

Carbon Labelling: Public Perceptions of the Debate

Summary report

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Accompanying video

The DVD used to aid discussion in the focus groups can be viewed here:
<http://vimeo.com/2727318>

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Executive summary

This report is an applied summary of the results of a research project funded by the University of Manchester Sustainable Consumption Institute (SCI), undertaken by researchers at Tyndall Centre Manchester and Manchester Business School. The review is part of a wider SCI study of the public perceptions of carbon labelling, involving the Dept of Psychology at the University of Manchester (Principal Investigator being Prof. Geoff Beattie).

Here, we first provide an overview of (mainly UK) corporate and agency activity on carbon labelling, up to mid-2008. We then provide an overview of the controversies associated with carbon labelling, as a supplement to the market research on public perceptions of carbon labelling undertaken by Tesco Plc, Boots Plc and others. The controversies and value of carbon labelling were subsequently discussed in focus groups with the public. The detailed results of those focus groups are available in a separate, accompanying report by Vision Twentyone; here we provide only a short commentary on the results in the concluding section.

Interviews with stakeholders and review of the 'grey' material on carbon labelling reveals substantial divergence of opinion on its value: environmental managers, NGOs and commentators clearly held a range of views on the practice as of Spring 08. Although environmental life cycle analysis has been practised for several decades, high-profile, extensive carbon labelling of grocery products is at a relatively early stage and disagreement and debate should not be surprising. The debates can be summarised as follows; there are opposing and nuanced views on each position:

- Applying and publicly communicating the results of a product-based reduction standard is not the best way of reducing corporate GHG emissions. Even from a narrow corporate environmental management perspective, existing environmental standards such as ISO 14001 and EMAS, which can be applied at an organisational level, are a better way of bringing down GHG emissions.
- A product related emissions reduction standard should be delayed until there is greater consensus on how to measure product related emissions and experience in doing so and/or sufficient information to develop benchmarks.
- The Carbon Trust should develop guidance rather than a standard.
- Issues related to measuring carbon footprints, particularly boundary issues, need to be clarified prior to attempting to define 'reductions'.
- A numerical product label will not provide a frame of reference within which consumers may judge product-related emissions. A 'best-in-class' approach or product sector banded approach that provides a 'traffic-light' or A-G rating system, as is currently used for rating the energy emissions of white goods, should be developed.
- The use phase should be excluded from reduction claims, as claims relating to this phase are impossible to demonstrate.
- There is uncertainty that the data used, in particular the emission factors, will be the most reliable and the most recent.
- There is concern that requiring external verification goes beyond the requirements in Type III labelling requirements as defined by ISO (where self-verification is permitted).

There are many more specific contested issues in addition to the above, but most relate to the efficacy of carbon labelling. This is particularly so relative to alternative actions that consumers and citizens could take instead of (or in addition to) purchasing the lower carbon variant of grocery products. For this reason we have appended some illustrative calculations for use in our focus groups. At the extreme, for example, we show that an individual would

need to make at least some 32 years of daily purchases of lower carbon orange juice to 'save' the same quantity of carbon dioxide emissions as a family of four avoiding a flight from Manchester to Malaga for a holiday, in favour of travelling to Bournemouth for a domestic holiday. With a less extreme example (though only in terms of Tesco's data supplied to us), e.g. for potatoes, at least 1.8 years of daily lower carbon purchases would be required to make the same 'saving' as avoiding a flight. We are not suggesting that grocery-related emissions are negligible: due to their volume, in aggregate they are not. We are saying, though, that, to be effective on the timescale that climate change emissions reduction must take place, consumers would need to act on carbon labels en masse.

It should not be surprising to find that carbon labelling is contested, nor to find that this is for different reasons. It should be noted that there is more agreement on the value of firms commissioning product-based LCA studies, which are of course a precursor to labelling. LCA can help to identify emission 'hot-spots' in the production chain that can be subsequently addressed, with associated emissions and cost reductions. Extensive labelling itself, however, clearly raises the stakes for suppliers and retailers in terms of cost and reputation, and this appears to be behind much of the corporate-level concern. We suggest those firms that have decided to go forward with carbon labelling have done so because they have judged, on the basis of market research evidence, that the labelling has positive associations for consumers, despite the prospects for behaviour change being relatively small. Moreover, relative to inaction on product LCA, carbon labelling is of course preferable.

Our main points are that:

(a) In terms of GHG emissions reduction, the main benefits of carbon labelling are likely to be incurred not via communication of emissions values to consumers, but upstream via manufacturers looking for additional ways to reduce emissions. This point is quite widely accepted as applying to eco-labelling in general.

(b) The final stage of trying to communicate numerical values to consumers on product packaging may not be the best option, even in terms of a label-based approach to changing consumer purchasing behaviour.

(c) We suggest (b) above because most consumers find it difficult to make sense of grams of carbon relative to their lifestyle emissions, and because even though this can likely be remedied by providing further information, for most consumers, purchase of lower GHG substitutes is only likely where they perceive complete product equivalence. This would require ignoring brand-related and other marketing, much of which is designed for the opposite purpose, i.e. to make products distinctive relative to their competitors.

(d) As a result, consumer use of carbon label values on grocery products is likely to be of limited value as a greenhouse gas reduction measure relative to other actions open to consumers and stakeholders (both along the supply chain and at government level). This does not make it useless, but it should not distract from the need to make more substantial changes. A stronger case can be made for communicating emissions values to consumers more selectively, where products have substantial emissions differences.

(e) Although some proponents of carbon labelling intend it to be used at face value, i.e. to facilitate lower GHG consumer choices, in practice the primary function of the label is likely to be one of improving the public environmental image of the companies involved.

(f) It is too early to judge whether increased public exposure to a carbon-related symbol will, in a small way, help to foster the conditions in which more substantive emissions-reduction becomes politically acceptable, or, conversely, whether it will foster the misguided belief that such action is already underway.

In terms of our own carbon label focus groups, all three were conducted with people from Manchester from a range of social and economic backgrounds, in November 2008. One group consisted of people with a stronger pro-environmental stance than the other two. An educational DVD was developed for the groups, explaining carbon labelling in stages and posing questions for discussion. The DVD can be viewed at: <http://vimeo.com/2727318>

In general, the focus group results concurred with the previous attitudinal research summarised here and many of the points raised by stakeholders. That is, there was majority (i.e. not universal) support for carbon labelling as a practice and for the footprint logo, but doubt expressed as to its efficacy, particularly in relation to people's ability to make sense of the numerical values. This difficulty in comprehension was echoed in the DVD, for which shoppers were interviewed in a Tesco supermarket and asked about the carbon labels on Tesco products. When exemplar numerical values were contextualised for the focus group participants using the flight emissions values referred to above, the 'green' group found that this helped them understand the product footprint values. However, the non-'green' participants reacted negatively, taking the view that there was little point in buying lower-carbon grocery products if the carbon saving is small in relative terms. This bears consideration if and when carbon labels become more widely used: it would support a case for applying them selectively, where substitutable products have substantial emissions differences (e.g. for light bulbs).

Overall, our view is that this study evidences stakeholder and public support for use of the Carbon Trust PAS 2050 process and footprint logo, and for the view that companies will likely enhance their public reputations through association with these. However, we think the study also supports the views of stakeholders who have expressed doubt about the emphasis on public-facing product labels that attempt to communicate numerical values for the associated GHG emissions in a grocery context. It is this stage of the process that we think needs reconsideration. Our own view is that, for most grocery products, it may be better to use the footprint logo simply to indicate that the product is part of a carbon-reduction programme supported by the PAS 2050 process, with further detail available on a website, supported by a marketing campaign. The more important point, however, is that the emissions savings available from most substitutable grocery products are *relatively* small and that few consumers are likely to change their consumption patterns based on the information provided. Changing the upstream production processes, particularly the fuels used, and changing the more substantive aspects of consumption, such as travel behaviour and demand for low carbon energy, are in general much more important than communicating the associated values to consumers.

A stronger case can be made for communicating emissions values to consumers more selectively, targeting work where products have substantial emissions differences: using Tesco's examples, it is notable that the emissions saving arising from the lower carbon lightbulb are 45 times those of the highest emissions saving from a low carbon grocery product (uncooked potatoes relative to mash potatoes).

1. Introduction

This report is an applied output of a research project funded by the University of Manchester Sustainable Consumption Institute (SCI), undertaken by researchers at Tyndall Centre Manchester and Manchester Business School. The purpose of the study was to investigate public perceptions of the more controversial aspects of carbon labelling. This is intended to supplement commercial market research on public perceptions of carbon labelling, undertaken by Tesco Plc, Boots Plc and others (much of which is not publicly available, and, for this reason, is summarised here). A partner SCI study by the Department of Psychology at the University of Manchester is using non-discursive techniques to investigate consumer perceptions of carbon labelling. This report is not a comprehensive overview of carbon labelling, but provides contextual material subsequent focus groups, the results of which are commented on in the concluding section. A separate, stand-alone report by Vision Twentyone describes the focus group results in more detail and further academic papers will relate these to theoretical literatures.

1.1 Rationale

There are three specific reasons for undertaking a study of the controversial aspects and debates relating to carbon labelling. The first is that although companies will inevitably conduct their own market research into consumer perceptions of labels, these will likely be referenced to their own brands or sales, the research findings will not quickly reach the public domain and they may well neglect wider, contextual issues. Second, studies of public perceptions of and attitudes to climate change show that context is important. People are more likely to act in 'environmentally-friendly' ways if they believe that their actions will be effective and that they are not being asked to make an altruistic sacrifice ('I will if you will'). Carbon labelling potentially increases the salience of environmental sustainability as a purchasing issue, but labelling may also confuse or be ignored. We thus aim to study carbon labelling in its wider perceptions and opinion context, to identify how people conceive of it in relation to other priorities (if at all). Thirdly, we have known for some time that carbon labelling is conceptually and methodologically contested and debated by stakeholders and commentators. At some point this debate may well be brought to the attention of the wider public, perhaps through a disputed claim, and the ways in which this may play out may be implicitly prefigured in the project findings. While much of the Carbon Trust's efforts are designed to minimise this possibility, it cannot be eliminated and may be driven by circumstances beyond their control. In short, carbon labelling needs to be judged in its wider context.

At a different level, a further reason to investigate carbon labelling is the significance of end-consumption for national and global GHG emissions and other impacts. In a review of LCA studies of the impacts of European final consumption, Tukker et al (2006) identified four product groups as consistently occurring in the higher percentiles when products are ranked by impact: cars, food, heating and the production and fitting of new housing. Using their own input-output model (which, as is usual, assumes specific, fixed ratios between units of monetary flow in an economy and units of environmental impact), Tukker et al (ibid) conclude that some 20% of product groups account for some 80% of impact (some 60 product groupings out of 283). (It should be noted that passenger air transport is one of several product types under-reported in this method (ibid: 14)). Note that this form of analysis takes the volume of consumption into account (i.e. relatively small per-product impacts are scaled up due to their frequent purchase).

Tukker et al (ibid) found that 22 product groups are responsible for half of the impact in each impact category. However, taking into account their study and all the others reviewed, Tukker et al (ibid) found that *food and drink, transport and housing (especially heating and*

electricity) are consistently the most important areas – across both different studies and across different impact categories (global warming, acidification, photochemical ozone formation, and eutrophication). Together these few forms of consumption account for 70-80% of the life cycle impact of all products.

Looking at this 70-80% in more detail, 'Housing, furniture, equipment and utility use' (CP04 and CP05 in the COICOP classification) makes up 20-35% of total impact in most impact categories. Household space and water heating is consistently one of the most important contributors for each impact category in all studies (ibid). 'Food and drink, tobacco and narcotics' (CP01 and CP02) are responsible for 20-30% of the total environmental impacts of end user consumption. Within this, meat and meat products have the greatest environmental impact, with an estimated contribution to global warming is of 4-12% of all products (ibid).

Most studies identify Transport (CP07) as contributing some 15 per cent to global warming potential and acidification of all products, though less to eutrophication and more to photochemical oxidation (ibid). Within this category, all studies indicate cars as by far the largest contributor: private cars and other private motor vehicles account for about 80% of the transport related impacts of consumption. However, Tukker et al (ibid) rightly point to the treatment of air transport as a problem, with very likely under-counting of emissions, especially, but not only, for international flights.

A further factor worth mentioning, but not explored in detail here, is that there is likely to be significant differences between groups of individuals in terms of their consumption impacts. The values given by Tukker et al (ibid) are for the EU25 as a whole. As an example of the striking disparities in consumption that averages can hide, recent examination of French transport statistics (Gössling et al, forthcoming) reveals that 5% of the French population are responsible for 50% of the transport CO₂ emissions of the French population. Those contributing most to that 50% are people taking frequent long haul flights for business and leisure (ibid). The emissions savings that could be made by avoiding one long haul flight or using the train instead of a short haul flight would hugely exceed the emissions savings consequent on choosing lower emission grocery products on the basis of carbon labels. This is an issue we illustrate and will discuss in the focus groups. It is not to imply that one should give up on the little things (not make small savings), but it is to suggest that large retailers with carbon label programmes and travel businesses should think very carefully about which products to prioritise.

1.2 Carbon label research and practice

This section summarises publicly available, on-going research and practice relating to carbon labelling, particularly in the UK. Although carbon labelling per se is relatively new, in so far as it refers to a consumer-facing label that states the mass of carbon dioxide released over the life cycle of a product or service, environmental and social labelling is of course not new and forms a historical context to carbon labelling. DEFRA provides a guide to 'green labels'¹ as an introduction to the wide range of national and international labels that exist. Of particular relevance are the European energy label and eco-label schemes, and the UK fuel economy label. The European energy label is not life cycle based but relates to energy consumption in the use phase and bands appliances in terms of their performance in a similar class. In the UK, this is supplemented by the Energy Savings Trust's 'energy saving recommended logo'. The European eco-label is loosely based on a life cycle approach, in that products must meet particular criteria in different aspects of their life cycle, but there is no summation of inputs and outputs through the life cycle stages to give a single index, as in LCA and carbon

¹ <http://www.defra.gov.uk/Environment/consumerprod/glc/index.htm>

labelling. Nonetheless, we are here focussing on carbon labelling as derived via LCA, and particularly on UK activity.

1.2.1 The Carbon Trust initiative

The Carbon Trust is a private company established by the UK government, with the stated aim of facilitating a low carbon economy. It has been working with several UK companies to develop and trial a publicly backed, standard measure of the carbon emissions associated with a product through its life-cycle, intended to help consumers in their decision-making towards lower carbon emissions. Displaying a Carbon Trust label will commit a company to reducing the carbon emissions associated with a product within two years (Carbon Trust, 2008a).

Three key documents are being developed by or for the Carbon Trust as part of this process, each of which is intended to define associated terms and procedures:

- A standard LCA method for GHG estimation. This is being developed as a Publicly Available Specification (PAS 2050) of the British Standards Institution (BSI), sponsored by the Carbon Trust and DEFRA.
- A Product-related Emissions Reduction Framework (PERF) intended to define the requirements for making credible claims regarding reduction commitments and achievements when using the PAS.
- A Product-related Emissions Communications Guidance document intended to support companies implementing either or both of the above in their communication of LCA GHG results (Carbon Trust, 2008a; OneWorldStandards and Arup, 2008; superseded by Arup et al, 2008, itself still a draft at the time of writing).

The development of the PAS 2050 began in June 2007, when the Carbon Trust and Defra approached BSI Standards Solutions to oversee the development of the specification (BSI, 2008). The process has included an extensive stakeholder engagement process, including two consultation documents, input from expert work groups, support via commissioned research (e.g. Minx et al, 2008), and insights arising from testing the draft standard with pilot companies.

BSI (ibid) define a PAS as a consultative document with a development process and format based on the British Standard model. BSI state that the main difference between a PAS and a British Standard is that the latter must reach “full consensus between all stakeholders on technical content, whilst a PAS invites comments from any interested party but does not necessarily incorporate them.” (ibid). The PAS 2050 is intended to apply to all goods and services, with consideration given to how and whether it may need customising for specific product groups. It is intended to consider all lifecycle stages, the six GHGs identified under the Kyoto protocol and be suitable for use by all sizes and types of organisation. It is also intended as the first step towards a future internationally agreed method for organisations to measure the GHG emissions embodied in their goods and services (ibid). At the time of writing, the publication date for the PAS 2050 is autumn 2008 (ibid).

1.2.2 Examples of retail firms involved in carbon labelling

Both Berry et al (2008) and OFN/OEA (2007) provide an overview of corporate carbon labeling activity as of 2007/early 2008. This includes the following (sources are Berry et al [2008], OFN/OEA [2007]) and the FCRN e-list [Tara Garnett]:

Companies working with the Carbon Trust, UK

As described, several companies have worked with the Carbon Trust, including PepsiCo for Walkers Crisps, and Innocent Drinks.

Max, fast food chain, Sweden

Max announced in May 2008 that it had put detailed information about the carbon impacts of its products onto its menus.

Casino, supermarket, France

Casino is trialling an on-pack traffic light carbon label that highlights whether a product has a high (red), medium (amber) or low (green) carbon impact in terms of waste, packaging and transport (EC Bio Intelligence Service, 2008).

Sapporo Breweries Ltd, Japan

Sapporo Breweries Ltd. plans to introduce a carbon label on its 350-milliliter cans of Black Label draft beer in the first half of 2009, once the Economy, Trade and Industry Ministry in Japan issues unified calculation rules on this (Daily Yomiuri Online, 2008).

Carbon Action Plan (beverage industry)

An initiative of the beverage industry, the carbon action plan a CO₂e measurement protocol for its sector, as part of a wider initiative on sustainability measurement. The primary pilot was undertaken by Highland Spring, the UK's largest bottled water producer, and the scheme will underpin carbon labelling, for which designs have already been developed and copyrighted (Carbon Action Plan Partnership, 2008).

Tesco own brand labelling

In May 2008, Tesco in the UK launched a pilot of 30 carbon labelled, own-brand products. The product groups include: light bulbs, orange juice, tomatoes, potatoes and laundry detergent. Plans as of February 2008 were for the label to be on the pack and shelf-edge, with a pamphlet to be sent to 1 million of the greener clubcard users and to be available instore and on-line. Tesco have designed a second generation of carbon labels (i.e. the build on earlier efforts by Walkers crisps) and have given the intellectual property on these to the Carbon Trust. The Carbon Trust will act as verifier of the data collated by Tesco from suppliers (i.e. that the data was collected according to Carbon Trust protocols, as specified in their Publicly Available Specification. ERM was the consultant on the pilots. Tesco have 40,000 own label products and scoping of priority products is underway at the time of writing. The following sections summarise the commercial public opinion material available to us, provided by Tesco.

1.2.3 Commercial research on carbon labelling perceptions

At the time of writing, little commercial public opinion material has entered the public domain. The material on previous studies presented here reflects only short summaries of several studies that have informed Tesco's work on carbon labelling. We assume that there is more work available that we do not have access to.

1.2.3.1 Pepsico/Populus: quantitative

Consumer perception studies available to Tesco include a programme of 6 focus groups run by Populus Ltd for Pepsico² in Birmingham, Leeds and London between the 12th and 21st November 2007. These consisted of people who shopped across the range of main supermarket chains:

- 2 groups of non-primary shoppers (Men 35-54, C2DE; Women 18-34, C2DE)
- 2 groups of primary shoppers (Men 18-34, ABC1; Women 35-54 C2DE)

² Pepsico brands include Walkers crisps, an early carbon label trialist (see section 1.2.1).

- 2 groups of "Concerned Consumers" – those who say that ethical considerations shape their purchasing behaviour (Men 18-34, ABC1, Women 35-54, ABC1)

The Populus study confirmed that few people think about the environment at all when shopping (this lack of 'top of mind' awareness of environment is common in other contexts – e.g. Bellaby and Upham et al, 2007, in relation to public opinion of transport). Even the "Concerned Consumers" – who generally do try to take account of some of the environmental and ethical implications of their purchasing decisions – had little understanding of how shopping relates to carbon emissions in particular. Most "Non-concerned Consumers" take little notice of existing labelling on nutrition etc., and would be no more inclined to take the time to read carbon labelling. Nonetheless, carbon labelling is generally seen as a positive – or at least benign – initiative. But many resent the onus it places on the consumer when they are already 'doing their bit for global warming', usually by recycling or trying to be more energy efficient.

Populus found cynicism about the motives of companies that provide carbon labelling. Most people assumed that the primary objective is simply to sell more products, rather than to reduce carbon emissions. This impression is strongly reinforced if consumers perceive the product packaging to be in any respect short of what they regard as best environmental practice – and/or if there are other ways in which they think the company in question fails to show a consistent commitment to tackling climate change. Consumers overwhelmingly said they would not be willing to pay a premium for a carbon-labelled product – even those who say that they might accept paying a little more for ethically, locally-sourced or organically-produced products. There was a general underlying assumption that products labelled as having a relatively lower – or reducing – carbon footprint would probably be more expensive.

In terms of information content, the Populus study found that consumers feel that if carbon labelling is to be adopted more widely, it should be prefaced or accompanied by a broader explanatory advertising campaign. The carbon label itself also needs to be simple, clear and eye-catching – and, in the view of many, on the front of packets, not the back. Some thought that carbon labelling should incorporate a traffic-light system. People were sensitive to information-overload on packaging and felt that if there is too much data on the label it will simply be ignored. The approaches showing tracked reductions in carbon emissions over time – whether past or future – fell into this category. The study also found that even environmentally articulate consumers are generally baffled by the use of grams as a measure of carbon emissions, particularly in relation to the gram figure for the weight of the product.

Populus found that some consumers found a comparative measure of carbon a little easier to comprehend than an absolute figure in grams. Comparisons are regarded as most relevant if they relate to very similar products (e.g. to other brands of chilled orange juice, rather than to different types of juice or other types of beverage). Many people favoured a simple 'kitemark', indicating that a product manufacturer is committed to reducing carbon emissions. They considered that this would provide the information that busy consumers need, standing out more clearly than a more detailed label while avoiding the use of confusing numbers. Of the different graphical approaches tested, the symbol of the single footprint was overwhelmingly regarded as the best, clearest and most direct; some consumers make an immediate association between a footprint and a carbon footprint.

1.2.3.2 *Pepsico/Populus: qualitative*

Populus have in parallel conducted a quantitative survey for Pepsico on public perceptions of carbon labelling. On awareness and understanding, Populus found a high prompted awareness of carbon labelling but uncertainty as to its precise meaning: 52% had heard of

carbon labelling but were unsure of its meaning; 27% had heard of it and knew basically what it meant (see below); and 21% had not heard of it. When prompted, understanding of carbon labelling was strong: 68% correctly identified it as referring to the 'amount of carbon emitted during the whole life cycle of the product – from seed to store'. This compares to 14% who chose the option stating that it related to the 'amount of energy used in the factory to make the product and 13% who thought that it related to the 'amount of carbon used to make the product's packaging'.

On general perception, carbon labelling was viewed positively by most 'concerned consumers' and others. Thus 72% of concerned consumers and 68% of others strongly or somewhat agreed that carbon labelling 'shows that a company is committed to reducing its carbon emissions'. Majorities in both categories also agreed that carbon labelling assisted on environmental information provision in relation to shopping. Self-anticipated effect on shopping behaviour was more mixed, though: 59% of concerned consumers agreed that it would make them more likely to buy their products, while only 41% of non-concerned consumers agree this. Of course, 41% is much more preferable than 0% (if such self-rating can be relied upon).

In terms of the effectiveness of carbon labelling, respondents were sceptical: 31% agreed with the statement that it allows people to make a modest personal contribution to climate change; 21% agreed that 'it is purely a gesture'; 20% agreed that it is a positive development that more companies should carry out; 12% didn't know or didn't care; 10% found the idea confusing and difficult to understand; and only 6% agreed that 'it is an effective way of addressing the problem of climate change'. The latter is a key statistic that should not be overlooked. On the other hand, Millward Brown's internal tracking for Pepsico was more positive: 75% of 'social influencers' and 57% of others found the carbon logo useful; and 59% of influencers and 45% of others said they would be likely to refer to the logo.

In terms of perception of the company, 44% of consumers (63% of social influencers) agreed that carbon labelling made them more positive about Walkers. Only 3% of consumers (and 1% of social influencers) agreed that carbon labelling made them less positive about the company. However, the level of belief that 'Walkers has reduced its carbon emissions' is limited: 36% of all consumers agreed with this and 52% of social influencers. This is very close to the pattern of agreement with the statement that 'Walkers cares for the environment': 37% of all consumers agreed and 52% of social influencers. It also mirrors agreement with the statement 'Walkers is honest and open about its environmental impact' (38% of all; 56% of social influencers).

1.2.3.3 Boots: quantitative

Boots offered an optional five-question questionnaire to in-store Advantage Card readers in all Boots stores, for the two weeks commencing 7th September 2007. There were a total of 1029 respondents. In terms of understanding of carbon labelling, Boots found that consumers understood that the term 'product carbon footprint' relates to environmental performance but they were less clear about its specific focus on climate change. Thus 28% said that it related to 'climate change', 22% to 'pollution', 4% to 'recycling', 2% to 'fair trade' and 44% to 'all of the above'. 82% answered 'yes' to the question: 'as an individual, do you think you can help to reduce carbon footprints?' When asked whether it was important, on a carbon footprint label, that the actual number of grams of carbon per product was stated, 72% said that it was important. 65% said that a label indicating that suppliers were 'working to reduce carbon' would make them more likely to buy a product. Overall, Boots interpret this as indicating that their customers are positive about carbon labelling.

1.3 Non-commercial studies of carbon labelling perceptions

There are very few publicly available studies of public perceptions of carbon labelling by non-commercial bodies. In fact a recent Forum for the Future study (Berry et al, 2008) is the only one of which we are aware (though it uses a broader definition of carbon labelling than does the present study, including, for example claims to carbon neutrality and on-pack advice). It echoes a viewpoint that is prevalent, if not dominant, in the debates that can be found, for example, at conferences and on the Food and Climate Research Network e-list:

“In our view, carbon labelling every product is not a realistic or indeed desirable goal, especially within the limited ‘window of opportunity’ for addressing climate change. There is, however, value in a carbon label when it gives the consumer a genuine choice (rather than simply being ‘for information’).” (Berry et al, 2008: 1).

Of course this begs the question of which products and services have the most propensity for choice; an issue we return to later. Berry et al (ibid) make the point that “Often the desired consumer response [to carbon labelling] is not certain even amongst sustainability experts.” Again many observers concur: consumers who take environmental and social labelling seriously are already faced with trade-offs that are practically impossible to resolve, most notably where there is a choice among near-identical products of developing country origin that may be produced according to Fairtrade or organic standards. Hence the issues raised by the House of Commons Environmental Audit Committee (EAC) in their 2007-8 examination of environmental labelling, among which are:

- *What should be shown under a labelling system? The Sub-committee would like to assess which criteria should be illustrated by an environmental label, and how overlaps between different concerns could be adequately dealt with.*
- *The case for rationalising environmental labels. The Sub-committee would like to assess whether concerns over the proliferation of environmental labels are justified, and the extent to which consumers are able to cope and engage with the many different labels on the market. (EAC, 2007).*

As of mid-2008, the EAC inquiry on labelling was still in progress and had not yet issued its conclusions.

The Forum for the Future study (Berry et al, 2008) conducted its own stakeholder interviews and focus groups with the public, as well as an omnibus survey³, drawing conclusions that will likely be shared by many observers. These include the view that much of the value of carbon labelling comes from measurement, acknowledgement and action on carbon emissions along the process chain, rather than from communication of numerical values on packaging (ibid). Other actions that Berry et al (ibid) argue have a greater role to play than communication alone include:

- removing the worst-offending products from the shelves;
- promotion of key, lower-carbon options, both non-product (such as driving) and product (focussing on the major energy-consuming products);
- giving consumers options, not just information (ibid).

In the case of products for which carbon labelling makes most sense (by inference, those for which there are high/low emission options – though we would concur that the former should be removed from sale), Berry et al (ibid) identify two main challenges:

³ Forum for the Future held a series of eight focus groups in four different locations across the UK. Participants were split into four lifestyle categories (‘pre-family’, ‘young families’, ‘older families’ and ‘empty nesters’) and into two general categories (‘green’ or ‘non-green’, based on their self-reported behaviour). They also commissioned a telephone omnibus survey of 1,000 adults aged 18+, carried out by ICM Research (Berry et al, 2008).

- Fitting carbon messaging with other sustainability messaging (e.g. Fairtrade/organic/low carbon trade-offs) (echoed by the EAC above);
- Communicating LCA results simply and meaningfully – i.e. in the context of related products or everyday activity (normalisation).

Of these, the former is likely to be the most contentious in the long run. Also of note is the fact that although Berry et al (ibid) found low consumer awareness of the Carbon Trust, there is also a potential credibility gap with retailers (an issue considered in the focus groups commissioned for the present study).

Finally, at the time of writing, a German initiative on carbon labelling is underway that will also 'explore the possibility of communicating PCF to customers and end users, taking into account recent developments in other markets' (Öko-Institut, 2008). Nine firms are working together to measure the CO₂e associated with selected products and services, overseen by WWF, the Öko-Institut (Institute for Applied Ecology), the Potsdam Institute for Climate Impact Research, and THEMA1 (ibid). The Project will work towards an international standard methodology for PCF measurement, in discussion with stakeholders and taking into account existing international initiatives on product carbon footprint methodology. The Project will present its preliminary statements on methodology and communication towards the end of 2008. On the basis of these initial results, the partners and participating firms will consider the continuation and expansion of the Project to include other interested companies. Product carbon footprints are being assessed for the following products: dm-drogerie markt toilet paper, Claristar enzyme, FRoSTA convenience food 'Tagliatelle Wildlachs', Schwarzkopf & Henkel shower gel, Henkel washing powder, sealant, adhesive, REWE Bio strawberries, Tchibo coffee & sporting bag, Tengermann Naturkind organic eggs, T-Home Call & Surf phone and internet connection, and a Tetra Pak beverage carton (Garnett, 2008).

2. Stakeholder Opinion and Concerns

2.1 Introduction

This section describes the opinions expressed by stakeholders in telephone interviews and comments on carbon labelling sent to the FCRN e-list (neither of which have been collated elsewhere), followed by a summary of consultation responses published by the Carbon Trust and finally by a summary of the methodological recommendations expressed by Minx et al (2007) in a report commissioned by DEFRA.

In terms of selection method, firstly stakeholders were identified as having a position on carbon labelling via their presentation at a recent conference on the topic. These stakeholders were questioned on the role and value of carbon labelling (recorded telephone interviews were used, and questions are appended). Secondly, further stakeholder views were obtained by using the comments on carbon labelling sent to the FCRN (Food Climate Research Network) e-list (<http://www.fcrn.org.uk/>) in relation to the BSI/Carbon Trust/DEFRA consultation referred to above. In all, the summary opinions of 16 stakeholders from non-profit, university research, food retail, consultancy research and industry association sectors were obtained. While this cannot be fully comprehensive in terms of capturing stakeholder opinion, to our knowledge we have recorded the main points of contestation and agreement. PAS Steering Group members were not interviewed because they are internal to the Carbon Trust/DEFRA PAS process: although stakeholders, they are also, in a sense, proponents.

2.2 Interview results

Stakeholder opinions and concerns, as identified via interviews, are summarised in Table 1 and the key that follows it. The seven sections of the key match the seven greyed columns of the table: each relates to a topic category about which stakeholders were either directly asked, or on which they commented spontaneously in interviews, or on which they commented in responses sent publicly to FCRN. Each numbered point in the key describes a specific opinion relating to the topic category, and in the table any subscription to that opinion by a stakeholder is denoted with an asterisk.

The asymmetric pattern of asterisked cells in Table 1, together with the substantial number of low percentages of stakeholders holding a particular concern, indicates a wide spread of opinion. Indeed only the cells highlighted in yellow in the final row have above 50% agreement. These relate to items 2, 4 and 5 of the technical aspects of the LCA, namely the concerns about:

2. No inclusion of all relevant emissions, nor other environmental, social, economic impacts/issues (e.g. justice, biodiversity, water consumption).
4. Risk of giving misleading information due to inaccuracy and insufficiency of data.
5. Not robust, comprehensive, comparable and/or specific enough - in particular for all products.

These concerns were shared by, respectively, 56%, 81% and 63% of the stakeholders considered here. The concern that carbon labels are not effective is shared by the next highest proportion, i.e. 44%. Although one can take issue with the representativeness of the stakeholder views considered here, this is nonetheless a relatively high level of concern on key issues, albeit part-way through the label development process. We would expect higher levels of consensus in future, unless unexpected problems arise.

Table 1 Stakeholder views of carbon labelling: interviews and responses to Carbon Trust consultation

Sector/Organisation	Label effectiveness					Technical aspects (LCA)					Consumer understanding				Cost, burden & engagement					Prioritising consumers				Prioritising product groups			Trust/Reliability							
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	4	1	2	3	1	2	3	4	5	6		
Non-profits																																		
International Institute for Environment & Development						*	*		*	*																								
National Consumer Council	*	*	*	*	*						*		*	*	*	*	*	*					*	*		*			*	*				
Soil Association									*	*																								
Compassion in world farming							*		*																									
Sustain - Alliance for better food and farming		*	*				*	*		*	*				*	*				*	*							*						
University research																																		
Manchester University	*		*						*		*	*	*	*	*					*	*						*	*					*	
Surrey University							*		*	*																								
Food retail																																		
Blaencamel Farm							*		*	*																								
M&S									*	*																								
Somerfield	*						*		*																									
Consultancy research																																		
Carbon Sense	*	*	*				*		*		*	*	*	*	*				*	*	*	*		*	*		*	*	*	*				

e3 Sustainability Consulting	*						*			*																						
Centre for Sustainability Accounting (CenSA)									*	*																						
338ppm	*						*	*	*	*																						
Xanfeon									*	*																						
Industry association																																
Chilled Food Association	*						*		*	*				*																		
SUM	7	3	4	1	1	3	9	1	13	10	5	2	3	4	3	3	1	2	2	3	3	0	1	1	1	1	1	4	1	1	1	1
% of stakeholders	44	19	25	6	6	19	56	6	81	63	31	13	19	25	19	19	6	13	13	19	19	0	6	6	6	6	6	25	6	6	6	6

Key to Table 1

Carbon label effectiveness

1. Not effective.
2. Low effectiveness due to influence of other labels (energy, health etc).
3. Increased effectiveness if supplemented by complementary actions and information, and if these translate into actual behaviour.
4. The information is quite specific and extremely difficult to communicate.
5. Low - high degree of uncertainty in results/impacts.

Technical aspects of methodology (LCA)

1. High cost and technical expertise required.
2. No inclusion of all relevant emissions, nor other environmental, social, economic impacts/issues (e.g. justice, biodiversity, water consumption).
3. Lack of engagement with all relevant stakeholders.
4. Risk of giving misleading information due to inaccurate and insufficient data.
5. Not robust, comprehensive, comparable and/or specific enough - in particular for all products.

Consumer understanding

1. Difficulty in understanding carbon-related concepts.
2. The environmental impact of purchasing behaviour is not well understood for food products.
3. Difficulty in understanding the difference between carbon, energy, and health labels.
4. Proliferation of different types of labels results in visual clutter, increased confusion and ineffectiveness (consumers may ignore all of them).

Cost, burden & stakeholder engagement

1. Too focused on consumers. More emphasis is needed on the supply chain.
2. Costs will be translated into higher prices (that consumers are not willing to bear).
3. Willingness to pay extra/ bear cost depends on consumer type.
4. Impact on small producers unknown.
5. More engagement and responsibility of retailers required.

Prioritising consumer groups

1. Target those consumers more ready to act: those who are interested and who understand the labels.
2. The above will be: 'Positive greens', 'Concerned consumers' and 'Cautious participants'.
3. Consumers are not interested in particular products having a carbon label.
4. Consumers will be interested in any products for which any claims are made.

Prioritising product groups

1. No label at all on any product is the best option. If a label is used, it should be for food products only and transport in particular (especially air travel).
2. Labels should be used on products for which a reasonably reliable full life-cycle carbon assessment can be demonstrated.
3. Product prioritisation should be made on the basis of a cost-benefit analysis.

Trust/Reliability

1. Consumers will trust the label only if the information is verified by a third party.
2. Increased trust if third party is a combination of private and government institution.
3. Increased trust if third party is a NGO.
4. Consumers will trust companies and brands rather than the label.

5. Trust will depend on the specifics of the label (e.g. Organic and Fairtrade, Carbon Trust, Food Standards Agency, major supermarkets).
6. It is not clear what type of institute acting as a third party would increase consumer trust.

2.3 Published responses to Carbon Trust consultations

The following are a summary of notable objections by commercial and non-commercial stakeholders, submitted in response to the Product-related emissions reduction standard (PERS), now termed Product-related emissions framework (PERF) (Carbon Trust, 2008b,c). We have only listed objections below that we consider to remain valid despite the Carbon Trust's responses, which are closely relevant and not repetitive, and which are amenable to possible discussion with the public within the limited time available:

- A product based reduction standard is not the best way of reducing GHG emissions. Existing environmental standards such as ISO 14001 and EMAS which can be applied at an organisational level might be a better way of bringing down GHG emissions.
- A product related emissions reduction standard should be delayed until there is greater consensus on how to measure product related emissions and experience in doing so and/or sufficient information to develop benchmarks.
- The Carbon Trust should develop guidance rather than a standard.
- Issues related to measuring carbon footprints, including boundary issues, need to be clarified prior to attempting to define 'reductions'.
- This approach will not give any frame of reference in which to judge product related emissions. A 'best-in-class' approach or product sector banded approach that provides a 'traffic-light' or A-G rating system as is currently used for rating the energy emissions of white goods should be developed.
- There is disagreement relating to the calculation and size of the proposed commitment to (at least) an annual 2% reduction in company-wide emissions, definition of baseline emissions for this, mitigating circumstances, the time allowed to reach the target. For example, the proposed approach will favour big polluters and companies that have not yet taken significant action on climate change and therefore will find it easier to reduce emissions.
- The use phase should be excluded from reduction claims, as claims in this phase are impossible to demonstrate.
- The minimum target of a 2% reduction will not be evident in the carbon footprint number after rounding, and the analytic uncertainty is in any case higher than 2%.
- One approach to uncertainty reporting would be to use a coloured bar above and below the reported reductions (portraying standard error defined as standard deviation/square root of sample size).
- The Carbon Trust should work towards development and implementation of uncertainty assessment techniques for product carbon footprints. There are many possible approaches to uncertainty evaluations.
- How will one be 'certain' that the data being used, in particular the emission factors, are the most reliable and the most recent?
- Short-life products could be treated in terms of generations of products, or with the process assessed rather than product, or with a 6 month period specified, or in terms of a product type, or at a company level, or not at all (each option favoured by different firms or organisations).
- Requiring external verification goes beyond the requirements in Type III labelling requirements by ISO where self-verification is allowed.

2.4 SEI/University of Minnesota methodological report for DEFRA

In support of PAS2050 and to inform the PAS team and Steering Group, DEFRA commissioned an independent fitness-for-purpose review of the current methods relevant to measuring embodied GHG of products and services, published as Minx et al (2008). These were Process LCA (e.g. defined in ISO14040), Input Output (IO) LCA and Hybrid (H) LCA. For each, a SWOT analysis was undertaken to identify the strength, weaknesses, opportunities and threats associated with their application for estimating the GHG emissions embodied in goods and services in the context of PAS2050. This assessment was informed by a literature review, the expertise of the project team members and a survey of 17 relevant international experts.

The report concludes that a PAS methodology can be established in the foreseeable future, able to provide sufficiently comparable and robust estimates for at least some of the intended PAS applications. However, it also concludes that the method most suited to meet the needs of the PAS various applications is not process LCA, as currently being used in the PAS trials, but a Hybrid LCA approach that combines the detail of process LCA with the complete supply chain coverage of input-output LCA. This should aim to include GHG emissions from the input of capital goods and (intermediate) services in production processes, company overheads as well as use phase emissions. A hybrid LCA approach is considered crucial for applications where the robustness of the final estimate is of relatively high importance, such as in ISO-defined Type 3 eco-labelling, carbon trading or product comparisons (Minx et al, 2008) (type 3 involves a third party at the stages of standard-setting and verification).

Minx et al (2008) argue that the PAS2050 should endorse one particular hybrid life cycle inventory (LCI) database to maximise the comparability of embodied GHG estimates across studies and that this database should collate the best available process information from a variety of existing LCI databases and link it with available input-output and GHG emissions data from the UK environmental accounts.

As such a database does not exist currently for the UK, and requires developing, this is a radical proposal. It is presumably intended to increase the level of accuracy and further reduce the opportunity for disagreement over carbon label values, by widening the boundaries of the analysis. Minx et al (ibid) are emphatic in their view that process LCA will not deliver sufficiently robust and comparable results in the foreseeable future for applications such as Type 3 ecolabelling, carbon trading or product comparisons. Although we tend to agree with Minx et al (ibid) on methodological grounds (though without comparing the results of both approaches, we cannot know their relative implications), in our analysis and interpretation in section 4 we explain why we think that no methodology will be able to pre-empt objection and controversy if there is a motive for this. It is also worth noting here that input-output data based on economic flows tied to environmental indicators provides a relatively coarse measure of impact due to the high level of data aggregation and the central role of inference rather than measurement: one widens the scope of the analysis at the expense of resolution. This is acknowledged by Minx et al (ibid), but it does open up the opportunity for dissent if an organisation wishes to challenge a numerical value derived through this method.

2.5 Conclusions

Stakeholder concerns about carbon labelling are many and varied. For our set of interviewees, concerns that were relatively widely shared relate to the over-prioritisation of a single environmental issue and the possibility of emissions information being misleading

and/or inaccurate for various reasons. Looking at the wider debate, stakeholders voicing an opinion clearly have opposing and mixed views on the benefits and effectiveness of carbon labelling. In some cases, concerns are motivated by a commercial need to protect a brand or avoid additional costs; others simply doubt that the effort and resource required for carbon labelling is well-directed, given competing environmental management demands and options.

3 Conclusions

End-consumption, environmental input-output studies confirm that the types of products sold by supermarkets are implicated in a large proportion (about one third) of total impact and emissions arising from EU economies. Given the economic significance of supermarkets and of grocery sales generally, this should hardly be surprising. There is, therefore, justification for focussing emissions reduction efforts on high volume grocery products.

At issue, however, is how best to reduce those grocery emissions. Carbon labelling places the responsibility on the consumer, to understand, make sense of and respond positively to quantitative information on a label. Few would disagree that this is at least a somewhat contentious proposition, particularly given the competing demands on shoppers' attention. When issues of cost and brand risk are added, one has to wonder why firms would pursue carbon labelling. The answer presumably lies in both the commercial market research findings summarised above and the results of our own focus groups: when all things are considered, carbon labelling is unlikely to harm a company's reputation and may well improve it by signalling a concern for climate change. That the same research suggests that quantitative labelling is unlikely to have a substantial impact on purchasing patterns is, we would suggest, of secondary importance for the firms involved. It would appear that the symbolic value of carbon labelling is perceived by companies as more significant.

It is in this *symbolic and associative* light that we suggest that the controversies associated with carbon labelling should be seen. At the time of questioning (Spring 2008), many stakeholders had doubts about the technical reliability of carbon labelling and its efficacy with respect to behaviour change. It is also clear, as we have illustrated, that other changes in purchasing behaviour could have a much greater impact or the same impact in a much shorter period of time. This is particularly important when time is short, as it is in relation to climate change. Yet corporate decision-makers appear to have judged, probably correctly, that there remain net commercial advantages to the activity, and that these arise from its affective and associative functions. In short there is likely to be a 'feel-good' association with carbon labelling – though that the commercial market research also revealed a degree of cynicism about company motivations should not be forgotten.

We found our initial views of carbon labelling confirmed through the interviews with stakeholders, with members of the public as part of the production of the DVD, and through the focus groups. We too are supportive of the PAS 2050 process. What we doubt is the efficacy of attempting to meaningfully communicate the GHG savings on the footprint logo. Although a simple grading system (e.g. of traffic light colours) does merit further consideration, use of the logo alone, to indicate that a product is part of a PAS 2050-assisted GHG emissions reduction process, would be the simplest option. We have further thoughts on how carbon labelling fits with the philosophy of ecological modernisation and individualism that dominates contemporary environmental policy, but we will explore these further in academic papers rather than here.

To repeat our main arguments:

(a) In terms of GHG emissions reduction, the main benefits of carbon labelling are likely to be incurred not via communication of emissions values to consumers, but upstream via manufacturers looking for additional ways to reduce emissions. This point is quite widely accepted as applying to eco-labelling in general.

(b) The final stage of trying to communicate numerical values to consumers on product packaging may not be the best option, even in terms of a label-based approach to changing consumer purchasing behaviour.

(c) We suggest (b) above because most consumers find it difficult to make sense of grams of carbon relative to their lifestyle emissions, and because even though this can likely be remedied by providing further information, for most consumers, purchase of lower GHG substitutes is only likely where they perceive complete product equivalence. This would require ignoring brand-related and other marketing, much of which is designed for the opposite purpose, i.e. to make products distinctive relative to their competitors.

(d) Consumer use of carbon label values on grocery products is likely to be of limited value as a greenhouse gas reduction measure relative to other actions open to consumers and stakeholders (both along the supply chain and at government level). This does not make it useless, but it should not distract from the need to make more substantial changes. A stronger case can be made for communicating emissions values to consumers more selectively, where products have substantial emissions differences.

(e) Although some proponents of carbon labelling intend it to be used at face value, i.e. to facilitate lower GHG consumer choices, in practice the primary function of the label is likely to be one of improving the public environmental image of the companies involved.

(f) It is too early to judge whether increased public exposure to a carbon-related symbol will, in a small way, help to foster the conditions in which more substantive emissions-reduction becomes politically acceptable, or, conversely, whether it will foster the misguided belief that such action is already underway.

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Appendix 1 Interview questions for stakeholders

Questions for 30 minute phone interviews of illustrative stakeholders

- **Top of mind responses**

Before I ask specific questions, are there any issues you think are top priorities that we should explore in the focus groups?

- **The general benefits/disadvantages of consumer-facing carbon labelling**

Q1: What do you think of carbon labelling in general?

Q2: How do you see carbon labelling evolving and being positioned in terms of environmental claims, environmental labelling and environmental marketing?

Q3: Do you think consumers will be prepared to pay a higher price for eco-labelled products?

Q4: Do you think companies will be prepared to bear the increase in costs (or part of it) of the carbon labelling process, to reduce the burden (through a higher retail price) on consumers?

Q5: Do you think there are better ways of increasing consumers' awareness of the effect of their individual decisions/actions on the environment? e.g. Through marketing campaigns/product promotions etc? Can you suggest other ways?

- **Selective use of carbon labelling: priority product groups**

Q1: Which products/services do you think consumers would be more 'interested' in having a carbon label on?

Q2: Which products/services do you think should be given priority in being assigned a carbon label? Most polluting ones? More popular ones? A combination of both criteria? Would you use a different selection criteria? If yes, which one?

Q3: Which groups of consumers do you think should be targeted to build carbon labelling support?

- **Likelihood of consumer understanding**

Q1: Do you think that consumers will understand the meaning of 'embodied carbon'?

Q2: Do you think consumers will understand how they can influence environmental impact through product choices?

- **Potential for confusion with eco-label and energy efficiency label**

Q1: Do you think consumers will clearly understand the difference between carbon labels and energy efficiency related labels?

Q2: Do you think the proliferation of labels on products and services is contributing negatively to their intended effects, for instance causing (or increasing existent) confusion to consumers?

- **Potential for visual clutter and competition with health labels**

Q1: Do you think consumers have a clear understanding of the difference between environmental labels and health labels?

- **The need for a complementary marketing strategy**

Q1: Do you think that the use of supplementary information and marketing campaigns will be necessary to increase the effectiveness of carbon labelling?

Q2: Do you think firms will be willing to run and pay for these campaigns?

- **Any relevant consumer segmentation aspects**

Q1: Which types of consumers are more likely to pay attention/understand the information provided by a carbon label? DEFRA's top 18%, presumably?

- **Legal, consumer trust and brand reputation aspects**

Q1: Do you think consumers will trust the information provided by carbon labels?

Q2: Do you think consumers trust voluntary labelling schemes, i.e. labels not verified by a third party?

Q3: When labels are verified by a third party, who do you think consumers trust? A private institution, a government institution a combination of both?

- **The appropriate extent of the LCA system**

Q1: What do you think about LCA as a method to measure products carbon emissions?

Q2: Do you think there is a particular phase of the LCA of a product which a carbon label should give account of? Which one? The most polluting one? The one that is best known (more familiar) for consumers?

Q3: Do you think there is potential for LCA studies underpinning carbon labels to be critiqued by NGOs, e.g. re the scope of the LCA (i.e. the extent of the system boundary)?

- **Are there any key issues that we have omitted?**

Appendix 2 Numerical Values for the Focus Groups

Table 2 Comparative Potential Carbon Savings Among Tesco Carbon Label Pilot Products (All Own Brands)

Potatoes	Footprint gCO₂e	Functional Unit	High-Low carbon emissions difference (gCO₂e)
Anglian New (2.5 kg)	140	per 250g serving	
Organic Baby New (750 g)	140	per 250g serving	
British Maris Piper Mash (505 g)	750	per 250g serving	610
Toms			
Tomatoes on the vine loose Conventional Spain Winter (1kg)	65	per 100g serving	
Baby Plum Conventional UK (250g)	650	per 100g serving	585
Clothes Detergent			
Tesco Super Concentrated Non Biological Liquid Wash (750mL)	600	per wash	
Tesco Non Biological Tablets (1.8kg)	850	per wash	250
Orange juice			
Tesco Pure Orange Juice (3x200ml)	220	per carton	
Tesco 100% Pure Squeezed Orange Juice (1L)	360	per 250ml serving	
			140
Lightbulbs			
11W CFL (per hour)	6500	per 1000 hrs of use	
60W Pearl Lightbulb (per hour)	34000	per 1000 hrs of use	27500

Table 3 Flight Emissions And The Number Of Low Carbon Purchases Equivalent To The Avoidance Of One Flight

Flight: LHR to...	Return kms (great circle)	DEFRA emission factor (gCO ₂ /pkm)	Flight gCO ₂ per passenger	Equivalent number of low CO ₂ potato purchases	Equivalent number of low CO ₂ tomato purchases	Equivalent number of low CO ₂ clothes detergent purchases	Equivalent number of low CO ₂ orange juice purchases	Equivalent number of low CO ₂ lightbulb purchases
Bordeaux	1480	130.4	192992	316	330	772	1379	7
Malaga	3352	130.4	437101	717	747	1748	3122	16
New York	11108	105.6	1173005	1923	2005	4692	8379	43
Paris	696	158	109968	180	188	440	785	4

Notes:

- The LCA emissions data supplied to us by Tesco is in units of CO₂e, i.e. including non-CO₂ gases. As we do not have the disaggregated data that would provide CO₂ alone, in our comparison of lower carbon grocery purchases with flight avoidance, we have necessarily compared emissions of dissimilar types (i.e. CO₂ with CO₂e). This renders the comparison conservative, i.e. the number of equivalent grocery purchases would be higher if only the product CO₂ was considered.
- Tesco assumes that the lightbulb is used for 1000 hours, which is 41.6 whole days.
- DEFRA emission factors are gross averages that inevitably over-estimate the emissions of some flights and under-estimate those of others.
- No uplift factor is applied to aircraft emissions to account for non-CO₂ effects; including these would increase the indicated impact substantially, but to apply a multiplier is scientifically problematic. Although we know the warming effects of aviation emissions to be 2-4 times those of CO₂ alone (IPCC, 1999), the method by which this has been determined is referenced to accumulated aviation CO₂ emissions since 1945, be these actual or with respect to future scenarios (e.g. Peeters et al, 2008). In other words, the multipliers that have sometimes been used to express the additional climate warming arising from aviation emissions – and which arguably do still have a communications/educational role – strictly speaking relate to aviation as whole rather than to single flights. Finding a new metric is further complicated by the non-uniform atmospheric distribution of aircraft exhaust gases and their effects, their differing lifetimes, and on-going uncertainty over the role of cirrus clouds that are induced by aircraft contrails.
- The distance is Great Circle as calculated at <http://gc.kls2.com/> . This is likely to under-estimate actual flight distance by perhaps 10%.

Interpretation

1 To save (avoid) the quantity of CO₂ that could be saved by avoiding a flight from London Heathrow to one of the stated destinations, a shopper would need to buy according to carbon label information (i.e. buy the lowest carbon option) on the number of occasions specified in the product cells.

2 Alternatively, the effect would be the same, with respect to the emissions of one flight, if one low-carbon purchase was made by multiple shoppers, the number of which would be as stated in the product cells.

Table 4 CO₂ Emissions of four people travelling from Manchester to a UK seaside destination by car or train, compared to flying to Malaga

	Return distance Manchester to Bournemouth	Per person emission factor (gCO ₂ /pkm)	Return journey for four passengers (gCO ₂)	HST CO ₂ saving relative to car	UK HST CO ₂ saving relative to Malaga flight	UK Car CO ₂ saving relative to Malaga flight	Average CO ₂ saving of UK holiday relative to Malaga holiday
Car	840	51.875	174300			1574103	1619909
HST	760	27.2	82688	91612	1665715		

Table 5 Number of low carbon purchases required to avoid the same level of CO₂ emissions as would taking a UK holiday instead of flying to Malaga (transport only; car/train average)

Equiv no of low CO ₂ e potato purchases	Equiv no of low CO ₂ e tomato purchases	Equiv no of low CO ₂ e clothes detergent purchases	Equiv no of low CO ₂ e orange juice purchases	Equiv no of low CO ₂ e light bulb purchases
2656	2769	6480	11571	59
1.8 yrs of daily servings for a 4 person family	1.9 yrs of daily servings for a 4 person family	17.75 years of daily clothes washes	31.7 years of daily servings of orange juice	59,000 hours of low energy light bulb use, i.e. 6.7 years

Notes

- As noted above, we have had to treat CO₂e and CO₂ as identical. This is acceptable for our purposes but does lead to underestimation of the number of equivalent grocery purchases.
- Car and train distances are from Transport Direct, with slight adjustment; flight distance (an under-estimate) from <http://gc.kls2.com/>
- No 'uplift' of flight CO₂ means significant under-estimation of flight impacts, by perhaps 2-3 times. Four air passengers assumed.
- HST - UK West Coast mainline high speed train, emission factor from Virgin trains: <http://www.virgintrains.co.uk/gogreener/tandc.aspx>
- Car emission factor from DEFRA (2007); family of four car passengers assumed (average car, unknown fuel, real world conditions: 207.5gCO₂/km [32.2mpg]).
- Rationale for selection of Bournemouth: a relatively distant UK seaside location relative to Manchester (compared to e.g. Blackpool) served by mainline high speed train.

Interpretation

1. When travelling from Manchester to Bournemouth, the family can save 91,612gCO₂ if they travel by train rather than by car.
2. If the family takes a UK seaside holiday instead of a holiday in Malaga, they will save an average of 1.6 tonnes of CO₂ (the average relates to whether they travel by car or train).
3. To make the same saving by buying the lowest carbon versions of Tesco's pilot project goods would require a number of purchases as stated in Tables above.