# Appendix

## Carbon Labels: evidence, questions and issues

### Table of Contents:

# 1. Carbon intensity of energy carriers:

**Table 4: Embodied carbon of different fuel sources**

| **Fuel** | **kgC/MJ** |
|---|---|
| Coal | 0.029 |
| Oil | 0.019 |
| Natural Gas | 0.014 |
| Electricity | 0.034 |

The carbon intensity of electricity depends on the fuel mix used to produce it. In the UK this is primarily coal and gas. The fuel mix varies from country to country. This must be taken into account when comparing embodied carbon emissions from studies carried out abroad. France for example has a low electricity carbon intensity because of nuclear power, as do the Scandinavian countries because they primarily rely on hydropower.

# 2. Environmental Input-Output Analysis & the relative carbon intensity of consumer products:

### 2.1 Environmental Input Output Analysis:

EIOA is a broad brush approach that quantifies the environmental impacts of aggregated product categories. Environmental impacts that are usually included are – abiotic depletion, global warming, ozone layer depletion, human toxicity, ecotoxicity, photochemical oxidation, acidification, eutrophication. It can therefore also be used to determine where trade-offs between climate impact and other environmental impacts occur within a product grouping as well as prioritising where a carbon label might be used according to the carbon intensity of product categories.

*Method:*
*A*ll national emissions are taken from primary production categories (electricity production, steel, agriculture) and allocated to user categories according to monetary flows in the economy between sectors. For instance, emissions from electricity are split into the main users according to money spent on electricity. Residential is one such user, and within residential electricity use is split between lighting, appliances etc, again according to how much money is spent on these. This can help rank product groups in terms of carbon impacts.

*Drawbacks:*
The approach's weakness lies in its level of aggregation. Impacts can be allocated to sectors– such a 'food', or 'meat and dairy', but no more detailed. Because it only maps economic flows, other greenhouse gas emissions – methane and nitrous oxides etc, which are a key part of food production, are not accounted for. Waste production from the home, and some industrial sectors – where the waste has no economic value, are also 'hidden'. Therefore results presented below are likely to underestimate the impact of food, and overemphasise home based and travel impacts slightly in comparison to indirect emissions.

There are also data quality issues as creating input-output tables is incredibly time and effort intensive, usually taking place at the national scale. The UK created the last table in 1995 (Jackson et al 2006) with 93 sector categories, and will not have another until around 2010

(Nicky Chambers Pers. Comm 11.04.07). There are US based models with 480 sectors (Tukker et al 2006) although these also map relatively old flows from 1998 (http://www.pre.nl/simapro/inventory_databases.htm#USIO ).

### 2.2 Input-Output Results – the impact of products:

The Environmental Impact of Products (EIPRO) was a study undertaken for the European Commission in order to determine the environmental impact of European consumption (Tukker et al 2006). Below are listed carbon label relevant consumer goods/services that appear in the top 35 most greenhouse gas intensive product categories, as measured by their global warming potential. They are listed in descending order:

1. Motor vehicle driving
2. Eating and drinking places
3. Meat packing plants
4. Poultry slaughtering and processing
5. Sausages and other prepared meat products
6. Fluid milk
7. Household laundry washing
8. Cheese
9. Household refrigerators and freezers
10. Clothes
11. Fats and oils
12. Lighting
13. Household audio and video equipment
14. Household cooking equipment
15. Household appliances
16. Bottled and canned soft drinks
17. Bread, cakes and related products
18. Drugs
19. Frozen fruits and vegetables, fruit juices
20. Cigarettes
21. Vegetables (assuming fresh)
22. Roasted coffee
23. Maintenance and repair of farm and non farm buildings
24. Water supply and sewerage systems
25. Fish and seafoods

Of the 25 listed, 52% are related to food production (not consumption). 24% are related to household appliances and electrical equipment (both production of these goods and their use). Other goods with high global warming impacts that are sold in a supermarket are clothing, drugs and cigarettes. The top three food categories are: meat, dairy and fats and oils.

This study looked at carbon emissions from fossil energy use only, not all greenhouse gases. So it is interesting to note that meat and dairy are still very carbon intensive despite a considerable part of their impact not being covered here.

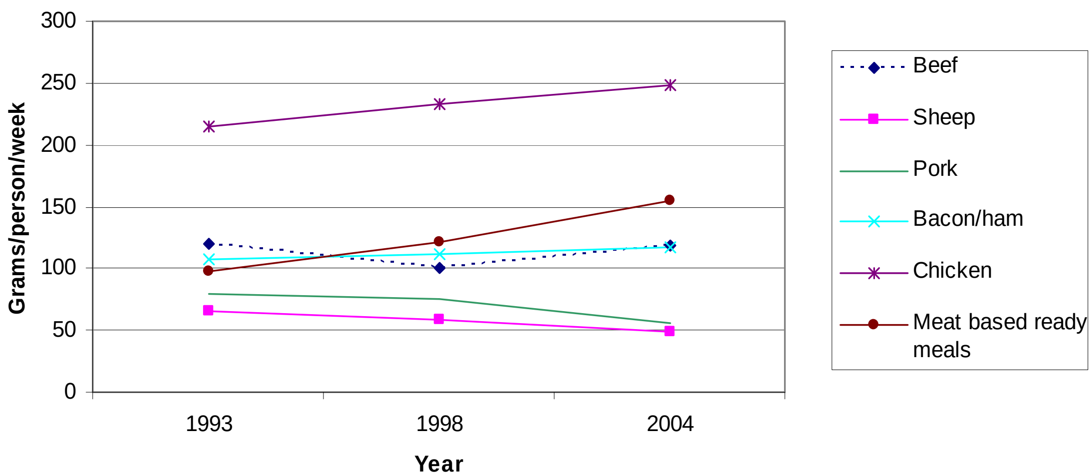
Another study using similar methods, but applied to the UK only, had broadly concurring results. The Carbon Emissions in all we Consume (Carbon Trust 2006) found that the most carbon intensive consumer need was recreation and leisure, followed by space heating, food and catering, household (embodied carbon), health and hygiene and clothing and footwear. This study also separated carbon between direct, indirect and travel categories. Within food 21% of carbon emissions were at the household or food service outlet stage, 10% from travel and 69% were indirect.

The volume of the good or service consumed, the energy carrier used in production, how energy intensive the production process is and the degree of direct emissions all influence the overall carbon footprint of a good or service category.

## 3. Trends in consumption:

This section provides a brief overview of consumption trends for the most carbon intensive products highlighted in the EIPRO study: meat, dairy, oils and fats (for food), and electrical appliances and clothing (for non-food).

**Changing consumption of meat products 1993-2004**



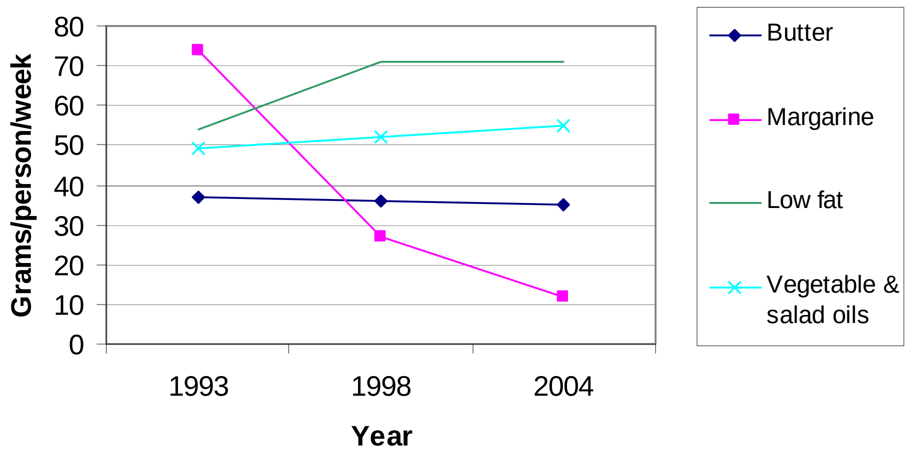

Source: National Statistics (2004)

Table 5: Changing consumption of dairy products in the UK 1993-2004

| | 1993 | 1998 | 2004 |
|---|---|---|---|
| Milk | 1958 | 1839 | 1666 |
| Yoghurt | 139 | 143 | 177 |
| Cheese | 109 | 103 | 113 |

Source: National Statistics (2004)

**Changes in consumption of fats & oils 1993-2004**




Source: National Statistics (2004)

The consumption of household lighting and appliances has been increasing at 2% a year over the last 31 years (Boardman et al 2005). And the number of garments bought per person per year has increased by a third between 2001 and 2005 (Allwood et al 2006).

## 4. Carbon Counting Methodologies:

This section briefly reviews Life Cycle Analysis (LCA) as laid out in the ISO 14040 standard and the Carbon Trust methodology that is based on this.

### 4.1 Life Cycle Analysis:

Life Cycle Analysis is a more in depth method for carbon counting than EIOA. It is done on a product by product basis. LCA has been carried out for a number of systems and products but a full application of the methodology is rare as the information, time and money requirements are large. The fact that it is a tool rather than a set methodology also means that it is not applied uniformly and results are therefore often not directly comparable between studies. LCA studies can be used to garner general rules (for example where product hotspots lie) or help in the development of priorities. They can also highlight the difficulties and issues around putting this tool into practice.

As a tool rather than a prescribed methodology, LCA is applied according to the question being asked, the system under study and with relation to available data. In its fullest sense a range of environmental impacts are measured (and those chosen relate to the question or goal under consideration), these can include energy use, global warming impact, resource use, ozone depletion, ecotoxological impacts, human toxological impacts, land use, photochemical oxidant formation, acidification, eutrophication, work environment (Jensen et al 1997).

LCA is discussed below just in terms of energy use and global warming impact.

The approaches are reviewed and compared under the 4 stages used in a traditional LCA, that is:

1. Goal and scope definitions
2. Inventory Analysis
3. Impact Assessment
4. Interpretation

*Goal and Scope Definition:*
The first stage of the goal and scope definition is defining why the LCA is being done (goal) – what question is being posed or remit filled. In the case of a carbon label this could be, for example: determining the carbon footprint of all fresh apple products such that a consumer is able to choose the least carbon intensive apple product available in a supermarket at any one time.

In relation to this it is necessary to define the audience for which the study is being carried out. This will affect the form of results required, how they will be presented and perhaps help in determining which stages of production are included. Continuing with the example above, the consumer is the main intended audience and the information needs to be displayed on or near apples and in such a way that consumers can make an easy decision. If it is felt that only limited information can be displayed near the apples, a back up information source might be required in which case how and what information needs to be displayed here must be decided. In addition, the stages included in the life cycle must cover all significant contributions to the apple's embodied carbon such that the least intensive apple can be chosen with assurance etc.

The product or service under study is then defined. This is called the functional unit. A functional unit is usually described in terms of a certain weight of product or a service, for example1000 hours of lighting at x lumens, or 1kg of fresh apple products ready for sale on a supermarket shelf. Sometimes a quality description is needed also – such as human consumption grade, or bread making grade wheat etc. This means that comparisons can be made between different supply chains or specific products offering the same function.

The boundaries around the system producing the functional unit are then defined. There is little guidance on how this might be done as it depends on the question being asked. The boundary drawing process is likely to be iterative as data quality issues come in to play and it becomes clearer where the main impacts lie. Simplified or streamlined LCA can be carried out to help determine where boundaries are drawn (Jensen et al 1997), this includes a comprehensive coverage of all stages, but less detail required in the data – for example by using a large proportion of database figures or a more aggregated level of data. Alternatively a mass rule can be applied – as has been done with the Carbon Trust methodology whereby 90% of the total product mass must be included. The CT hope to develop this into a more sophisticated system much like screening analysis whereby information about ingredients or constituents are listed on a database and used to decide which must be included and which can be excluded. ISO14040 states the following should be considered for inclusion within the system studied for LCA: acquisition of raw materials; inputs & outputs in the main manufacturing/processing sequence; transport, production & use of fuels; use & maintenance of products; disposal of process wastes and products; recovery of used products; manufacture of ancillary materials; manufacture, maintenance & decommissioning of capital equipment; additional operations – lighting & heating (ISO 14040 2006).

Once boundaries are drawn it becomes clearer what data is required. Ideally all data collected is empirically measured and therefore optimal control over quality is maintained. However this is usually impractical. Therefore rules need to be drawn up that dictate which data should come from primary sources and which can come from secondary sources (as well as defining which sources, what quality they should reach, geographical scope etc). Primarily sourced data might require further rules that relate to when the measurement is taken, how, how many times and what confidence intervals are required around the final quantity.

Further rules need to be stated clearly including: assumptions, limitations and the type of critical review to be carried out (Jensen et al 1997). In particular the rules of allocation must be laid out. Allocation arises when a single input to a process leads to two outputs – for example a lamb produces both meat and wool. It is necessary to allocate the impact of the lamb to the two outputs. This can be done by mass, by economic value, energy content or by system expansion.

Finally a process must be laid out by which results are reviewed by a third party. This will depend on who the intended audience is and question being asked.

The output from this stage should be a clear document containing the goal and all accounting rules plus a clear process map including exactly when and where the LCA starts and ends.

*Inventory Analysis*:
This is the second stage of LCA and involves data collection, calculations, validation of data and allocation (Jensen 1997). This stage is likely to require some sort of database or spreadsheet-like software that allows clear input of data. Into this database will go all the flows through the process map. This can be checked by making sure all that goes in comes out.

This stage is often very iterative as more is learned about the product in question and boundaries might be re-drawn or data quality rules changed. Obviously those stages of production with high carbon intensity should have higher data quality rules than those with lower impact. Units here are likely to be in MJ per kg, cubic meters $CH_4$/$N_2O$etc/kg.

ISO 14040 recommend that data validation take place throughout conducting the inventory stage of LCA.

*Impact Assessment*:
In the case of an LCA looking only at energy use and/or global warming impact, this involves translating all the data gained into a common climate change unit (kg $CO_2e$) per unit weight of output at each stage in the process map produced. This is then summed for the whole process to give a final measurement of impact.

*Interpretation*:
In relation to a carbon label, this stage requires translating the final measurements into a form that is useful for the consumer. In the case of the CT label, this stage is not necessary as the exact amount of embodied carbon is exhibited on the label. However if a banding or grading system is used, the interpretation stage would require placing the LCA results in the context of the grading. The LCA results might also be contextualised with a comparative figure like $gCO_2e$ per kilogram (so a 250g packet of peanuts can be compared with a 500g packet).

### 4.2 Carbon Trust Methodology and Label:

The Carbon Trust (CT) label appears on the packaging or website of a product: it is a producer's label, not a retailer one. The information on the front is in the form of a symbol and number showing the embodied carbon dioxide of the product in grams. The symbol shows that the brand is working with the CT to reduce its emissions. It must reduce its emissions over a two year period or the label is lost from the packaging. The aim of the label is two fold:

1. Allow consumers to compare products on account of their carbon footprint which in turn could lead to brand switching and possibly product type switching/lifestyle change
2. Allow companies to improve their product carbon intensity, compete on green credentials, influence the supply chain and move away from carbon intensive products.

This label is still in its infancy and aims to develop with further stakeholder involvement and under the supervision of a Technical Advisory Group. To date it has grown bottom-up – working with case study goods, developing a methodology, trialling and growing its labelled product base, rather than in a top-down sense. There has been less emphasis on developing a broader framework within which the label sits – such as a standardised data gathering framework across all good types, verification procedure, mechanism for information sharing or benchmarking, targets for what constitutes success, or a strategy for consumer education. This is not to say that this is the 'right' approach – trialling allows lessons to be learnt, experience to be gained, difficulties appreciated and responses to be gauged, all of which are very important when introducing such a new concept.

The Carbon Trust (CT) methodology is based on LCA thinking and provides a means by which producers can better understand the carbon footprint of their supply chain. It is 'front-ended' by a carbon label that appears on the packaging of a product showing the grams of embodied carbon. This has been applied to: Boots Organics shampoo range, Walkers Crisps and Innocent smoothies (although here information on embodied carbon is on their webiste). The methodology will be piloted over the next 12-18 months in conjunction with stakeholders and under the supervision of a technical advisory group (TAG). Therefore, the methodology reviewed here is by no means final and the comments here are suggestive rather than criticisms of a finalised approach.

*Goal and Scope*:
The aim of the methodology is to 'enable businesses to quantify emissions across the product supply chain' (Carbon Trust 2007, p4). Whilst the aim of the label can be summarised as enabling consumers to differentiate between product brands (Walkers and Tyrells) and product types (Crisps and peanuts), as well as allowing companies to compete in terms of carbon, improve their carbon footprint and develop new low-carbon products. This is akin to the 'goal' stage in LCA.

The label measures embodied grams of CO2e – a common denominator for measuring a group of greenhouse gases with different global warming potentials (GWP). It is assumed that this means the 6 GHGs used in the Kyoto protocol.

The equivalent of the LCA's functional unit is a 'product unit'. This is defined as 'the item that can be purchased by the consumer…[it] is inclusive of the individual packaging in which the product is sold' (p.5 Carbon Trust 2007). The carbon footprint can also be calculated in terms of kilograms $CO_2e$ per kilogram of product. But this is not clearly shown on the label, and so consumers are currently required to do the calculation themselves. For example a 250ml Innocent smoothie has 294g embodied carbon, or 1176g per litre, whilst the 1litre bottle only has 760g approximately (Innocent 2007). If the economies of scale are to be appreciated by customers then it is important that this can be easily assessed. Associated with this is the issue of where the label is displayed and its size.

The CT have applied the same methodology to a number of products within company product ranges, such as Innocent smoothies of different size and different crisp brands (Walkers, Doritoes and Quavers) (Carbon Trust 2006). This approach is useful in that applying one methodology to a range of supply chains at once can help to identify where the difficulties lie in maintaining consistency across product types, and therefore comparability.

The Carbon Trust label includes all stages, except consumer use, of production from raw material to product disposal stage. The life cycle begins when carbon is emitted (mining ore from the ground) and ends when the product stops emitting (plastic is in a landfill). Inputs such as fertilizers and pesticides are included in crop production.

Disposal has been included as suppliers can affect the carbon emissions here in their choice of packaging material. So, although the label is applied at the point of product packaging, further transport, storage and retail storage have been included (and waste from these stages too?). It is not clear how these further figures are derived – of necessity, they are based on averages, from past information, not on current use.

Not included are indirect processes (transport of workers to a factory), consumer shopping and use stages and the lighting and heating of factories. The embodied carbon of capital goods (factory machinery, combine harvester etc) is not included.

The Carbon Trust approach does not currently use reference systems in their footprinting, that is take account of land-use change in any carbon balance. For example, beef produced on savannah ranch land would be given the same carbon footprint as that produced on land previously covered in rainforest despite the fact that deforestation leads to carbon emissions. The CT realise that this might not be optimal for some goods. Clear accounting rules would need to be worked out if a reference system were to be used.

*Inventory Analysis*:
(This is termed data collection in the CT methodology.) Primary data collection is preferred over secondary. It does not provide guidance on how direct GHG emissions are measured, for example as a result of fertilizer application, direct emissions from animals or how carbon emissions from soils are measured (if included). These might best be determined through secondary sources.

Sanctioning of secondary sources may be required as the quality, assumptions and boundaries differ – the Carbon Trust suggest a recommended data set. There are a number of LCA databases available however quality differs between and within them depending on what process figures are required (Pers Comm. Nicky Chambers 11/04/07). The Carbon Trust suggest triangulation of data, which could be used as part of sanctioning sources or figures.

The CT suggest that secondary data could be allowed for processes or goods that contribute only a little to impacts (this would need to be specified).

In the collection of primary data the CT recommend readings that represent the 'average product unit' (p.14 Carbon Trust 2007). As the figures are planned for updating every two years, it is assumed this means representative over a year. This approach means that any variation in the annual energy requirements for a system will be averaged and not represented in a label. Seasonal variation in refrigeration and heating requirements or animal raising practices will not be reflected for example.

This is closely related to the issue of confidence margins on the data collected. It is important that data is representative of the true situation and therefore needs to be of a particular quality. For example, a crop yield can vary hugely depending on weather and pest levels. An average yield must be sure to capture this variation with confidence and not simply be representative of one harvest at one point in time. ISO 14040 state that 'descriptions of data quality are important to understand the reliability of the study results and properly interpret the outcome of the study' (p.13 ISO 14040 2006). Higher confidence intervals will be needed for data that has a large influence on the final product carbon footprint.

*Impact Assessment and Interpretation*:
The impact assessment stage is very similar to that of ISO 14040. As the label is a reflection exactly of the findings of the LCA, there is no further interpretation required.

## 5. Existing studies

This section reviews some major reports that have been carried out on embodied carbon of products. These are based on life cycle methodologies and have been chosen because they study a range of goods, are UK based, or the results are seen as useful for this review.

### 5.1 Williams, A.G., Audsley, E. and Sandars, D.L. (2005) Determining the environmental burdens and resource use in the production of agricultural and horticultural commodities. Defra project report IS0205, Natural Resource Management Institute: Cranfield University. Silsoe Research Institute

This study was undertaken at Silsoe Research Institute and Cranfield University. The project involved building an interactive model and tool that allowed the impacts of alternative farming practices to be compared in terms of their environmental burdens. Life Cycle Analysis forms the basis of the study which looked at bread wheat, potatoes, oilseed rape, tomatoes, milk, eggs, beef, pig meat, sheep meat and poultry.

Part of this process required the study authors to identify the 'major typical production systems in England and Wales for the commodities studied'. The burdens measured in the study were: global warming potential, eutrophication potential, acidification potential, abiotic resource use, primary energy use and land use. The study looked at production of commodities up to the farm gate, including storage and cooling of crops but excluding egg and tomato packaging, milk pasteurization and transport and slaughtering of animals.

The study lists a number of variables, with respect to arable, livestock and tomato production, that are very influential in determining the overall results of the LCA. These key variables are useful as they highlight where data quality must be of the highest standard – for example understanding feed conversion ratios, how much urea versus nitrogen fertilizer is used and live-weight gain in animals.

*Methodological issues*:
All inputs were traced back to their primary resources. Arable production is complicated by the rotation system and the long term strategies used to maintain soil fertility. Consequently averages over a cycle seem to best capture the impacts of these systems rather than a one off measurement or short term monitoring.

Capital goods and direct soil to air emissions were included in the inventory.

Different breeds or varieties have very different growing rates, land use and input needs, therefore their impacts vary. The authors advise that commodities not be treated homogenously – for example grouping all tomato breeds.

A range of data sources were used including established databases, data created by the authors, standard texts, national surveys and inventories, academic sources and statistics from websites, such as DEFRA's.

Burden components of the buildings were gained from SimaPro, BRE and Audsley 1997 (p.45) and methane and nitrous oxide emissions were calculated according to the IPCC national inventories.

*Results*:
The overall results from this study were in broad agreement with those from other studies carried out elsewhere in Europe. Below is a table that demonstrates the global warming and energy use impacts of producing different commodities.

Table 6: Results from Williams et al (2005) for climate impact and energy use of different UK farm outputs.

| Crop/System | GWP kg 100 yr CO2e/tonne | Primary energy use (MJ) |
|---|---|---|
| **Arable** | | |
| Bread Wheat | 804 | 2460 |
| Oilseed Rape | 1710 | 5390 |
| Potatoes | 235 | 1390 |
| **Feed crops** | | |
| Feed wheat | 731 (128) | 2260 (795) |
| Winter barley | 726 | 2410 |
| Spring barley | 710 | 2380 |
| Field Beans | 1010 | 2470 |
| Soya Beans | 1300 (944/853) | 3010 (6630/5990) |
| Grain Maize | 650 (338) | 1970 (3790) |
| Forage Maize | 577 | 1880 |
| **Animal products** | | |
| Beef | 15800 | 27,700 |
| Pig Meat | 6350 | 16,700 |
| Poultry Meat | 4580 | 12,000 |
| Sheep Meat | 17400 | 23,100 |
| Milk (10,000L) | 10600 | 25,100 |
| Eggs (20,000 eggs) | 5530 | 14,100 |

Some major feeds are produced by processing. Bracketed numbers include the field operations, processing, import and delivery – they are lower than the infield operations because the feed products can be the cheaper by-product of another process (eg. Soya oil production).

For beef, 41% energy burdens come from grass and a similar amount from feed. But the greatest impact is methane emissions from the animal.

Conversion ratio is key as to overall impact of an animal – eg. Chickens have high weight gain and good feed conversion ratios. Also of great importance is fecundity – pigs and hens produce many more young than sheep and cows. The authors highlight however that there are side effects to substituting ruminant production with chickens and pigs because the former tend to be raised on unimproved farmland that is unsuitable for crop production, whereas pigs and poultry tend to be raised on arable land (do they have to be?). Therefore there would be a land-use element to the change.

The study authors point out that tomato impacts according to variety are likely to be affected by waste levels – they speculate that the more expensive, and generally more resource intensive, varieties will be wasted less in the home, so might have relatively lower life cycle impacts compared to just on-farm impacts. However this also depends on wastage levels in transport and the packaging burden – as cheaper, lower impact varieties are sold loose whilst on the vine and specialist varieties are often sold packaged.
Nitrous oxide is the single largest contributor to global warming potential for all commodities except tomatoes, exceeding 80% in some cases. This is also the least well understood agricultural emission. The authors state that measurements of individual emissions may have coefficients of variation of as much as 70%. The errors in national inventories of GHG emissions from agriculture are typically about 30% with emissions from this study being about 32% (p.84).

Soil type has a big impact on yields and the direct energy use in field. Yields from clay soils are 104% of those on loam soils with sandy soils being lower still (Williams et al 2006). The authors have collated energy use data for field operations for different activities. The coefficients of variation around these numbers are typically 40%, but in some cases this is as high as 80-100% (p. 19 Williams et al 2006). This variation needs to be considered when deciding whether to use averaged or empirical figures.

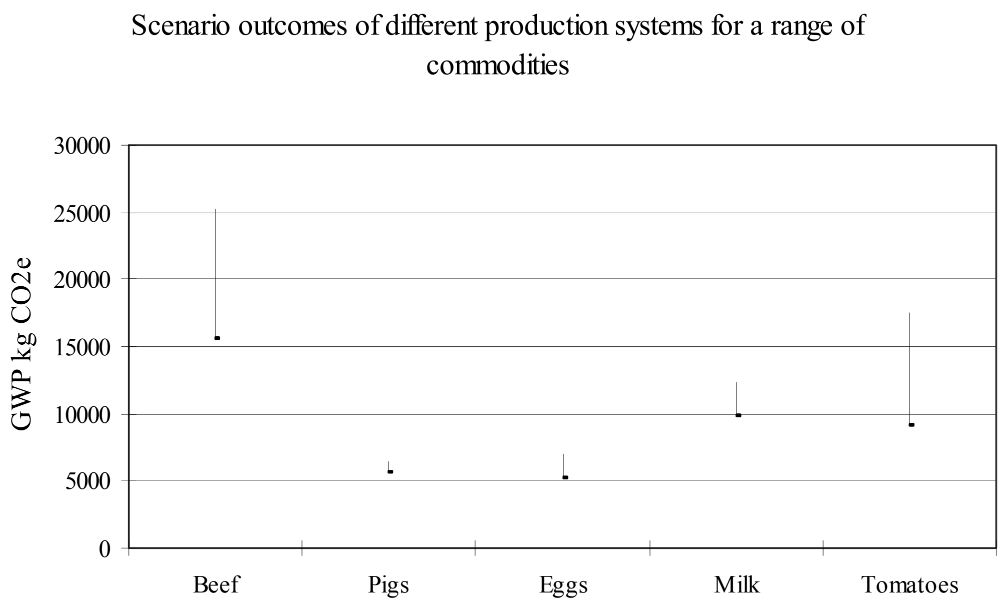
Both organic and non-organic systems were studied. Land requirements are a key impact of organic systems. This is a result of the lower yields of organic production as well as the clover rotation system and the required land for growing out rotation seeds. Below is a table showing this study's results regarding climate impact of organic versus conventional production (see Table 7). It is worth noting that the results from this part of the study have been questioned by the Soil Association. The following points were raised: that the model used by Silsoe-Cranfield was not truly representative of organic farming systems and inflated nitrous oxide emissions, leaching rates and land use from organic, that soil carbon was not properly represented in the model and that other benefits of organic farming are not reflected by the environmental impacts measured (eg. biodiversity advantages). Williams et al have defended their work particularly with respect to the first and second points and stated that other outcomes of organic farming systems such as biodiversity and soil structure improvements were outside the remit of their work. This area clearly requires further research and empirical studies/results that would arise were a carbon labelling scheme to be undertaken would hopefully clarify some issues (but not others relating to additional benefits of organic farming).

Whether organic is beneficial in terms of climate impacts depends on the commodity produced.

Table 7: Differing climate impact of organic commodity production

| Commodity | Organic: ↑ / ↓ climate impacts? | Comments |
|---|---|---|
| Beef | ↑ | Also trebling in nitrate leaching with organic |
| Milk | ↑ | |
| Pig | ↓ | |
| Chicken | ↑ | Slower growth rates lead to greater impacts |
| Tomatoes | ↑ | Lower yields |

Williams et al used their model to look at the differences that alternative production scenarios would achieve in embodied carbon of the commodities. Below some of the results are presented, with the scenario outcomes of each commodity presented as a range.




Beef: Low = Lowland rearing High = 100% suckler herds
Pigs: Low = Organic High = Indoor breeding
Eggs: Low = 100% caged non organic High = All organic
Milk: Low = More fodder as maize High = All organic
Tomatoes: Low = All Nutrient film technique High = All organic

*Implications for a carbon label*:
If the label is to truly reflect the climate impacts of farming, it should include nitrous oxides and methane. There are clearly still areas of high uncertainty in determining on farm carbon emissions. How this uncertainty is dealt with in a label will have to be addressed.

The study authors have a clear idea of what on farm processes contribute the most to on-farm impacts and therefore which data must be of high quality in the production of the label.

Improvements in one environmental impact can lead to trade-offs with other impacts. Therefore a label might look beneficial from a carbon point of view but hide increased negative impacts of other variables.

Animal products are clearly much more carbon intensive than arable crops. This is because energy is used to grow the crops which are then inefficiently converted into animal mass, or meat. As well as this, ruminant animals produce methane and their waste produces nitrous oxides. These results clearly show the importance of greenhouse gases other than carbon in the food system.

The climate benefits of organic methods are contested and more research is needed to clarify what is likely to be a more nuanced situation. There may be a trade-off between organic and low-carbon and this has implications for consumer confusion or difficulty in weighing up multiple environmental factors. A similar situation arises with carbon and animal welfare.

### 5.2 Saunders, C., Barber, A., Taylor, G. (2006) Food Miles – Comparative energy/emissions performance of New Zealand's agriculture industry, Research Report 285, Agribusiness and Economics Research Unit: Lincoln University

The aim of this study was to investigate the issue of foodmiles and determine whether this is a true indicator of a foodstuff's carbon emissions altogether. A life cycle based approach was used to quantify the energy related carbon emissions from the farming and transport stages of production for a range food goods destined for the UK market: milk, apples, onions and lamb. Production in New Zealand and the transport to the UK was compared with production in the UK. Methane and nitrous oxide emissions were not included in the calculations as they were assumed to be equal for both systems.

*Methodological issues:*
One type of animal rearing system was chosen in the UK as an example of UK production, and compared to a similar system in NZ. This study has been criticized for its choice of UK farming system, as some have seen it as unrepresentative of the dominant methods of rearing used in the UK.

The inputs measured on the farm included direct (fuels and lubricant), indirect (fertilizers, agri-chemicals, seed, animal feed, aggregate) and capital goods (machinery, farm buildings, fences, races, water supply, irrigation, drainage, effluent disposal). Energy use for shipping is also included, but the capital costs of shipping are excluded. Also excluded are the refrigeration costs that would be needed to move dairy and meat products. This is despite the fact that cold storage of onions and apples is included in the UK. It is possible that refrigeration is not needed in shipping these goods, but this should be stated.

The New Zealand data is based on a large scale empirical study of farming systems in New Zealand by Wells (2001). This involved sampling 150 farms across NZ between 1997 and 1999. The results of this study detailed use factors for inputs, average farm practices in NZ etc. Also included were recent industry studies, field work, databases and farm management knowledge. The lack of available data from the UK, as well as the issue of being far away, meant that the author's relied heavily on secondary data sources: Nix (2004) for farm management practice, DTI, British Survey of Fertilizer Practice, industry websites, Audsley et al 1997, DfT etc.

A ‘bounds’ approach was used where in situations of high uncertainty around data, the lower bound of data was used, so results would reflect a lower estimate of total impacts.

There were no testing of confidence intervals in this study as the data sources were mainly secondary in the UK portion of the study. However, secondary data inherently represents a mean and if dated, might not truly reflect the current situation. There was a large range of estimates for the energy use of shipping from less than 0.09 to 0.29 MJ/T-Km.

*Results:*
The report concluded that the agricultural stage of production is very important to consider when evaluating the ‘sustainability’ of food production, and that food miles alone were not at all representative of a product’s carbon footprint. Carbon emissions were significantly higher for UK production in all products except onions, and extremely so for dairy and lamb production. This was attributed to the feed and rearing methods used in the UK versus NZ [however some criticisms and omissions of this study mean that these results are not water-tight].

As Williams et al state that nitrous oxide emissions dominate agricultural impacts (80%), it is surprising that this was not included as a small difference in N2O emissions between the UK and NZ would potentially have dwarfed any differences in energy use.

This approach of looking at only limited stages of production shows some of the difficulties that arise in using results. The inclusion of long distance shipping but exclusion of waste leaves the reader wondering whether there are trade-offs between these stages. Equally the packaging requirements associated with longer distance transport are not discussed, nor the chilling/cooling/freezing that might need to occur to transport goods for long distances and therefore time periods.

*Implications for a label*:
Despite the limitations of this study the carbon label is likely to show that food miles are of limited use with respect to estimating overall climate change impacts.

Not being consistent across what is measured between stages – such as refrigeration – will leave the label open to criticism.

Where average figures are used this masks a huge range of variation (such as that used for shipping) and unless this variation is reported along with the average, this can be seen as a weakness. The use of averages confuses signals transmitted back to the relevant production stage – such as shipping – that acts to encourage the use of more efficient ships and routes. A similar issue arises with the author’s use of a ‘representative’ farming system for the UK. Any variation from this standard figure is not transmitted in a label and so more efficient farming systems do not benefit from their efforts. Conversely, less efficient producers can ‘free-ride’ on those making more effort.

**5.3 Foster, C., Green, K., Bleda, M., Dewick, P., Evans, B., Flynn, A., Mylan, J. (2006) Environmental impact of food production and consumption**
**A report for the Department of the Environment, food and rural affairs, Manchester Business School, DEFRA, London, 2006**

This study (otherwise known as the Shopping Trolley report) aims to inform government policy within the Food Industry Sustainability Strategy (FISS) and Sustainable Production and Consumption agenda, and to provide the basis for developing a better knowledge base on more sustainable food choices.

The report authors reviewed the results of a number of LCA and Input-Output studies covering 35 food goods. The studies chosen represent food goods in the 150 highest selling items provided to the authors by a retailer. They present results detailing the climate change impact, acidification from acid gas emissions, eutrophication, ozone impacts on air quality, ozone depletion, abiotic and biotic resource depletion.

Unfortunately due to the lack of consistency between studies – in terms of production stages included and country of origin (and therefore differing carbon intensities of fuels or different technologies used), it is not possible to compare between different studies in many instances. These results are discussed in terms of energy use as many studies have been done in Scandinavia where their energy mix is much less carbon intensive than the UK. The reported life cycle energy use is given for each product discussed, however these numbers should not be taken as exact as no confidence intervals are given with the numbers and no detailed information about the date or methodology of study are provided, they are simply indicative of the proportional differences between different product types.

*Methodological issues:*
Variable stages are included in the studies reviewed here. Agricultural production is always included as is transport and processing. Consumers, packaging and retail are sometimes included, despite the fact that packaging and consumers both contribute significantly when studied. Lack of good research on consumer behaviour is a key reason for this stage being omitted. The treatment of storage is often unclear – whether or not this falls under retail or the farm. Other stages that are less obvious and intermediate are often not reported, these include the role of the wholesaler and secondary packaging use. Carlsson-Kanyama (1998) found secondary packaging to constitute 30% of the entire life cycle energy use, Andersson, Ohlsson and Olsson (1998) found it to contribute 18% to total global warming impacts. Waste is only sometimes included.

The data can seem inconsistent between studies and this kind of report highlights the frustration involved in dealing with multiple studies with different boundaries and assumptions.

*Results*:
The life cycle impact profiles are very different for different food goods – both between and within a food type. If food has been frozen the whole impact profile changes for instance.

The results presented below are quoted from different studies, with different boundary conditions, carried out in different countries. Therefore they cannot be compared. They have been used in the table below to give the reader an understanding of the magnitudes of difference between different food products.

Table 8: Energy use per kilogram of product from cradle to shelf

| Food stuff | Energy use: MJ/ Kg cradle to shelf |
|---|---|
| **Dairy:** | |
| Milk | 3.35 |

| | |
|---|---|
| Butter | 29 |
| Cheese | 50 |
| **Meat:** | |
| Beef | 44 |
| Pork | 33.7 |
| Chicken | 12 |
| **Fish:** | |
| Fishfingers | 57 |
| Farmed salmon | 53.5 |
| **Carbohydrates:** | |
| Potatoes | 4.5 |
| Spaghetthi | 10.4 |
| **Fruit/Vegetables:** | |
| Carrots | 1.2 |
| Apples | 5.6-7.5 |
| Tomatoes (open field to heated glass house) | 1.25-125 |
| Tomato ketchup | 18.2-24 |

Rice has a much higher global warming impact relative to energy use because of the methane emissions associated with rice paddies. Carlsson-Kanyama (1998) quotes an estimated global warming impact of 6.4kg (using a 20 year carbon equivalent measure).

The primary production stage dominates all animal based goods when other greenhouse gases are included. With milk the inclusion of methane and nitrous oxides increases the impact from energy alone by 3.5 to 9 times. Packaging also has a large influence and can vary the product embodied energy by more than 7 times. The weight of packaging used in turn affects the transport stage. The high energy requirements for cheese are a result of it taking over 10kg of milk to make 1kg of cheese. A study by Berlin (2002) on cheese found that the primary production stage contributed 94% to global warming impacts. The high energy intensity of animal based primary production is then compounded by requiring further processing, refrigeration and cooking in the home.

The fishing stage dominates both the energy and greenhouse gas impacts of fish. Transport is not included in the studies reviewed by Foster et al (2006), but this can be significant as fish need to be kept cold, and are often air-freighted. Energy use in the home varies considerably – cooking with a microwave means a 5% contribution to the overall energy footprint, versus 17-32% where fish is stored for longer and fried. It is perhaps surprising that farmed fish has a lower energy use than wild caught when one considers that each kg of farmed fish requires between 3 and 5kg of wild fish based feed. This might be a result of economic allocation methods to split fish into fish feed and human consumption.

*Implications for a carbon label:*
LCA results are very context specific and therefore the lack of work done in the UK means that results provide guidance, but nothing that can be used for labeling purposes.

Foster et al point out the need for central coordination of any further LCA research, and this point would be echoed for anything leading to a label.

Waste is rarely reported separately in these studies so it is difficult to determine its overall contribution. This is an area that might well need further research – in particular how significant it is in contributing to the carbon footprint of each production stage.

Packaging can increase the product's carbon and energy footprint a lot. However, there is no research to clearly decipher the relationship between fresh produce waste versus packaging use and therefore what the overall carbon impact is.

The contribution of the retailer is sometimes not made explicit. It is generally small except for the contribution the carbon footprint of frozen carrots. Were generic figures to be used in a carbon label for the retailer stage – as the CT have done this must take into account the way the good is stored. This raises the further issue that some retailers will keep some products chilled whilst others will keep the same products ambient.

Home energy use is incredibly variable and difficult to predict. It is affected by the state of the good – whether it is precooked, canned or preserved. There is a 19% increase in the energy used per portion to cook spaghetti for 1 versus 4. Storage of tomato ketchup in a domestic refrigerator for a year (rather than a month) increases the *entire* life cycle energy footprint by more than 50%. This suggests that longer term storage is a part of the supply chain that needs better research or at least more explicit reporting. For ice-cream energy use here varies by more than 4 times depending on the age and efficiency of the refrigerator.

### 5.4 Williams, A. (2007) Comparative study of cut roses for the British market produced in Kenya and the Netherlands, A report for World Flowers, Cranfield University: Bedford

This work was carried out to compare the carbon impact of growing 12,000 marketable quality cut stem roses in Kenya and air-freighting them, with growing them in the Netherlands and driving them to the UK. This was a cradle to RDC in Hampshire study.

*Methods:*
This study looked at one specific production centre in each of the countries. Some figures used in the life cycle were from inventories that use averages – such as for embodied carbon of fertilizer (although these were adjusted slightly for the transport stage to/within Kenya) and air-freighting.

The impact of air freight is shown both with and without an 'altitude factor' of 2.7 (taken from the DEFRA food miles study). This is because the impact of flight is traditionally measured with a radiative forcing by the Intergovernmental Panel on Climate Change (IPCC), not global warming potential. So it is difficult to integrate into a study that measures GWP for everything else (even the radiative forcing of aeroplane emissions are not fully agreed upon).

*Results:*
The impacts were overwhelmingly carbon dioxide from fossil energy use (90% and 96% for Kenyan and Dutch roses respectively).

Table 9: Comparison of impacts for the production of 12,000 cut stem Kenyan and Dutch roses

| | Kenyan | Dutch |
|---|---|---|
| Climate impact | 2,400 kgCO2e (no altitude impact)<br>6,200 kgCO2e (with altitude impact) | 37,000 kgCO2e |
| Most carbon intensive stages | Air freight (73-89% of climate impact) | Heating and lighting of greenhouses (99% of climate impact) |
| Other key differences | Geothermal source for energy use & almost double the yield per unit area | Fossil intensive heating and lighting, and just over half the Kenyan yield rate |

The authors recommend viewing the results with caution as they represent the comparison of specific examples. It is not clear how representative they are of the general situation. Other caveats include the geothermal embodied energy being a world average, not Kenyan specifically, and generic air-freight figures. Errors are reported to be ± 30% the values reported here.

It was not clear how waste was incorporated into the embodied carbon figures produced.

*Implications for a carbon label:*
Rose production is clearly very carbon intensive. Out of season European production of flowers is likely to be impacted by a carbon label. It is not clear whether roses are ever produced out of doors for UK consumption.

How to include air-freight impacts into a carbon label needs to be resolved.

**5.5 Carlsson-Kanyama, A., Pipping-Ekstrom, M., Shanahan, H. (2003) Food and life cycle energy inputs: consequences of diet and ways to increase efficiency, Ecological Economics 44: 293-307**

This study carried out in the Swedish context, presents estimates for the embodied energy of 150 food items. These are used to determine what energy use reductions can be gained through dietary change.

*Methodological issues:*
The Functional unit used was 1kg of ready to eat food, cooked or not cooked. Research was conducted through surveys of supermarkets and suppliers to determine what a ‘typical’ representative food good comprised (such as a typical jam sold in Sweden).

Each life cycle, based on data from 2000, included all stages up to the preparation in the household, excluding packaging and transportation between retailer and the home. Allocation was done using economic value, and the energy use values do not include the production and delivery of fuels, just their use.

*Results:*
A number of ‘high’ and ‘low’ meal combinations were designed from the data compiled. Each provides the same amount of dietary energy. These are summarised in the table below:

Table 10: Variation in the embodied energy of a daily meal plan

| Meal | Ingredients | Life Cycle Energy Use (MJ) |
|---|---|---|
| Breakfast | High = Imported yoghurt, baked cereal product, raspberry jam, frozen imported bread, cheese, butter | 6.8 |
| | Low = Milk, oat porridge, Lingonberry jam, Swedish apple, local fresh bread, egg, margarine | 3 |
| Lunch | High = French fries, pork, frozen broccoli and canned pineapple | 14 |
| | Low = Legumes, whole wheat, tubers & leeks | 3.1 |
| Dinner | High = Beef, rice, greenhouse tomatoes, wine | 19 |
| | Low = Chicken, potatoes, carrots, oil, tap water | 6.1 |

Although not to be used to market the benefits of a low carbon diet (!), this example does highlight the large difference that food choice can make to one's embodied energy impact. Although clearly quite extreme, the high diet is over three times as energy intensive as the lower diet.

## 6. Further research highlighted in the reviewed studies:

There is a general lack of publicly available UK based research on life cycle analyses of products. This makes it hard to draw specific general conclusions, trends or what constitutes an average or representative figure. In particular with respect to carbon labels, there is a general lack of understanding about the range of embodied carbon within a product type – for example amongst all flowers, all beef providers and all types of breakfast cereal. This means it is difficult to determine what kind of savings can be achieved by brand switching. A better understanding of embodied carbon ranges would also help in determining how suitable an average is to represent a particular process or input.

There is need for more data on contemporary storage practices (Williams et al 2005).

A better understanding of carbon emissions from primary production, in all its forms, is needed. Williams et al (2005) recommend further research into the differences between livestock raising systems and their subsequent impacts. Soil carbon balances in domestic agriculture, soya production and palm oil production, how nitrous oxide emissions are calculated and the use of waste products from the food industry in farming systems were all also highlighted by Williams et al (2005).

There is a wide spectrum of shipping impacts reported (Saunders et al 2006)

Trade-offs with other environmental or even humanitarian impacts are likely with a carbon label and need better understanding.

The contribution of waste to overall product life cycles, how this differs at different stages and the ease with which this could be mitigated require further investigation.

## 7. Reporting frameworks:

As well as a methodology by which the correct data is gathered for a carbon label, reporting, data collation, allocation of information collection, and final impact calculations need to be carried out. Two approaches are reviewed here under the concept of a 'reporting framework', these are the Greenhouse Gas Protocol and some aspects of the IPCC Guidelines for National Greenhouse gas Inventories. These approaches highlight the need for very specific, common accounting rules that can be widely applied, as should be the case with a carbon label.

**7.1 The Green House Gas Protocol:**
http://www.ghgprotocol.org/templates/GHG5/layout.asp?MenuID=849 (Ranganathan 2004)

Launched in 1998 by the World Resources Institute and the World Business Council for Sustainable Development, the aim is to develop internationally accepted greenhouse gas accounting and reporting standards for business and governments. It is the most widely used accounting method by business in the world.

The protocol provides general guidance, and for some industrial sectors, specific spreadsheets for how to measure emissions, what information is needed, common unit conversions. Where there are potential difficulties in measuring impacts, they provide very specific tiered (with an order of preference) alternatives. Some groups, such as the International Council for Forest and Paper Associations have teamed up to create more industry specific approaches. This might be a good precedent for a carbon labelling framework: provision of a basic tool with the option for further sanctioned development for more specific industry sectors.

The protocol has been developed with the widespread inclusion of stakeholders and after the first two years of use was revised after further consultation.

The protocol has a strong emphasis on 'completeness': this means that they do not believe in eliminating emissions below a certain threshold: they believe that to determine it is below a certain threshold, it needs to be roughly quantified, and that it is worth exactly quantifying and including them.

The GHG P website has a number of different tools developed to aid reporting – including cross-sector and sector specific spreadsheets. All calculation tools have been peer reviewed and tested by practitioners to represent a best practice approach.
For example there are spreadsheets and guidelines for:

- GHG allocation from a CHP plant, indirect emissions from electricity use etc.
- There are sector specific aids: ammonia production, cement, iron and steel, lime, pulp and paper mills, aluminium, wood product facilities, HFC and PFC emissions from the manufacture, operation and disposal of refrigeration and air conditioning equipment, N2O emissions from adipic and nitric acid, and PFC emissions from development of semi-conductor wafers.
- GHG emissions from service sector and office based organisations, including business travel, employee commuting, facilities use, electricity conversion and small business use.

These spread sheets could be useful in the development of guidelines for carbon counting for a carbon label, or might be used directly.

An emissions inventory is calculated every year so that change over time can be tracked. They emphasise the importance of choosing a base year against which to make comparisons. They also measure absolute reductions in emissions, rather than efficiency improvements.

There are two approaches to reporting GHG emissions data:

- Centralised → Activity data gathered across the company and its facilities and sent to a centralised place for processing and converting to common GHG indicators. This is better if office based, emissions factors are the same across the company and activity/fuel use data is not too diverse (this can be seen as a proxy for a 3rd party gathering data from across supply chains and calculating total emissions themselves).

- Decentralised → Activity measured, collated and converted at sites across company then sent to HQ. More risk of mistakes and greater training needs/burden. But greater awareness at facility level results. Preferred if: there is a range of equipment and processes taking place in different facilities, GHG emissions calculations vary across facilities, process emissions make up an important share of total emissions.

There are parallels here as to who is responsible for measuring the data that is used in a carbon label, and where it is collated and translated into a common carbon measurement.

### 7.2 IPCC Guidelines for National Greenhouse Gas Inventories

Reference manuals have been devised for different aspects of a country's greenhouse gas emissions sources. These give specific directions for how to measure greenhouse gas emissions of different parts of the economy. This could be useful for a carbon label if average figures are required for greenhouse gas emissions from abroad, or for UK sources where measurements are harder to make – such as direct emissions from livestock.

For agriculture all emissions sources are described, the variables that influence these emissions and how these variables can be measured are laid out. For example, livestock manure based methane emissions are determined by:

- Animal type and breed
- Population
- Milk production level
- Whether they are in hot, temperate or cool climates
- Manure production based on estimated feed intake and manure management practices etc.

Conversion factors are provided so that all these variables can be interpreted into methane emissions. .

Countries can measure their footprints more specifically and submit the results and methodology for approval to the IPCC. There is an incentive for this if it is felt that the standard less granular approach is over-estimating emissions.

## 8. UK and EU projects, and policies and that relate to the carbon label:

The following is a brief description of some surrounding projects and policies currently being undertaken that may interact with a carbon label:

**EU Integrated Product Policy:** Integrated Product Policy (IPP) seeks to minimise product environmental impacts by looking at all phases of a products' life-cycle. Action will be taken to reduce these impacts where the greatest improvements can be made with least cost. A 'tool bag' approach will be taken whereby the appropriate policy/measure/agreement will be used according to the product. http://ec.europa.eu/environment/ipp/

**UK Framework on Sustainable Production and Consumption:** Lays out how government will take forward its commitment to sustainable production and consumption over the next 10 years. Tool box approach is highlighted here falling into two main areas – better education and awareness and more carrots and sticks for business. Supply chain management, eco-design, skills and public procurement highlighted within a 4 E's framework: Encourage, enable, engage and exemplify.

**DEFRA Product Roadmapping**: Product roadmapping involves better understanding the impacts of a product, setting a future improvement target and then mapping a number of interventions that will enable this target to be reached. This project covers 10 products: milk and fish, passenger cars, TVs, lighting and motors, window systems, toilets, plasterboard and clothing. http://www.defra.gov.uk/environment /business/scp/index.htm

**Producer Responsibility Obligations (PRO) & the WEEE Directive**: PRO requires all businesses producing more than 50tonnes of packaging and with a turnover exceeding £2million to recover and recycle a certain proportion of their packaging. The Waste Electronic and Electrical Equipment (WEEE) Directive: the manufacturers of new equipment must pay for the collection, disposal and recycling of the products they produce.

**The EUETS and the Climate Change Agreements:** Current UK and EU based energy and greenhouse gas regulatory mechanisms. CCAs are created under representative industry bodies. An agreement is made between the particular industry body and the government affirming that a percentage reduction in energy use will be achieved. This then allows all companies involved to receive an 80% reduction in the Climate Change Levy – a per unit tax on energy use for all business. The EUETS is an emissions trading scheme within Europe for businesses that fulfil specified greenhouse gas intensive activities, eg. energy activities, production & processing of ferrous metals, paper and pulp production etc. Emissions are capped according to National Allocation Plans, companies can reduce emissions and sell carbon allocations, or buy from others where reductions are not possible or economical.

## 9. Label Case Studies:

Achieving the aim of the label and determining what constitutes success will require a good understanding of how consumers and suppliers will use the label in their decision making framework.

This section comprises a more general overview of issues surrounding labelling followed by a discussion of two case study labels: the Soil Association Organic label and the EU white goods Energy efficiency label. These labels have been chosen because:
- They represent a relatively complex notion
- Both require a verification framework

- The energy label has both numerical and comparative information displayed
- Both have been part of a successful policy framework

### 9.1 The role of consumers

It is not known, for certain, whether a carbon label will influence consumers to lower the carbon emissions in their food supply. However, consumers have demonstrated an interest in ethical products and markets, as the size of markets such as Fair Trade and local farmers markets is growing (National Consumer Council and Sustainable Consumption Roundtable, 2006; Yiannis, 2006).[1] There is also evidence that typical behaviour can and does change easily to accommodate new products and information – mobile phones, for example, even with the existence of landlines and email access for communication, are much more prevalent today than they were a few years ago (Jackson, 2005).

Assuming consumer ability and willingness to change, there are many barriers to ethical food consumption:

**Barriers to ethical consumption:**

- Time and convenience. Shoppers do not usually have time to consider ethical trade-offs when making purchasing decisions in a supermarket, and may grab the first product they see if they are in a rush.
- Norms and habits. It is difficult to change shopping habits. Additionally, we currently live in a society where consumption is the norm, and where definitions of success do not include sustainability. Helping the environment is sometimes viewed as an activity for hippies.
- Identity as individuals and as communities –we are what we eat. Food consumption is linked to communities, cultures, and up-bringing, and people may not feel comfortable varying something which might affect their culture. Furthermore, humans are influenced by their peers, and consumers are more likely to change if their surrounding network of friends and family are changing as well.
- Health and diet. Shoppers may not be able to change their consumption patterns because of health restrictions.
- The premium price for environmental goods. Consumers are constrained by their budgets and income, and may not always be willing to pay higher prices for goods.
- The loss of choice with participating in ethical consumption. Some consumers are irritated by Fair Trade's lack of variety in coffee, for example.
- The supply of non-sustainable goods, which provides distraction and temptation away from ethical goods.
- Lack of trust. Some consumers do not trust labels or information sources.
- Lack of confidence or information in personal actions. People may be of the belief that one purchase by one person will not affect climate change. People may also not have enough information to make ethical choices.
- Information overload. Today's consumers are controlled and bombarded with labels and moral issues, which many leave many confused or resigned.

Sources: National Consumer Council and Sustainable Development Commission, 2006; Yiannis, 2006; Jackson, 2005; Wilkins, 2005; Darnton, 2004; EHN, 2003; Jensen *et al*., 2003; MORI, 2003; Lockie *et al.,* 2002; Grankvist and Biel, 2001; Korthals, 2001; Bell and Valentine, 1997; Bedford 2004.

[1] For example, the UK Fair Trade market is expected to reach £300 million by the end of 2007 (Fairtrade Foundation, 2007).

Consumers are also highly influenced by brands (Cheftel, 2005; Perlsmacker *et al.*, 2005) and taste (Kihlberg *et al.*, 2005) and not so much by environmental issues, which may be lower on their list of priorities (Mintel, 2004). However, consumers may sometimes let ethical values trump norms, habits, and tastes. A taste study of tomatoes, for example, showed that when consumers knew about the production processes behind the tomatoes they were tasting, organic tomatoes scored higher on their preference lists (Johansson et. al, 1999).

### 9.2 Consumer knowledge of climate change

Consumer reaction to a carbon label is likely to depend on their knowledge of the issue surrounding carbon's link to climate change. More research is needed in this area; what is needed in particular is more in depth and analytical research of what consumers think of carbon, and what connections consumers have made between carbon and climate change.

Some research has been done on people's knowledge of climate change. This is summarised in the table below.

**Table 11: Survey data: consumer knowledge of climate change**

| | |
|---|---|
| *Q. 1* I am now going to read out a number of terms that relate to the environment. For each one, I would like you to tell me if you were aware of the phrase before today (*Weighted Base: All Adults (3134)).* | |
| Global Warming | 95% |
| Climate Change | 93% |
| Greenhouse Effect | 92% |
| Carbon Dioxide | 92% |
| Carbon emissions | 84% |
| Climate Change gases | 82% |
| Do you agree or disagree that the world's climate is changing? (*Weighted Base: All adults (3134))* | |
| Agree strongly | 71% |
| Agree slightly | 23% |
| Disagree slightly | 3% |
| Disagree strongly | 2% |
| *Net: Agree* | 94% |
| *Net: Disagree* | 5% |
| Don't Know | 2% |
| To what extent do you think Climate Change is a result human behaviour or natural changes? Do you think Climate Change is ......? (*Weighted Base: All aware of Climate Change at Q1,(3095))* | |
| Due to human behaviour | 71% |
| Entirely | 17% |
| Mainly | 54% |
| Due to natural changes | 23% |
| Entirely | 5% |
| Mainly | 19% |
| Don't Know | 5% |

| |
|---|
| How concerned are you about the impact of Climate Change in the UK? (*Weighted Base: All aware of Climate Change at Q1 (3095)*) |

| | |
|---|---|
| Very concerned | 34% |
| Fairly concerned | 45% |
| Not very concerned | 14% |
| Not at all concerned | 7% |
| *Net: Concerned* | *79%* |
| *Net: Unconcerned* | *21%* |

How much influence do you think … can have on limiting Climate Change? *(Weighted Base: All aware of Climate Change at Q1 (3095) in %.)*

| | The UK Government | Industry and businesses | You, personally | Your local community |
|---|---|---|---|---|
| No influence | 11 | 10 | 26 | 17 |
| A little influence | 13 | 17 | 45 | 40 |
| Some influence | 21 | 21 | 21 | 29 |
| A large influence | 52 | 50 | 7 | 12 |
| Don't Know | 3 | 3 | 1 | 3 |

Source: COI, 2005, Wave 1

Moreover, people do not always make the connection between their personal energy they use and the effects it has on climate change (National Consumer Council and Sustainable Development Commission, 2006).

### 9.3 Consumer knowledge of "carbon"

Little research has been carried out as to people's knowledge of 'carbon' as such. However, preliminary investigations have demonstrated that there is confusion about what carbon means, and whether it is a positive or negative thing. The following words and phrases were mentioned when the question "what is carbon?" was asked of 8 focus groups (each 8-10 participants aged 20-55) (Dragonbrands, 2007):

- Type of matter—molecule
- From the periodic table
- Carbon chemical, a thing in everything.
- Diamonds are made from carbon?
- CO2, a gas which produces carbon
- Emissions
- Gas
- Something breathed
- Poisonous
- Blanket in atmosphere (keeps the planet warm)
- Emissions that heat up earth and cause a hole in the ozone layer
- CO2 makes me think of deforestation –cutting down trees that are supposed to break down carbon
- To do with trees
- Problem caused by China and US
- Problem caused by consumption, cars, the burning of fuels, industry, and coal fired power stations
- Relates to driving, insulation, double glazing
- Relates to fuel

- The amount of energy you use
- Carbon footprints
- Climate damaging
- So many documentaries showing pros and cons
- Climate constantly changes across thousands of years
- It's bad and we have to reduce it
- Don't know

The range of responses, from "poisonous" to "do not know" confirm the confusion over carbon. Consumers may therefore react negatively or not at all to the knowledge that there is carbon in a product, if no context or additional information is provided with the carbon label. Additionally, most of the participants had not heard of carbon labelling and were unaware of the recent initiatives by the Carbon Trust to promote carbon labelling. When shown the new carbon label on the back of Walkers' Crisps and the airplane symbol on Marks & Spencer's products, many responded with confusion. On the Walkers Crisps label, which simply states "75g CO2", consumers stated that they do not understand whether "75g" is good or bad, a lot or little. As for the Marks & Spencer's label, most consumers had not noticed the airplane label on products. Also, some consumers argued that an airplane symbol is unnecessary on products, because country of origin is sufficient enough to tell whether a product has been imported into the UK – this sentiment demonstrates that the effects of the mode of transport on climate change has not been conveyed by the label to consumers.

### 9.4 Consumer knowledge about food miles

How consumers have reacted to the issue of food miles may give some indication on how people will react to a carbon label. There is conflicting evidence about this issue. In a recent survey put out by the British Market Research Bureau, 61% of the respondents indicated that they were not concerned about what country their food came from (Campbell, 2006). Only 9% of the people described themselves as "very concerned" and only another 30% claimed to be "fairly concerned" about food miles. Just under a quarter of the respondents remarked that the UK should maintain or increase food imports to keep costs down and preserve variety, but 36% of the sample did not know what food miles meant (Campbell, 2006).

On the other hand, a sample of environmentally-conscious consumers demonstrated great concern for food miles. When asked, "have you ever thought about the fossil fuels (oil/petrol, coal, and gas) and electricity used in growing, moving, storing, and selling the food you buy?" 83% of those surveyed said "yes." 61% of them then answered that their purchases have been affected by their thinking of fossil fuel use in the food system – they changed their behaviour to accommodate more trips to farmers' markets, buy more organic food, eat seasonally, cut down on packaging, and avoid air-freighted products (Thottathil, 2006). A questionnaire administered by Farmers Weekly also asserts that food miles is becoming an important issue for UK consumers. Their survey shows "that there's a strong appetite among consumers for a more sustainable approach to agriculture. People said they trust local over imported food, think local food tastes better, and believe it to be better for their health" (Farmers Weekly, 2006).

### 9.5 Conclusion: Consumers do change, but do consumers know/care enough to respond to a carbon label?

There are many barriers to ethical consumption, including the potentially stronger influence of brands, health, and diet. Consumers have altered their purchasing behaviour - and therefore could in future - especially if something becomes trendy (like having a mobile phone), easy (like the growing presence and proximity of farmers markets), and tasty (like organic tomatoes).

Although consumers have demonstrated willingness to change, they may not react to a carbon label.  While today's consumers are currently faced with information overload, existing data and research shows that consumers may not have enough background knowledge to respond to the information presented in a carbon label.  This, coupled with the inability to link personal action with climate change may also threaten the efficacy of a carbon label.

The evidence from research on food miles suggests that whilst there is a minority of 'ethical' shoppers who are acting on this, many people still do not. This small group of concerned shoppers cannot be relied upon to make significant shifts in product markets. It often takes action by retailers, manufacturers or government to create these (Sustainable Consumption Roundtable 2006). This may well be the case with carbon labelling.

These survey results reinforce that more information is needed on these issues, that many shoppers are still heavily influenced by factors such as price, and that there is a general unawareness of the links between consumption, carbon, and climate change. Consumers are also generally unaware of own power with regard to their choices.

### 9.6 Are labels effective?

There is conflicting evidence and literature on whether and how people use labels, with assertions ranging from people looking at labels to not looking at labels, understanding versus not understanding etc. The real situation is likely to be far more nuanced than many reports state, with variation in both levels of understanding amongst the population and between label types. It is also likely that use of labels vary over time as people settle into buying patterns and feel comfortable with what they buy and eat.

There is evidence that there has been an increase among consumers in looking at and recognizing labels such as the nutrition label and the Fair Trade label (Food Standards Agency, 2006; Fairtrade Foundation, 2005).  When consumers do consider labels, though, there is evidence that some are confused by the information presented on them.  According to one study, 22% of the UK population does not understand or are distrustful of information on food labels (IGD, 2004). The confusion arising from labels is compounded by the fact that consumers may not know anything about the issue discussed on the label (Jordan *et al.*), or may feel inundated with too many labels and too much information (Environment Directorate, 2001; DG Environment, 2000; Jordan *et al.*).

Amongst those that do use labels, it is the 'ethical' shoppers who are most likely to respond to a carbon label, at least initially. There is a danger that carbon labelling with create 'concern' overload as consumers try and juggle carbon, organic and Fair Trade for example (Thottathil, 2006). Differing definitions for terms like "free range" can also cause a decrease in consumer confidence (Pollan, 2006).  An alternative perspective, for an unknown proportion of the population, could be that appropriate labels provide a way of limiting choice – choice editing by the consumer. Some, anecdotal evidence, demonstrated this with energy labels of refrigerators.

To conclude, a label is unlikely to reach everyone. For the key market of aware, concerned consumers who buy with their conscience, the carbon label may well be effective, but awareness of possible conflicts between issues is important if this group are not to be overwhelmed. Consistent definitions and trust are imperative if the label is to grow in popularity.

### 9.7 Existing labels and the lessons learned from them

The process of developing a carbon label could be aided by the lessons learned from the successes and failures from the several existing labels in the UK. The following table (Table 12) briefly details the strengths and weaknesses of five labels (Marine Stewardship Council, Forest Stewardship Council, Fair Trade, EU Ecolabel, and nutrition). The first four labels were chosen for discussion as they are all mentioned in a Defra guidance document (Defra, 2003). The last label (on nutrition) was included in the table since it has been the subject of much academic research. With the exception of the nutrition label, the other labels are voluntary, and can be obtained by producers or manufacturers once an independent body verifies and certifies that established standards are being met. Those companies that chose to carry one of these labels are subject to inspections and fees for the privilege. Details are focused around UK and European experiences.

### 9.8 Summary of elements of a successful label:[2]

- Comparative labels (for instance the mandatory EU energy label, with A-G categories) have proved easy for consumers to understand and effective.
- Many of the award labels are voluntary, with the resultant partial coverage, so they are less effective.
- There should be product availability of the labelled good at the same or similar prices to others in the range (or the top in the range if banded), so that consumer demand can be met and the market can grow.
- Consumers must perceive the label to be credible. Credibility often comes with monitoring, verification, transparency, and stringent and up-to-date standards.
- Consumers need to be educated and made aware of the issues that the label addresses.
    - People need to be able to make easy connections between their shopping habits and environmental outcomes. Positive feedback of some form could aid in this education.
    - A label that fits into other labelling schemes is less likely to cause more consumer confusion.
- Good aesthetics are important – people are more likely to look at labels that appear in visually-pleasing formats and bright colours seem to help
    - The logo of the organisation should be visible, if it is a credible institution.
    - The layout should be easy to follow, with good alignment lines and fonts.
    - The label should appear in the same format on every product. This consistency makes information easier for consumers to spot and recognise.
- Labels and consumer action alone are not enough for change. Government involvement, either through legislation or regulation, and business support, provide a better atmosphere

[2] Additional sources: National Consumer Council and Sustainable Development Commission, 2006; Cowburn and Stockley, 2004; EHN, 2003; Environment Directorate, 2001; Food Standards Agency, 2001; DG Environment, 2000; Assured Food Standards; Jordan *et al.*, Bedford.

for a successful label, especially when coupled with a long-term approach. This is usually referred to as ‘market transformation’.

- Retailers and producers must also have confidence in the label and trust in the process.
    - This confidence may come with treating data provided by them sensitively and in confidence.
    - Early involvement with stakeholders creates more support for the label.
- Low costs encourage retailers and producers to participate more easily.

**Table 12: Lessons to be learned from existing labels: their strengths and weaknesses**

| *Label name and targeted products* | *Strengths and successes of label* | *Weaknesses and challenges of label* |
|---|---|---|
| *Marine Stewardship Council (fish)* | The label is trusted by many because:<br>• There is third party verification of standards.<br>• The standards are maintained and overseen by the "MSC Standards Council," whose members have expertise in science and fisheries.<br>• The standards were created with industry and non-profit collaboration (Unilever and WWF).<br>• A lot of stakeholder involvement and consultation occurred in developing the standards (one of the requirements towards certification is to also engage in formal stakeholder dialogue).<br><br>Formation of standards and label has led to better data-collection of fisheries, ecological risk assessment completions, and dialogue with local communities.<br><br>There is confidence that this label will help fisheries. | Awareness of and demand for products with the label is still low, and confidence in the label by most of the fishing industry and environmentalists is still low. One of the reasons for this is because the label is relatively new (first products labelled in 2000).<br><br>Certification is necessary for fish products to carry the label. Initial certification costs for fisheries are high (may range from $10,000-$100,000+) –this excludes the price for annual audits. Certification is also a bureaucratic process that involves many steps.<br><br>The Marine Stewardship Council has to be careful to not violate world trade rules. |
| *Forest Stewardship Council (timber)* | The market is growing for products with this label because of retailer leadership of companies like B&Q, who have committed to phasing out non-sustainable wood, putting labelled wood into the spotlight.<br><br>The label is supported by most environmental NGOs.<br><br>The label is gaining in credibility in the UK, especially since it merged with the UK government's Woodland Assurance Scheme (UKWAS), which holds legitimacy in the UK. | Forestry is a controversial issue filled with many global stakeholders (from tribal people to the developing world and large companies to NGOs), and creating a label has been difficult as a result.<br>• The large number of stakeholders involved led to a "consultation dilemma": How to engage all the stakeholders appropriately to find optimal standards that are not costly for business but rigorous enough to address both environmental concerns and the rights of indigenous people and local communities (Gale, 2004).<br><br>In the early development of the label, agencies, land-owners and supply-side interests proposed that instead of using this label, merely putting the country of origin on the timber would be sufficient. These interests did not like the label because:<br>• They claimed that that the label had an environmental bias and was created in a top-down manner that did not include |

| *Label name and targeted products* | *Strengths and successes of label* | *Weaknesses and challenges of label* |
|---|---|---|
| | | their interests.<br>• The label was seen as superfluous, since it was felt that existing government regulations were adequate.<br>• Certification has been a controversial issue, as many forest managers have been uncomfortable having their practices scrutinized, and believe their management of forests has been environmentally-sound.<br><br>A competing label was created by the forestry industry to address the above concerns: the Pan-European Forest Certification Scheme.<br>• The Forest Stewardship Council is in competition with this label.<br>• There is confusion among consumers between the two labels<br><br>This label is criticised for not being very transparent. |
| *Fair Trade (products from the developing world)* | The market for Fair Trade is growing because:<br>• People can afford Fair Trade. The price for Fair Trade products is within the normal price range for comparable goods.<br>• Supermarket leadership from the Co-op, Marks and Spencers, and Sainsburys (where all bananas are Fair Trade) is making Fair Trade more available to all consumers.<br><br>Over 50% of UK consumers are aware of the Fair Trade label.<br>• One reason for this awareness is that unlike in other countries, such as the U.S., there one widely-used label in the UK, making the identification of Fair Trade products less confusing to consumers. Since there is less confusion, there is also more trust of this label.<br><br>Fair Trade has wide support from religious groups, who sell Fair Trade products in their shops. | A few Fair Trade consumers equate the Fair Trade label with lower quality taste.<br>• Lack of confidence in taste may arise from the fact that coffee was among the first product to receive a Fair Trade label, and many consumers are very particular about the brand and taste of their coffee.<br><br>The label is associated with higher prices, and many consumers cannot afford higher prices.<br><br>There is a level of distrust in the label.<br>• There has been a lot of criticism of the Fair Trade movement itself (as in, whether producers really are receiving benefits), leading to declining trust in the Fair Trade movement by some consumers, and therefore no justification for higher prices.<br>• Additionally, supermarkets have been accused of marketing Fair Trade products at even higher than necessary prices, and then pocketing the extra money.<br>• The Fair Trade movement has also been receiving criticism for giving Fair Trade labels to products sold by large |

<table>
<tr><th>Label name and targeted products</th><th>Strengths and successes of label</th><th>Weaknesses and challenges of label</th></tr>
<tr><td></td><td></td><td><ul><li>companies, such as Nestlé.</li><li>Some producers may not be able to afford inspections and the fees that are required if carrying the label.</li></ul></td></tr>
<tr><td>EU Ecolabel (range of goods)</td><td>The label is evolving in response to criticisms<ul><li>The European Commission engaged in a stakeholder consultation/review of the eco-label a few years ago.</li></ul> The label has contributed to setting targets for better environmental product performance. Products with an ecolabel have a smaller environmental footprint. </td><td>The existence of other labels has made the spread of this ecolabel slow, and there is low consumer awareness for the label. The amount of eco-labelled goods remains small (0.1% of the market share).<ul><li>There are several eco-labels in existence at the national level in Europe. As a result of the older labels, the EU eco-label has had a difficult time of establishing itself throughout Europe, particularly in countries where there are already other eco-labels (the Netherlands, Germany, and Austria, for example).</li><li>Companies have been put in a difficult situation – in some countries, they must chose between a national label and the EU eco-label and if they chose the EU eco-label, they must spend resources justifying that it is not an inferior label.</li><li>Governments have done little to promote the EU eco-label.</li><li>Only a few product groups are currently eligible for the label.</li></ul> The label is considered inferior to the existing labels, not transparent, and cumbersome and expensive to obtain. There has been criticism that this label violates WTO rules (although it is important to note that the scheme is voluntary). </td></tr>
<tr><td>Nutrition labels (pre-packaged goods)</td><td>Most people claim to look at the label<ul><li>People may look at this label because health concerns are more immediate and personal</li></ul> The label is evolving in response to criticisms. <ul><li>The EU has recognized that the label can be confusing, and is updating label requirements to meet consumer needs</li><li>To decrease confusion among consumers, and to make determining the nutritional quality of a food product more easy, the Food Standards Agency in the UK is promoting the use of “traffic light” labelling on the front of food products and in addition to the nutrition label. With traffic light</li></ul></td><td>Food labelling rules and legislation are unclear (there are many inconsistencies and exemptions). No labels are required for non-packaged food, so little information is provided to consumers about these products. Labelling costs pose undue burden on industry. Consumer needs are not met by the label, and the label is confusing overall: <ul><li>The terminology used in the label is confusing (eg, consumers do not understand “percent energy”)</li></ul></td></tr>
</table>

| *Label name and targeted products* | *Strengths and successes of label* | *Weaknesses and challenges of label* |
|---|---|---|
| | labelling, the amount fat, saturated fat, sugars, and salt in 100 grams of a food product are coloured in one of three colours: red (to indicate high levels of the nutrient), amber (to indicate medium levels of the nutrient), and green (to indicate low levels of the nutrient, the healthiest amount).<br>• This label has received support from consumer and medical groups. In a recent survey, 80% of consumers supported this label.<br>• "This label allows consumers to quickly and correctly identify whether a product is a healthier option or one high in fat, salt or sugar<br>• This label helps consumers make comparisons between products, by quickly identifying which one is lower in fat, salt or sugar and which is higher." (Food Standards Agency, 2007b) | • Numerical information presented on the label is often confusing, especially without a benchmark<br>• Some consumers have difficulty in performing calculations required to understand the label, such as figuring out how many grams of a nutrient may be in a serving<br>• The labels are lacking in information about important topics such as allergens<br><br>On reason the label may not meet consumer needs is because the content and the design of the label is mostly controlled by legislative requirements, and not by what may be helpful to consumers. Part of the legislative inconsistencies and unhelpfulness may be a result of free trade objections to labelling, the lack of consistent health standards (for example, there are different attitudes towards additives, from GMOs to artificial sweeteners), and the fact that many laws on food labelling exist and have not yet been consolidated throughout Europe.<br><br>Supermarkets have communicated concern and fear over the new "traffic lights" nutrition scheme that has the colours red (indicating the least healthy), amber, and green (indicating the most healthy), expressing that consumers may shy away from buying products with any red. |

Sources: Brimelow, 2007; European Commission, 2007; Food Standards Agency, 2007b; Food Standards Agency, 2007c; Garcia *et al.*, 2006; Low Carbon Vehicle Partnership, 2006; National Consumer Council and Sustainable Development Commission, 2006; Fairtrade Foundation, 2005; Guldbrandsen, 2005; Cheftel, 2004; Cowburn and Stockley, 2004; Gale, 2004; Cashore *et al.*, 2003; European Heart Network, 2003; Leatherheadfoods International, 2003; Kill *et al.*, 2000; Forest Stewardship Council, 2006; Food Standards Agency; Peacy.

### 9.9 Summary of elements of an unsuccessful label[3]:

- Lack of information and little understanding of the issues by the consumer
- Complexity
    - Consumers are reluctant to carry out their own calculations.
    - People want simple, clearly informative labels, particularly when they are pressed for time and cannot read all the information on the label.

## 10. The Organic Label:

Here, the organic labelling of food products is discussed in more depth since it contains energy components that may be useful to carbon labelling.[4] Defra defines organic as follows: "organic production systems are designed to produce optimum quantities of food of high nutritional quality by using management practices which aim to avoid the use of agro-chemical inputs and which minimise damage to the environment and wildlife" (Defra, 2006b).

### 10.1 The growth and history of organics

The organic movement in the UK was born about 1946, with the beginning of a charity and membership organisation called the Soil Association, which was formed in response to the perceived deterioration of nutrition in food and soil erosion. The early days of the movement were pioneered mostly by farmers, and were mostly driven by supply-side concerns (Dimitri and Oberholtzer, 2005). In 1967, the Soil Association drew up its brief organic standards that farmers could sign onto voluntarily. The early standards were "developed by a technical advisory committee made up of farmers, scientists and other experts reporting to an elected Soil Association council" (Soil Association, b). The standards were simple, required no inspections, and were based on trust (Vaughan, 2007).

As the number of products making the claim "organic" grew, farmers and consumers demanded a system to prove that products were produced by Soil Association standards; consumers and farmers wanted a label for credibility. In 1973, a certification and labelling system to identify products that met Soil Association standards was created (Soil Association, a). According to the Soil Association, "the certification system set up in 1973 is now used to provide an independent audit and tracking system from the individual field through to the final packing" (Soil Association, a).

Due to the enormous growth in the organic market, the realisation of the environmental social benefits of organic food, and scheduled CAP reforms, the EU formally defined organic in the early 1990s (Vaughan, 2007; Dimitri and Oberholtzer, 2005). IFOAM (the International of Federation of Organic Agriculture Movements), a global, democratic umbrella organisation for groups promoting the organic

[3] Additional sources: Brimelow, 2007; Dragonbrands Focus Groups, 2007; EHN, 2003; DG Environment, 2000.

[4] For example, there are claims that organic production produces less CO2 emissions than conventional production, because of less energy inputs; on the other hand, organic production may producer higher amounts of methane, because livestock is more likely to have diets higher in roughage (Defra, 2002).

movement, was particularly involved with helping the EU to define legal standards for organic products.[5]

Although still a voluntary scheme, organic food and labelling is now regulated throughout Europe and the UK, by European legislation (EEC No. 2092/91) that describes the "inputs and practices that may be used in organic farming in growing," and the inspections that occur to make sure the practices are abiding by the definition of organic (Defra, 2006b). Products in the UK may then only be labelled as organic if they are annually inspected and certified as meeting the EU's minimum standards by any one of ten approved certification bodies in the UK (such as the Soil Association) all of whom require that the EU's and UK's minimum standards are met.[6]

Farmers both embraced and rejected the EU's stricter, more complicated standards. On the one hand, the government's involvement gave greater legitimacy and attention to organic foods in the market (Vaughan, 2007). On the other hand, becoming organic now requires inspections and comes with more red tape.

Changes in the official (legal) organic standards now also requires more time. A modern-day example of the time involved to make substantial changes includes the Soil Association's desire to extend labelling to health and beauty products and textiles, which are not discussed in depth in current EU standards. Response at the EU level has been slow in changing the standards to accommodate these new products, and as a result, the Soil Association has begun to independently award its labels to these qualifying products, without regulation.

Despite any difficulties, organic sales in the UK are now over £1 billion, and two out of three consumers knowingly buy organic food (Soil Association, 2006). The movement today is mostly consumer-driven, and demand for organics is continuing to increase. Recent food scares such as mad cow disease have contributed to the success and growth of the organic movement, as consumers perceive organic products to be safer (Dimitri and Oberholtzer, 2005).[7]

### 10.2 Challenges that face the organic movement and label:

- Consumer confusion over the definition of organic
    - Many consumers consider organic to be healthier and free of all additives. However, there is no conclusive evidence that organic food is healthier, and it is not free of additives (BBC, 2007; Food Standards Agency, 2007a). This confusion may lead to distrust of the organic label.
    - Many producers and retailers have started using similar terminology on their products, such as "natural." These terms benefit from organic's

[5] Details on the structure and organisation of IFOAM can be found on this site: http://www.ifoam.org/about_ifoam/inside_ifoam/organization.html

[6] Each certification body in the UK has differing standards and inspections procedures. The Soil Association, for example, has stricter standards and more requirements that it asks of producers, particularly with regard to pesticide-use (Vaughan, 2007). Organic produce labelled by other European bodies can also be sold in the UK: due to the overarching European standards, "produce from within the EU can be imported into the UK and sold freely as organic, provided it is produced or processed by an operator registered with an approved EU Organic Certification Body" (Defra, 2006a).

[7] "In 2001, organic food sales in Germany increased by 30 percent as a result of BSE" (Dimitri and Oberholtzer, 2005).

growing popularity, and are being used as a substitute to avoid the certification costs and bureaucracy involved in becoming organic.
    - The increase in the supply of organics has led to debate over the meaning of organic and to extent which principles may be compromised by industrial production methods, more processed foods, and energy intensive transport. These issues have caused many original promoters of the organic movement to criticise how the movement is evolving, and to turn away from organic products.
- Converting to organic may not be easy and convenient for a farmer because of organic's lower yields, certification costs, and bureaucracy. This can pose a barrier for entry into the organic market for smaller producers, putting them at a disadvantage (Tovar *et al.,* 2005; Bray *et al.,* 2002).
- Government bureaucracy has been an impediment for the organic movement to accommodate science, new products, and new standards in a timely manner (Vaughan, 2007).
- Many consumers are turned off by the higher prices of ethical foods such as organic foods (MORI, 2003; Lockie *et al.,* 2002).
- Buying organic food can be inconvenient. Mainstream consumers may have little access to organics, as organics are marketed as luxury goods (Lockie *et al.,* 2002). Organics are also often sold in separate areas of supermarkets, making it hard for consumers to break their shopping habits.

**10.3 Opportunities leading to the growth of the organic movement:**

- Perceived deterioration of environment
- Media interest
- Food scares
- Government involvement and subsidies for organic land

## 11. EU Energy Label

This is a mandatory, comparative label (there are seven categories) that has been applied across successive domestic products since 1995 across the whole EU. The first group was refrigeration equipment, but this has now been extended to the wet appliances (washing machines, dishwashers, tumble dryers), ovens, light bulbs, boilers and buildings. In some countries, it is now being applied to electricity and cars. Further extensions are being discussed [EE Action Plan, or EUP?].

The label provides information about absolute energy consumption (kWh pa), according to detailed test procedure that can only carried out in an accredited laboratory. A relative level of energy consumption (eg kWh / litre of volume of the fridge, or per wash cycle with a washing machine) is derived and it is this relative value that determines the energy efficiency category on the label. The manufacturer defines and prints the labels for distribution. From the beginning, there were 7 label categories (A-G). For some products, minimum standards have been introduced, so it is no longer possible to sell products in all these categories, and in some cases the label has been extended to an A+ and an A++, as an alternative to regrading the whole label.

With a comparative label, such as this, then a consumer that chooses to buy an F rated product, instead of a G, is having as much impact as a consumer who is moving from a B to an A. That is one of the major advantages of a mandatory, comparative label: all purchases can help to shift the market.

More details on the label's history, for instance the way in which the distribution of products was mapped onto the categories and consumer responses have been described previously (Boardman 2004).

The EU Energy Label has been successful at helping to transform the market for energy efficient products, partly because the label is seen as the first, the pre-requisite policy, that other initiatives can be built on. These might be incentives (discounts for A rated appliances), the introduction of minimum standards. The opportunities to build policy around the label contribute significantly to its impact. A label in isolation is much less effective.

When the refrigeration label was introduced in the UK in 1995, the average model sold had an energy efficiency index of 1.2, whereas now, in 2007, it is probably about 0.4 [check] – a two-thirds improvement in efficiency. This effect has been achieved primarily by the label and the minimum standards, but all along the label has been easily understood by consumers, without the need for any interpretation through advertisements, or by retail staff.

Another reason for the success of the EU Energy Label is that it is bright, clear, understandable and has become trusted. And, it is applied to products that are going to be bought anyway, usually as a distress purchase because the original machine at home has broken down. As a result of its success, it is widely recognised by consumers: there is immediate read-across when the label appears on other products, and this is a major reason why it is being trialled by the car industry.

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