the electricity and heat used in Kenyan greenhouses being derived from geothermal energy rather than fossil fuels. Fogelberg and Carlsson-Kanyama (2006) point out the trade-off between the high use of diesel in Swedish broccoli production and carbon emissions from long-distance transportation of broccoli from South and Central America where, on the other hand, the agricultural technologies used are less mechanised and primary fossil fuel consumption is much lower. Schlich and Fleissner (2005) explore the trade-off between close-to-market but small-scale fruit juice production and far away carbon efficient large-scale production, and find that better use of scale economies outweighs transportation-related emissions.

The exact structure of emissions is likely to be highly specific to the given supply chain under scrutiny, and the limited body of existing evidence offers few rules of thumb. Mila i Canals et al. (2007a) find that the balance between emissions from refrigeration of local apples and from transporting apples from the other side of the globe shifts throughout the year. In the European Spring and Summer, long-distance trade is most efficient, but when European apples are in season the balance tips and local apples are most efficient. Emissions from the use of imported inputs that have been transported long distances are important in comparing the carbon footprints of products from different locations. Fogelberg and Carlsson-Kanyama (2006) compare chicken consumed in Sweden from two sources: Sweden and Brazil. Two key differences are highlighted. First, energy consumed in Brazilian production is lower than that in Sweden due to the more clement climate. Second, the feed used in Sweden is produced partly from imported soy meal (which may come from Brazil). In Brazil, all ingredients in the feed are obtained domestically.

Thus, the complexity of carbon emissions discredits simplistic but intuitively appealing concepts such as food miles and buy-local campaigns. Such concepts may be more relevant when particular food qualities such as freshness and authenticity are

sought by the consumer. But the available evidence lends little support to the notion that they have much to offer in terms of climate-change mitigation.

3.2 Transportation is one source of carbon emissions among many

The popular belief is that trade, by definition, is problematic from an environmental perspective since it necessitates transportation. But this is generally not true; transportation is one source among many. Carbon emissions per tonne-km vary with the different types of transport and generally fall in the order of air freight, road, ships. However, while aviation emissions are widely known to be high, some discussion remains as to what they actually are. Energy use differs between short and long-haul flights (23.7MJ/tonne-km and 8.5MJ/tonne-km, DEFRA, 2005) and also between freight carried in the belly of a passenger plane and in a dedicated freight plane. As a result, there are a variety of emission factors available for air transport.

Emissions from ocean-going ships are considerably lower. Indeed, Jones (2006) estimates that if beans were transported from Kenya to the UK by ship (Mombasa to Southampton), the energy use would be 1.7MJ/kg, 56MJ/kg less than the air freight from Nairobi to London. However, given that the journey by sea would take 11-12 days it would be necessary to chill, or otherwise treat, the beans in order to render them saleable on arrival. In a similar set of calculations, Wangler (2006) estimates that the emissions from transporting 1kg of produce from Cape Town to London by air would be 14.9 kg CO₂e, and by ship from Cape Town to Southampton between 0.1 and 0.12kg CO₂e.

Thus, air transport is a carbon hotspot and the airfreight of fresh fruit and vegetables is clearly responsible for a substantial, if not the major, proportion of carbon emissions in the supply chains to wholesalers (Edwards-Jones et al., 2009; Sim et al., 2007). However, the transport emissions are perhaps more evident in these supply chains than in other food items. Supply chains of fresh produce are relatively simple, since they contain few other intermediate inputs. Other foodstuffs, such as processed dairy products like yoghurts and meat items like sausages, tend to require more sophisticated processing, have longer production chains and use multiple inputs. All of these entail greenhouse gas emissions. As a result, the overall carbon footprint of fresh produce tends to be amongst the lowest for any food category (Barrett et al., 2002; Wallen et al., 2004), and transport tends to be a proportionally higher contributor to it than in other foodstuffs.

Nevertheless, the vast majority of low-income country exports, and of international trade in general, is transported by ships for longer distances and roads for shorter distances. Notably, sea transport has become highly energy efficient (measured on a tonne-km basis) and for most products it is unlikely that transportation will be a disproportionate source of carbon emissions. This is particularly relevant for processed food and industrial products, for which energy-consuming processing weighs more heavily than for the relatively simple products analysed in LCAs so far.

3.3 LICs' carbon competitiveness needs to be explored

The potential of LICs to participate in global trade in a climate-constrained world in which carbon emissions carry a larger cost than today has not been investigated in any detail. The few existing studies suggest that LICs may remain competitive in sectors where they have traditionally done well (see Edwards-Jones et al., 2009), as is the case for Kenyan roses and presumably for many traditional bulk commodities transported by sea.

Some studies have shown that one particular agricultural process is extremely energy-intensive: protected production. Examples include production under glass or in polytunnels in the case of horticulture. This arises because of the use of energy for heat and light, whereas it is inputs of natural light and heat that are used in non-protected agriculture. In addition, substantial emissions in the cultivation of protected agriculture arise from the production of the materials used to build the glass houses and polytunnels; steel, glass, plastics.⁷ Hence, LICs are likely to have an advantage in competing with protected production in richer Northern countries. The source of energy is also important. This was highlighted in the case of roses produced using thermal energy in Kenya but energy generated from fossil fuels in the Netherlands.⁸

3.4 Carbon accounting is complex and costly

The data requirements for detailed carbon accounting can be daunting. In the extreme, it would be necessary to measure the carbon emissions at every point along every production chain. Clearly this is impossible, and schemes have to deal with the issue of how practically to collect relevant information.

However, over-simplification and generalisation also carry problems, and schemes must be comprehensive enough to represent real supply chains and also enable identification opportunities for emission savings along a supply chain, including those involving LICs. This issue is further complicated, as low-cost approaches to obtaining data and certification are needed to ensure that small players can afford to participate. So far a mere handful of products have been labelled, and it is in the step towards general application that this issue will have to be addressed. It is worthwhile noting that the process of carbon accounting is common to all climate-change instruments that work around products. So, regardless of the nature of any final set of instruments, labels, taxes or standards, the issues associated with collecting accurate data at the right scale and at an affordable cost will be common.

4 Emerging carbon-labelling initiatives

This section takes a closer look at existing schemes of carbon labelling, discusses attempts to standardise and simplify measurement methodologies and highlights some

7. See the studies of protected lettuce and strawberries presented in Lillywhite et al. (2007).

8. Whilst such energy does not lead to global warming potential, it is likely that a label signifying that a product had been produced with energy from nuclear sources would influence the purchasing decisions of some consumers (cf. the example of Eurostar which is driven in England largely by nuclear energy).

emerging innovative solutions to data collection and certification. There is clearly a need for additional scientific studies to shed light on the nature of emissions along typical production chains and discuss representative values for particular regions and types of producer. 2007 became a boom year for discussions of carbon labelling, with a number of new initiatives emerging, often backed by large commercial players, and, in the case of the UK and France, by the government. Most approaches have been based on the development of voluntary standards. The following identifies their key characteristics.

4.1 Carbon labelling has great momentum

The combination of a strong private-sector push and public support has propelled carbon-labelling initiatives forward in the UK. For example, the supermarket Tesco announced plans in January 2007 to carbon-label all products (estimated at 70,000 items).⁹ A trial of about 20 products has been available in Tesco stores since April 2008. The stated objective is to allow consumers to integrate carbon emissions into their purchasing decisions by providing information in the same easily accessible way as for nutritional value or price. So far no more than a handful of products have been carbon-labelled, although an interim system puts a small airplane symbol on air-freighted products, under the assumption that airfreight is a major source of the carbon emissions in a product's lifecycle. The airplane symbols have also been used by Marks and Spencer and the Swiss supermarket Coop.

The French supermarket Casino has developed its own labelling scheme addressing issues of climate change and waste management; the former is mainly an application of the food miles concept rather than proper carbon accounting. Casino's own-brand food products will be marked with both a traffic-light system indicating environmental friendliness as well as a specific number giving the amount of carbon dioxide emitted during the transport stage of the product's life cycle. The French government is reported to have asked all French retailers to look into a system similar to Casino's (Casino et al., 2007; Ministère de l'Ecologie, du Développement et de l'Aménagement durables and FCD, 2008; Market New Zealand, 2008).

The Carbon Trust, a private company in statute set up by the UK government in response to the climate-change threat, has developed a pilot methodology to measure the carbon footprint of products as well as a label to display the information on individual products (Carbon Trust, 2007). Walker's cheese and onion crisps was the first product to be carbon-labelled in July 2007. The Trust is now working with the British Standards Institution and DEFRA to produce a standardised methodology to measure embodied carbon footprints using as a base the Trust's own pilot methodology.

9. The definition of what would actually be an 'item' is unclear. It is likely that 70,000 is an underestimate. Fresh produce like lettuce or apples, for instance, varies significantly in carbon footprint according to season, as do many other products, including manufactures. Electricity may be provided by hydropower in the rainy season in tropical countries, for instance, while relying on fossil fuels in the dry season. Two manufactured products may therefore have different footprints depending on the timing of production, despite being undistinguishable in appearance. This raises the issue of the time period over which emissions should be measured and whether emission information should be consignment-specific or averaged over a number of batches.

The initiative runs under the name of PAS 2050 (BSI, 2008). A PAS, or Publicly Available Specification, is a type of fast-track standard that should not be mistaken for a true British Standard, though it may serve as the basis for a future, more authoritative, British Standard. The methodology is currently being tested on approximately 75 product ranges from 20 different companies.¹⁰

The Soil Association, the major organic standard-setter in the UK, suggested excluding air-freighted products from organic certification on the assumption that air-freighted goods are major emitters of carbon relative to goods transported by other means. This led to a strong reaction from development agencies and from the Kenyan horticultural industry, a major source of off-season fresh vegetables and cut flowers.¹¹ The Soil Association subsequently decided to 'ensure that organic food is only air freighted to the UK if it delivers genuine benefits for farmers in developing countries' (Press release, 27 October 2007). From January 2009 air-freighted organic food will have to meet the Soil Association's own Ethical Trade standards or the Fairtrade Foundation's standards, and licensees will be required to develop plans for reducing any remaining dependence on air freight (Soil Association, 2008).

The UK debate has to a large extent focused on food, probably due to the fact that the idea of 'Food Miles' was born in the UK, and presumably because the low degree of processing of many foods makes calculating embodied carbon emissions relatively tractable. The development of carbon labelling is, however, far from restricted to the UK. A number of major US retailers and brand-name manufacturers are also in the process of developing their own schemes (for more details of the range of initiatives see Appendix 2).

Most often activities to analyse and label the carbon emissions of products take place within the larger context of a declared company goal to reduce carbon footprint and are often coupled with carbon offsetting schemes that companies are using to proclaim an ultimate goal of carbon neutrality. The methodologies used for measurement as well as the degree to which third-party verification is applied are often unclear. Some initiatives have also been taken in continental Europe. The Swedish organic standard-setter, KRAV, is in the process of developing a carbon-labelling scheme for food (organic as well as conventionally produced). Similar initiatives are being developed by Swiss standard-setters specifically for organic food (Gibbon and Bolwig, 2007).

Many of the recent initiatives emphasise the public relations element and downplay the practical problems of implementing these schemes. The motivation is to give a company a green profile and to target environmentally sensitive market segments. Broader issues of methodological rigour and how to develop cost-effective solutions on a scale greater than the individual company are naturally not addressed by those who are concentrating on the interests of their own shareholders. As such, the

10. The Carbon Trust recently announced its plan to open an office in Beijing to assist the Chinese business sector in reducing its carbon footprint.

11. An International Trade Centre-commissioned study found that 50-60 producer-exporters worldwide would be affected by a ban and that at least 21,500 livelihoods in developing countries would be compromised. Furthermore, the environmental impacts themselves may be ambiguous as organic growers would be tempted to convert to conventional products in order to keep growing for export markets (Gibbon and Bolwig, 2007).

approaches have been developed with little co-ordination and a lack of transparency. The attempts to define common standards in PAS 2050 and by KRAV indicate a concern amongst stakeholders that too many standards may provide few benefits as they will confuse users such as consumers with conflicting messages. There is a real danger of fragmentation. Governments may start to take more interest as the use of carbon labelling expands and the scope for abuse of labels becomes greater.¹²

Measurement and display standards are likely to become more established as business and standard-setters respond. However, as soon as a standard is established it becomes much more difficult to influence its design; hence the immediate need to ensure that the process of developing these standards is open and transparent and reflects the interests of all stakeholders large and small. We discuss the issue of the participation of low-income countries in carbon-labelling schemes in the next section, which concentrates not only on the challenges of developing effective and comprehensive carbon-labelling schemes but also on cost-effective methods of collecting and certifying the necessary information.

5 Development issues in carbon labelling

The state of the art of carbon labelling is that a number of schemes are emerging in an unco-ordinated fashion. These schemes are based partly on political and commercial desires to act on climate change and partly on scientific knowledge about emission patterns. It is fair to say that they are still far from being broadly applicable. Currently, they will be costly to implement and science has not yet produced the data upon which widely applicable schemes can be built. However, the situation is likely to change rapidly over the next few years.

We do not have sufficient knowledge to make strong predictions on how exactly low-income countries will be affected by carbon labelling. In standard-setting, the devil is typically found in the detail. But it is possible to identify key issues and to suggest appropriate responses that will push carbon labelling in a development-friendly direction. Naturally, carbon labelling is by design an environmental instrument. The development angle to this is to ensure that carbon-labelling schemes include the capacities of LICs in mitigating climate change as well as the reality regarding the ability of firms and farms in poor countries to measure and certify their carbon emissions.

5.1 *Measurement methodology*

There are four key elements of the approach to determining the carbon footprint of a product or service, and all can have a critical impact in determining the quality and

12. The European Parliament, for example, passed a resolution in 2007 calling for 'the introduction of WTO compatible common standards and labelling schemes regarding the GHG implications of different products, including at the production and transport stages'; 'a procedure to assess and label these ecological footprints and to develop software in order to enable businesses to calculate the quantity of GHG emitted from every production process'; and 'the development of a scheme based on sound life-cycle data which includes finished goods, such as cars and electronic equipment' (European Parliament, non-legislative resolution T6-0576/2007).

reliability of the study: the use of primary versus secondary data, the use of emission factors, the treatment of land-use change and setting the system boundary.

In general, it is preferable to use *primary data* (process-specific data collected from part or all of the supply chain) rather than *secondary data* (data obtained from sources other than direct measurement of the supply chain being investigated). The Carbon Trust pilot methodology and the draft PAS 2050 both recommend the use of primary data to the extent possible.¹³ However, the collection of primary data can be expensive and time-consuming, particularly for supply chains that cross international boundaries. Very few studies have collected primary data from low-income countries. For this reason, many companies prefer a more standardised approach in which secondary data from well recognised sources are used in conjunction with standard databases of emission factors to estimate the carbon footprints of particular supply chains. Such an approach will be relatively resource-efficient and easy to implement, and will tend to encourage the use of similar methodologies across different supply chains.

However, the available studies question the reliability of using secondary data and the representativeness of data obtained from specific or a limited number of suppliers. For example, using secondary data from producers in rich countries to estimate the carbon emissions of producers in LICs will not capture the fact that the technologies being applied in rich countries are unavailable or unsuitable. Even within countries, information from one farm or production unit may not reflect practices from others. Any method which assumes standard emissions will fail to capture this variation. While this may not be important to firms such as retailers, it is important to both individual producers, such as farmers, and consumers.

Rewarding the carbon-efficient producer serves simultaneously to encourage innovation and to bring about reduced atmospheric pollution. The development of a carbon label is potentially an excellent way of communicating the relative efficiencies of different supply chains and production units to the consumer. However, to achieve this would require calculating the carbon footprint of each individual producer. Further, consumers could only really respond to carbon labels in this way for relatively unprocessed goods such as fruit, vegetables, primary cuts of meat and some dairy produce (such as liquid milk). Here the carbon label would be able to reflect the management practices on individual farms or plants. However, for goods which utilise produce from more than one farm or production unit this becomes much more difficult to present.

Another critical issue concerns the choice of baseline year(s) for data collection; this will tend to have an impact on the outcome, particularly if the year was not typical of long-term conditions. Consider, for example, the variation in both inputs to crops between years (more fungicides on wheat in wet years) and also crop yields due to annual variation in weather.

13. The Carbon Trust methodology 'allows for use of secondary data (i.e. from secondary sources) where collection of primary data (i.e. actual data collected from supply chain) is not feasible' (Carbon Trust, 2007: 7) The draft PAS 2050 states that '[p]rimary data sources are preferable to secondary data sources as the data will reflect the specific nature/efficiency of the process, and the GHG emissions associated with the process' (BSI, 2008: 4).

The amounts of carbon emitted during particular parts of the manufacture and/or use of products are termed *emission factors*. These are usually expressed in terms of kg of CO₂-equivalents. If the emission factors for the manufacture, transport and use of a certain amount of product are known, and the amount of that product in a given process is also known, then the total carbon emission arising from the use of that product in that process can be estimated, by the simple multiplication of the amount of product used by the relevant emission factors. If this process is repeated for all products relevant to that process, then the total carbon emissions for the entire process can be calculated. However, some emission factors are location-specific. For example, a country generating a large proportion of its electricity from renewable sources should have a significantly smaller emission factor for electricity than one dependent on power-generation technologies which emit large amounts of GHGs, such as coal-powered generation. These differences can then have knock-on effects on the carbon footprint of products. So nitrogen fertiliser generated in an economy largely dependent on renewable energy should have a lower emission factor than the same fertiliser produced in a more coal-dependent country. This level of detail currently remains relatively underdeveloped in carbon footprinting methodology.

Further complications arise from a consideration of soils. All growing plants sequester atmospheric CO₂ in photosynthesis and when they die the carbon within them enters the soil as soil organic carbon. As a result of this ongoing process soils have come to represent a major stock of carbon. This store is not necessarily permanent, and through bacterial and chemical activity soils can also be emitters of GHGs (typically nitrous oxide and carbon dioxide, but also methane in some locations, such as paddy rice). Given the difficulties in measuring these fluxes accurately in the field, the IPCC undertook a meta-analysis¹⁴ of all the available experimental data to produce standard emission factors from soils (Bouwman and Taylor, 1996). This emission-factor approach is based on a limited number of data points and is applied worldwide for agricultural soils, regardless of variations in soil characteristics, land management or climate (Roelandt et al., 2005). This is obviously a crude approach that can have little relevance to local conditions (Smith et al., 2002).

The difficulties associated with emissions from soil are evident when considering issues of *land-use change*. For example, changing from forest to grassland or grassland to crop land can result in the release of large amounts of GHGs from the soil. Here the issue is not only how to measure the emissions; a decision also has to be made on how many years this 'one-off' increase in emissions should be spread over.

Currently gaseous emissions from soil are difficult to incorporate in LCAs, and the absence of up-to-date and locally specific emission factors introduces a degree of uncertainty into the magnitude of the estimated carbon emissions for a product or process. Hence, when standardised emission factors are used it would be appropriate to present the variation in published emission factors to derive upper and lower bounds for any carbon footprint. But this further complicates the task of presenting information to consumers in a clear and simple way.

14. Meta-analysis provides a means of assessing and combining empirical results from different studies. The approach takes as individual observations the point estimates of relevant parameters from different studies, which are then used to derive an overall estimate of the relevant variable.

The *system boundary* defines the extent of processes that are included in the assessment of GHG emissions, and estimates of the carbon footprint of a system will depend on where the system boundary is drawn. In the absence of an agreed framework for calculating a carbon footprint, there is the potential to draw the boundary in different ways.¹⁵ For example, when considering agricultural activities the system boundary should include emissions arising from the manufacture and distribution of farm inputs, and the transport of these inputs to the farm, as well as any impacts related to their direct use on-farm (such as emissions related to the use of fertiliser). However, the boundary could be extended to include emissions from soils related to fertiliser use and manure management and further to consider the flow of GHGs into and out of soils and plants in the productive and non-productive areas of the farm, such as woodlands.

Decisions have to be made on whether to include, *inter alia*, manufacture of capital goods, such as tractors, buildings, and transport equipment, routine maintenance of machinery, transport of employees, transport of consumers to retail stores and transport of the produce to consumers' homes. Such decisions will have important implications for the outcomes of carbon footprinting. For example, the methodology proposed by the Carbon Trust excludes emissions from the production of capital equipment; this will tend to favour capital-intensive techniques over labour-intensive processes and hence will be to the disadvantage of LICs. The same methodology also excludes emissions from worker transportation. LIC workers generally walk or take public transport to work, while richer countries' workers commute in cars.

5.2 LICs' carbon efficiencies

The choice of data sources, emission factors and system boundaries will influence LIC trade, but at the current state of knowledge it is not possible to foresee the direction of this influence. We simply do not know enough about the carbon efficiency of LIC production systems. We have much better knowledge about the transportation segment and, although air freight will often be a critical element, transportation in general does not look like a big problem.

The issue of the location of processing activities and how this affects the overall carbon footprint of a product may arise. In the case of the consumption of chicken in Sweden reviewed in Section 3 above, it may be more efficient from a carbon perspective to process the chicken close to the origin of the feed and then ship to the final consumer rather than ship the feed and process the chicken closer to the consumer. Traditionally, the location of the point of processing in agro-food supply chains has been based on a range of criteria, one of which being energy costs. With climate-change considerations on the rise, energy use will become more costly and the location of processing might change to low-income countries in some instances. Local processing will save on transport-related emissions, as the final product will contain much less

15. One has to be aware that the discussion of system boundaries is only relevant for process-based lifecycle and hybrid analyses. Input-output-based lifecycle analysis avoids this problem as it relies on a complete description of the whole economic system (Minx et al., 2007; Hendrickson et al., 1998; Leontief and Ford, 1970).

waste. For example, in the case of meats, only a fraction of the feed is converted into meat.

Relocation of processing to LICs is more likely when fewer carbon-emitting sources of energy are utilised to process the product. The evidence of Fogelberg and Carlsson-Kanyama (2006) further calls into question the 'buy local' campaign's claims that local sourcing is carbon-efficient. In today's globalised world, so-called local products rely on transported intermediary inputs, for instance, oil. There is no reason to expect, *a priori*, that the carbon emissions of local production plus transport of inputs are lower than foreign production plus transport of the end product. The final outcome of carbon accounting for processed products including agri-foods is likely to be supply-chain-specific.

The information we currently have on the domestic segment of the supply chain is piecemeal. However, it may be useful to speculate on its potential implications. The agricultural capacities and technologies of LICs are likely to give rise to new opportunities for exports to rich countries if carbon emission considerations and effective labelling schemes render the use of carbon-intensive inputs such as agro-chemicals and fertiliser by producers in rich countries a constraint upon competitiveness, compounded by dependence on fossil fuels.

Fertilisers tend to be used much less intensively in countries with lower incomes. Similarly, production is less mechanised, with much smaller use of tractors and other equipment using fossil fuels. In low-wage countries production is typically labour-intensive, and energy-using capital equipment, which also embodies energy expended in its production, is used much less intensively than in higher-wage countries. Livestock rather than machines are often used for a number of agricultural tasks.

5.3 LIC representation

The strong desire to act on carbon labelling has been running ahead of consideration of the methodological difficulties of measurement and the problems of effective communication through labelling. A growing number of standards are being developed with little effort to co-ordinate and generally little or no voice given to small stakeholders and to LIC concerns, with large players dominating discussions. The technical capacity and the resources needed to participate in standard development are considerable and may be the main cause of the lack of involvement so far.¹⁶

The development of appropriate standards for environmental and social purposes is difficult, due to the many opposing interests involved. The Code of Good Practice developed by the ISEAL Alliance has become the 'gold standard' for how such

16. The Kenyan fresh produce and flower industry has participated in the discussion in the UK on carbon and organic labelling. The National Taskforce on Horticulture of Kenya made a formal submission to the Soil Association pointing to the industry's renewable energy use and the importance of export horticulture for the country. The industry also commissioned the lifecycle analysis of Kenyan and Dutch flowers discussed earlier. It has also created its own campaign entitled 'Grown under the sun' that seeks to inform the consumer about the Kenyan industry and the role it plays in climate change and in poverty eradication efforts in the country. However, the Kenyan example is the exception, and most carbon-labelling initiatives are currently being developed with little input from LICs.

standards should be set.¹⁷ To develop an effective standard, in terms of meeting the objective set and of achieving the acceptance of the companies and consumers supposed to use the standard, requires a healthy mix of stakeholder consultation and use of good science. Most carbon-labelling standards are currently being developed in a way far from ISEAL-type requirements. Some are being developed in an open structured manner, notably the publicly or semi-publicly developed standards such as the Carbon Trust pilot methodology, BSI's PAS 2050, the standards of the Soil Association and KRAV. On the other hand, many emerging standards are private requirements where most of the details about their development are unavailable.

5.4 Impact assessment and emerging solutions

Another issue of concern is the lack of impact assessment of the evolving standards. The costs of compliance remain unknown and therefore there are no efforts to identify ways in which these may be lowered by adopting appropriate strategies of compliance or by modifying the standards themselves. The debate surrounding the potential exclusion of air-freighted products from the organic certification of the Soil Association is the only example of an attempt to consider the consequences of implementing carbon-labelling standards. The debate remains locked at a technical level centred on setting the standards that on paper would yield an impact of carbon emissions, but it fails to consider how they would function in the real world of implementation and compliance costs. It is important to emphasise that cost-effective standards are not just a purely economic consideration but will in the end determine their environmental effectiveness in mitigating climate change, since cost considerations will be a key driver behind their adoption by market players.

So, it is clear that carbon labelling involves complex technical issues and faces a number of challenges if it is to be a useful tool for reducing carbon emissions in a way that does not exclude small players. There is a need to support an emerging body of independent scientific evidence to ensure that standards are soundly based, whilst allowing for all stakeholders to participate effectively in the standard-setting process. A number of recent initiatives dealing with environmental and sustainability issues have addressed some of the critical issues that face carbon labelling, in terms of design and process. These can provide important insights for the development and practical implementation of carbon-labelling schemes.

17. The ISEAL Alliance is an open membership association for international social and environmental standard-setting and conformity-assessment organisations that seek to meet objective criteria for credible operating practices. Its Code of Good Practice stipulates, among other things, that standards be developed according to documented procedures including published work programmes, with enquiry points to which comments may be submitted, and with well published periods for commenting and a procedure for taking account of comments submitted. Furthermore, the standard-setting process must strive for consensus among a balance of interested parties, and standards must be published and subject to periodical review. The aim of following such codes of good practice is to ensure that a final standard meets the intended objective and will be acceptable to its targeted end users among companies and consumers rather than ending up as a tailor-made instrument for the use of vested interests. The Carbon Trust has begun a collaboration with the ISEAL Alliance.

While most activity on carbon labelling has been undertaken in the context of voluntary standards, the EC Commission has recently proposed a new regulation that includes mandatory requirements for measuring the carbon footprints of biofuels (Commission of the European Communities, 2008). Biofuels have been subject to controversy as claims have been made that biofuels grown under certain conditions may actually lead to more carbon emissions than they save.

The EC Commission has designed a scheme to ensure that the use of biofuels does have climate-change benefits. By 2020, it proposes that 20% of overall energy consumption should come from renewable energy, while 10% of fuels used for transport should come from biofuels. Biofuels used for compliance with the regulatory requirements (and that are entitled to benefit from national support systems) will be required to fulfil criteria for environmental sustainability, namely: (i) they must lead to at least 35% carbon savings; (ii) they must not be produced on land with high carbon stock; and (iii) they must not be produced on land with high biodiversity value. The last two requirements have been introduced to address concerns about emissions from changed land-use patterns and fears that relying on biofuels may harm other social objectives, notably biodiversity.

The EU scheme bears many resemblances to carbon-labelling schemes, although its nature is quite different since compliance is mandatory. It has already defined a methodology to measure the carbon footprint of biofuels as well as a way to use the measurements, including attempts to keep down the administrative costs. The proposed legal text allows for the use of default values laid down for common biofuel production pathways on the basis of typical values derived from independent scientific analysis.¹⁸ These default values vary by region. Producers of biofuels are entitled to claim the level of carbon savings established by these default values. However, if a producer feels that they are more efficient than implied by the relevant default value, they may use actual values if they use the LCA method defined in the regulation.

A number of other approaches to environmental issues provide examples of how developing countries can be effectively included. For example, the Roundtable of Sustainable Palm Oil, which has sought to deal with the issue of land-use changes although carbon emissions are not covered, has considerable developing-country participation and is addressing the concerns of small developing-country producers, for example, through the establishment of a smallholder task force.

6 Conclusions

There is clearly a momentum behind the idea of carbon labelling from consumers, producers and increasingly policy-makers. What is uncertain is precisely where it will lead. What is apparent is that simple, cost-effective methodologies for measuring carbon emissions will be required for carbon labelling to be broadly applied. But carbon-

18. The proposed directive does incorporate results for pathways of relevance to developing countries: sugar cane and palm oil. With regard to the potential carbon efficiencies of developing countries, it is interesting to note that sugar cane ethanol is identified as the best-performing technology in terms of carbon reductions. This supports the notion that a comprehensive approach to LCA in carbon labelling schemes is likely to identify developing countries as a low emissions source of agricultural products.

labelling schemes must also be designed so as to capture the complexity of carbon emissions and the many opportunities for reducing emissions that exist along international supply chains. Emissions from transport can be more than offset by efficiencies in other stages of production and distribution. Hence, intuitively appealing concepts such as food miles and buy-local campaigns cannot address the complexity of carbon emissions, will distort trade and may even increase emissions. Geographical location alone is a poor proxy for overall emissions; favourable production conditions may more than offset a disadvantage in transport. Hence, these concepts have nothing to offer in terms of climate-change mitigation.

Given their favourable climate and the use of technologies that are typically less carbon-intensive than elsewhere, the interests of low-income countries must be properly reflected in the design and implementation of carbon-labelling schemes. However, the potential for LICs to exploit the relative emission efficiencies that they possess depends on their ability to measure and verify emissions in a cost-effective way.

The development community can play a positive role on three fronts. First, with regard to knowledge, through support for the expansion of the scientific base and dialogue upon which the standards are being built. Second, on the advocacy front, it needs to ensure that the interests of LICs are properly represented in the debate and design of carbon-labelling standards. Finally, on the operational front, it should assess the capacity of LICs to participate in carbon-labelled trade and help ensure that new opportunities for exports are exploited. Effective participation in carbon-labelled trade will require the infrastructure and institutions that provide the necessary measurement and certification mechanisms that are often lacking in low-income countries.

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Appendix 1: Carbon terminology

Carbon	Shorthand for all greenhouse gases. Refers more directly to carbon dioxide which is the most common GHG.
Carbon emissions	Emissions of all GHGs
CO ₂ e	Carbon dioxide equivalent, measurement unit that translates the effect of all GHGs into carbon dioxide
Carbon footprint	Carbon emission caused by an activity
Carbon accounting	Measurement of carbon footprints
Carbon labelling	Display of the measurement of carbon footprints on a product. Also used to refer more broadly to the use of carbon accounting information
Carbon efficiency	Ability to have minimum GHG emissions
Carbon tax	Tax on emission of GHGs
Carbon hotspot	GHG-intensive activity in the supply chain
Carbon competitiveness	Ability to compete in terms of low GHG emissions
Life cycle analysis	Analysis of, in this context, GHG emissions throughout the various segments of a supply chain from primary production to end use and waste disposal. A comprehensive analysis takes into account emissions related to changes in land use.

Appendix 2: Carbon-labelling initiatives

Initiative	Aim	Context	Measurement methodology	Display methodology
Tesco (UK)	Long-term aim to carbon label all 70,000 products	Part of broader company goal to become more environmentally sustainable	Co-operate with the Carbon Trust. Preliminary use of air freight as proxy for climate change impact	Co-operate with the Carbon Trust. Preliminary label air-freighted products with airplane symbol
Casino (France)	To carbon label 3,000 of own-brand food products	Part of broader company goal to become more environmentally sustainable	Developed and BIS endorsed by French Environment and Energy Management Agency	Use a colour code denoting amount of CO ₂ emitted in manufacturing, packaging and transporting product, amount of packaging to be recycled
Migros (Switzerland)	To identify best performers in product range	Company goal to reduce climate impact	LCA developed by Climatop in collaboration with Ecological Centre	Labels products with least carbon footprints as 'CO ₂ champions'
Coop (Switzerland)	To reduce air-freight	Company goal to reduce climate impact	Simple indication of whether product was air-freighted	Air-freighted products labelled with airplane sticker
Carbon Trust (UK)	To promote labelling as part of general climate-change mitigation strategy	UK government goal to facilitate carbon labelling	Carbon Trust Pilot Methodology	Label products with grams of CO ₂ e and with downward pointing arrow indicating commitment to reduce emissions
BSI-Carbon Trust-DEFRA (UK)	Develop a potential, internationally applicable, measurement standard	UK government goal to facilitate carbon labelling	Develop fast-track standard for embodied carbon footprint measurement based on Carbon Trust pilot methodology	Not part of measurement methodology
Soil Association (UK)	Include climate change considerations in organic labelling	Desire to broaden understanding of organic agriculture to include climate-change considerations	Use air freight as proxy for climate change impact	Suggested to deny organic certification to air-freighted products
Wal-Mart (US)	To develop 'carbon scorecards' (indicators of carbon emissions of suppliers)	Drive towards ethical profile/large carbon footprint reduction goal	Own designed	No plans to display information to consumers. Presumed use of information as performance benchmark of suppliers

Patagonia (US)	To display environmental information on flagship products to the consumer	Part of company strategy to be environmentally sustainable	Own-designed simplified LCA	Display of information on individual product. Use of website to provide in-depth information
Timberland (US)	Long-term to display environmental information on all products to the consumer	Part of company strategy to be environmentally sustainable	Own-designed simplified LCA	Uses 'green index tags' on scale of 0-10
General Motors	To start a process of awareness about carbon emissions	Operates in a market where environmental awareness is on the rise	Unknown	Internal use of information, transfer of knowledge and technology
Carbon Disclosure Project	Set up Supply Chain Leadership Collaboration to create a standard to measure and manage emissions through supply chain	A not-for-profit organisation aiming to be largest repository of corporate carbon emission data in the world	Own-designed simplified LCA	Not designed for display but for supply chain management use
Reckitt Benckiser	To measure embodied carbon footprints so as to make reduction goals credible	Part of company commitment to reduce carbon emissions (embodied carbon footprint) by 20% by 2020	Own-designed simplified LCA	Not designed for display but for recording of embodied carbon emissions savings
Home Depot	To label products with sustainability information including carbon emissions	Part of company strategy to demonstrate environmental awareness	Unknown	Individual product labelling with range of sustainability indicators including carbon emission data
KRAY	To develop a label that may be used to carbon label both conventional and organic food	Joint industry and KRAY desire to avoid multiple climate labels	Defines climate-friendly production practices and labels accordingly rather than measure exact emission level	Not decided
Dell Computers	To commit suppliers to measure carbon emissions and to reduce them	Part of company strategy to demonstrate climate-change awareness	Unknown	Not for labelling individual products, but individual suppliers have to disclose emission data to the public
EU biofuel regulation	To define what constitutes a biofuel in order to facilitate compliance with forthcoming EU regulation	Introduced binding requirements for renewable energy use incl. biofuel use. Required definition of what constitutes a biofuel	Based on LCA taking complex issues like land-use changes into account	Not for display but to prove compliance with regulation