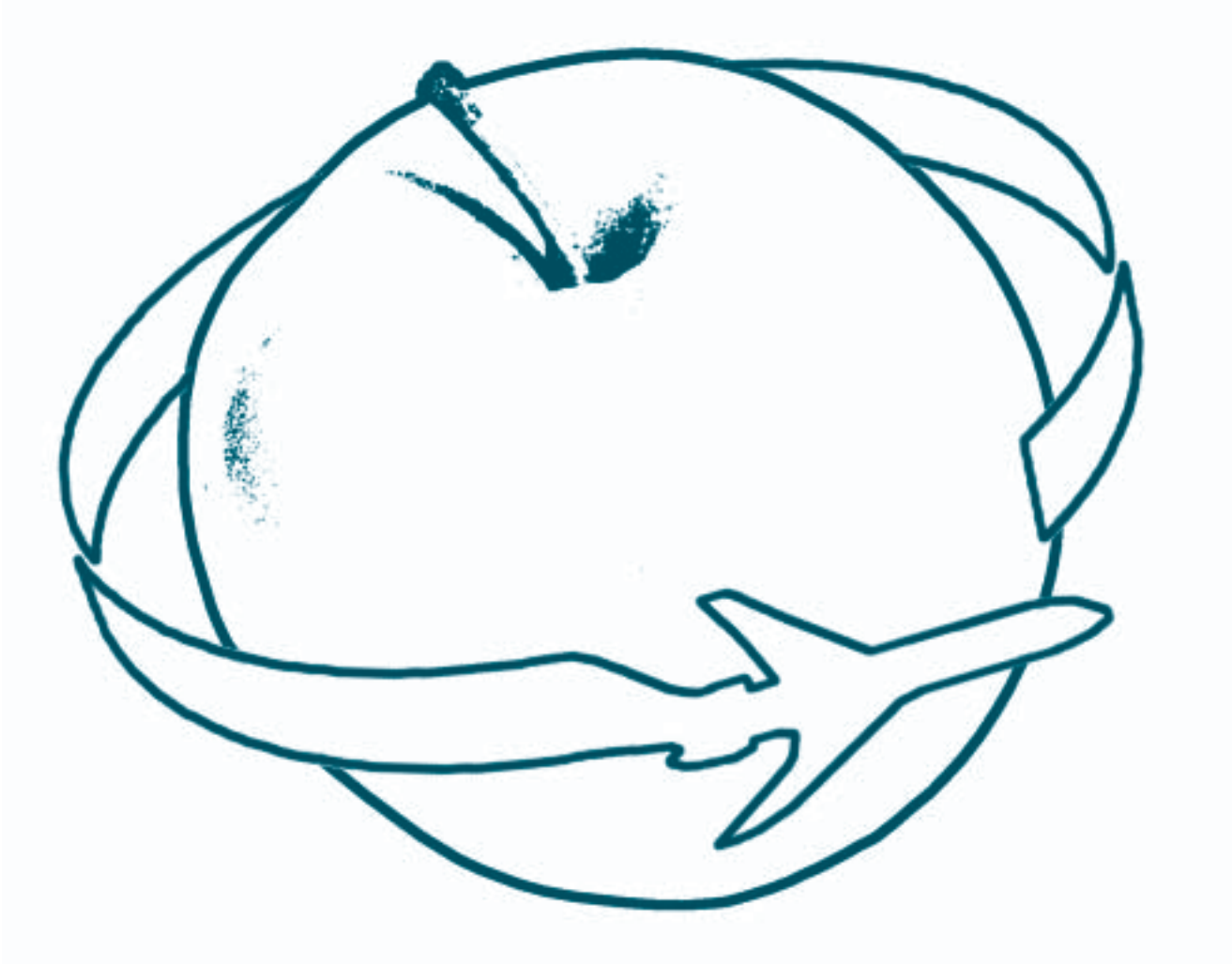
Wise Moves

Exploring the relationship between food, transport and CO_2

Tara Garnett



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Contents

A few definitions

Here are some of the key terms used throughout the report, together with a brief explanation of what we mean by them. Other definitions, including technical terminology, will be found in the glossary at the end.

Locally sourced or **local food**: Food whose main ingredients are grown, processed and sold from or within a given radius. The Campaign to Protect Rural England and Waitrose limit this radius to thirty miles; others may adopt a county-wide or less rigid definition. Few, if any, organisations take into account inputs such as agricultural machinery, although many would endorse local sourcing of these where possible.

Sometimes we use the phrase **locally focused** or **more local** systems. By this we mean an approach which favours sourcing from nearer to hand rather than from national or international sources. It is a relative, non-prescriptive term and could in some cases mean sourcing a product from France rather than from California.

A **local store**: An independently owned shop or a member of a symbol group or co-operative. Many multiple-owned store formats, such as Sainsbury's Local or Tesco Metro are also 'local.' However, their distribution systems are linked in with those of the retailers' bigger store formats and will be similar, if not identical to them. For the purposes of this study, and to differentiate clearly between systems to be explored, we do not include these multiple-owned local stores in this definition. We occasionally used the phrase **independently owned store** to clarify the distinction.

***Shorter-plus* supply chains**: An approach in which there is a deliberate attempt to shorten the supply chain, taking into account and balancing geographical distance against other transport-related factors with a bearing on CO_2. This approach strikes a balance between the differences in emissions from different modes of transport (rail, sea, road, air) as well as different types of road vehicle, loading factors, route and so forth.

Lower carbon food: A system focused on delivering lower carbon food is one which attempts to source, produce and supply food in ways that minimise carbon emissions. The ultimate objective is to achieve an absolute CO_2 reduction along the whole of the food supply chain, from plough to plate to landfill site, in keeping with Intergovernmental Panel on Climate Change (IPCC) recommendations. Strategies to minimise CO_2 impacts from transport (including the *shorter-plus* approach, above) will be balanced against those which focus on reducing other life-cycle emissions.

Summary

This report focuses on food miles – what they are, whether and how it might be possible to reduce them and what the consequences of so doing might be.

'Food miles' is a phrase used to encapsulate concerns about the increasing distances our food travels, and the environmental and social consequences thereof.

In this report we consider whether measures to shorten the food supply chain and reduce food miles can help cut CO_2 emissions from transport and, in so doing, achieve an overall reduction in greenhouse gas emissions from the food system.

The Intergovernmental Panel on Climate Change states that we need to achieve a 60–80% cut in human-generated greenhouse gas emissions.[1] All sectors, including the food industry, will have to make a proportionate contribution to achieving this goal.

Food: The wider social and environmental context

Few people go hungry any more in the UK. The British food industry supplies the collective British stomach with over 40,000 different products, sourced from around the world, seven days a week, 24 hours a day. Most of us have access to an abundance of cheap food, provided by a food industry which, once the farming, manufacturing and retail sectors are combined, collectively employs around 12.5% of the workforce, contributes 8% to the economy,[2] and is delivered by a logistics system that many claim to be the most efficient in the world.[3]

Nevertheless, the food system also places very significant burdens on our society and the environment. One study estimates the food chain's contribution to greenhouse gas emissions to be at least 22% of the UK total.
The Government's sustainable farming and food strategy, *Facing the Future*, puts agriculture's contribution to UK emissions at 7.5%[4] while its 2000 Climate Change report has it even higher, at 12%.[5]

Environmental and other critics of the food industry increasingly advocate a food system based on the principles of localism. They claim that such a system would help provide consumers with seasonal food produced mainly, but not exclusively, from within a given locality, at prices which reflect the true (including socio-environmental) costs of production and which give farmers a fair return for their efforts. They also argue that such a system would help cut CO_2 emissions from food transport and that this in turn would lead to an overall reduction in emissions from food.

These claims are contested by the food industry and by many policy makers. As there is little by way of conclusive evidence on either side, we sought, in undertaking this piece of work, to shed some light on the issue.

1 *First Assessment Report,* Intergovernmental Panel on Climate Change, Geneva, 1990

2 *The Strategy for Sustainable Farming and Food: facing the future,* Department for the Environment, Food and Rural Affairs, 2002

3 *UK Retail Logistics Overview,* Factsheet, Institute of Grocery Distribution, January, 2003 www.igd.com/default.asp?/CIR/secondlevel_fs.asp|menuid=26

4 *Facing the Future: the strategy for sustainable farming and food,* DEFRA (1990 figures)

5 *Climate Change: the UK programme,* DEFRA, 2000

Are things getting better or worse?

Is the food sector becoming more or less transport intensive and what are the implications for CO_2 emissions?

Perhaps the most important point to make is that food movements taking place outside the UK are not included in UK Government transport statistics, nor are the emissions they generate captured in the UK's greenhouse gas inventory. Indeed, those produced by aircraft and ships are attributed to nobody, meaning that there is little regulatory incentive to reduce them.

Emissions generated by road vehicles overseas carrying food destined for British stomachs will count towards the host country's annual greenhouse gas bill, not to the UK's. The reverse is also true; emissions produced trucking British products across the UK before they depart our shores for foreign markets will be included in the UK's balance. However, since we import much more food than we export – the UK is a net importer of food – the greenhouse gas imports/exports equation does not balance out. It is striking that, in contrast with the UK, the growth in freight transport in the European Union (EU) is outstripping growth in Gross Domestic Product (GDP).[6] This is true also of the growth in global freight transport.[7] For food journeys, this discrepancy suggests that we are driving our food on other nations' roads more than our own, and more than ever before.[8,9] As a result our food system is generating growing but, as far as the UK balance sheet is concerned, *hidden* quantities of transport-related CO_2 emissions.

The vast majority of food entering and leaving the UK will travel by ship, following a road journey in its country of origin. However, we are also seeing a rapid growth in the air-freighting of food, the vast majority of which flies in on dedicated freight aircraft rather than in the spare space or 'belly-hold' of a passenger aeroplane.

Within the UK almost all our food travels by lorry; rail accounts for less than 1% of food moved, measured in tonne-kilometres.[10] There are some indications that the growth trajectories of food transport within the UK and the CO_2 emissions this transport generates may be diverging. In absolute terms, however, food transport measured either in vehicle-kilometres or in tonne-kilometres still continues to grow.

In addition to greenhouse gas emissions, the transport of food by air, sea and land is also responsible for a number of other social and environmental problems, including air, sea and land pollution, human health impacts, road injuries and deaths, land take and consequent loss of biodiversity, and a less quantifiable but nevertheless important decline in the quality of life for many people.

Will technology solve the problem?

Much policy emphasis has been placed on promoting the development and adoption of cleaner technologies, more efficient driving and management practices and the use of rail and short sea shipping for freight transport.

The adoption of these technologies and practices can help achieve very significant reductions in greenhouse gas emissions. Important savings are already being made.

The fact remains, however, that whatever the gains in efficiency, more goods are being transported further and more frequently than ever before, leading to an absolute increase in tonne-kilometres not just in the UK but also, and very importantly, overseas, as a result of our increasingly globalised sourcing strategies. Despite the efficiencies achieved, existing technology is still a very long way off indeed from mitigating this growth.

6 *Term 2002 13 EU: freight transport demand by mode,* European Environment Agency, http://themes.eea.eu.int/all_factsheets_box

7 Simms A, *Collision Course: free trade's ride on the global climate,* New Economics Foundation, London, 2000

8 Kearney A T, *Insight to Impact: results of the fourth quinquennial European logistics survey,* European Logistics Association, Brussels, 1999

9 McKinnon A and Forster M, *Full Report of the Delphi 2005 Survey: European logistical and supply chain trends, 1999-2005*, Heriot-Watt University Logistics Research Centre, Edinburgh, 2000

10 Fowkes T, Senior Lecturer, Institute for Transport Studies, University of Leeds, personal communication, August 2003

Why are we moving things further than ever before?

Perhaps the three key influences which have fostered these globalised supply chains have been political and economic policies, the dominance and influence of food industry players with national and often global reach, and changes in consumer expectations.

The rules governing international trade, together with other economic policies (notably the low cost of transport relative to other production costs), increasing specialisation in the British and global agricultural industries, competition regulations and state aid rules have all favoured the development of international supply chains. They have also made it difficult for governments to internalise external, including transport-related, environmental costs.

Crucial too has been the growth in the power and popularity of a small number of large food retailers and manufacturers. Their appeal lies in their ability to supply consumers, wherever they are, with a very wide range of consistent products, all year round. A product on sale in Glasgow will be identical to one on offer in Slough. Large retailers and manufacturers have achieved this consistency and predictability by concentrating their manufacturing processes and sourcing from around the world, thereby overcoming seasonal or geographical variations and shortfalls.

The consumer has also had a part to play. As a society, we are busier, richer, more culturally diverse, more cosmopolitan, and more individualistic than ever before; and as a result we have come to demand ever more convenient, elaborate and exotic food – all at low cost. The food industry for its part has sought not only to fulfil, but also to anticipate where our desires might lead. This symbiotic relationship between the consumer and the food industry has fostered the development of ever longer supply chains.

Anticipating and preparing for the future

Recent years have seen the emergence of some counters to these globalising trends. At a European level, environmentally focused measures, such as an EU-wide aviation emissions charge, are being considered and in some cases developed. Within the UK, while the broad thrust of Government policy is in favour of further liberalisation and the promotion of international trade, Government has also put in place policies to promote British agriculture. The post-Curry agricultural agenda has spurred on the efforts of the major supermarkets to source and promote UK produce. It may be that in some areas of transport policy too, there are weak incentives for developing shorter supply chains. On the other hand, these may well be cancelled by other policy influences which actively support the development of longer ones. What we may see in future years is the co-existence of separate, parallel supply chains: one for niche local and regional foods; and another, international one, for the vast majority of the goods we eat.

There are also signs that consumer demand for alternatively-sourced foods, or foods with an ethical dimension, is growing. As such, the food miles issue may well grow in importance as part of a package of concerns.

There may also be some commercial arguments in favour of building up more domestic sources of supply as a way of improving the resilience of the supply chain, and preparing for the impact of climate change on existing sourcing patterns.

In the short term, then, the development of shorter or more locally focused supply chains may make sense to some businesses, in some areas, selling certain types of food to certain customers. On the whole, however, and for most foods, the existing globalising trends are likely to continue. It is possible though, that the situation might change more rapidly. A snowballing of concern by consumers about the climate changing actions of major food companies might be one trigger. A more rapid onset of very damaging climate change impacts is another. A terrorist or other threat to the global supply chain structure is a third.

Food, transport and life-cycle carbon emissions: Exploring the relationship

Here we set out to answer three questions.

- First, what contribution do the transport stages of the food chain make to the UK's overall greenhouse gas emissions?
- Second, how do measures to shorten the supply chain affect the generation of greenhouse gases both from transport and elsewhere within the life-cycle of the product? For instance, if you cut mileage, might you increase emissions from agricultural production?
- Third, what difference does the type of retail outlet make to overall greenhouse gas emissions?

Cooking and eating are also considered, but in rather less detail; we ask whether the highly processed foods we are increasingly eating are more or less carbon-intensive than the home-cooked foods that fewer of us now prepare.

Our discussion draws upon two separate research studies that we commissioned as part of the *Wise Moves* project. The first study[11] examined various sourcing and distribution options for three products – Braeburn apples, cherries and iceberg lettuce. The second[12] looked at cheddar cheese, white sliced bread and chicken, in whole carcass form. We also base our analysis upon the findings of other relevant studies where these shed further light on the questions we raise.

The studies commissioned by Transport 2000 are not full life-cycle analyses. These require large amounts of time and money, neither of which were available. Instead, the studies focus mainly on calculating transport-generated supply chain CO_2 emissions. For non-transport impacts such as refrigeration they either use generic, publicly available data, or else limit themselves to a qualitative discussion of the likely magnitude of different impacts. Even these apparently 'simple' analyses were in fact very difficult to perform, partly because of problems accessing data, and partly because the transport stages alone are full of variabilities and uncertainties.

With all these provisos in mind, then, we turn to the first question: how much of a contribution does food transport make to the UK's total greenhouse gas emissions?

Food transport accounts for 3.5% of the UK's total CO_2 emissions, with 2.5% from road haulage and just under 1% from car-based shopping. This 3.5% represents a very significant contribution indeed to the UK's greenhouse gas balance sheet, given that this is simply one life-cycle stage of one industrial sector. Importantly, the figure does not include the unquantified emissions which are generated during the course of transporting foods from overseas. These are not only likely to be considerable, but on the increase.

This said, CO_2 emissions from other life-cycle stages will often be greater than those from transport, at least when it comes to UK produced foods. Agricultural production, food processing and refrigeration can all generate very significant impacts. We need to take action to reduce greenhouse gas emissions at all stages in the supply chain.

As regards the second question, our analysis suggests that there is a complex relationship between transport distance and other life-cycle emissions. It is not a simple question of balancing transport, on the one hand, against other life-cycle impacts on the other. Many hands will be needed: alter one life-cycle area and multiple and complex interactions will occur among all the others, some positive and others not.

Proximity is not always a good measure of carbon sustainability, for three main reasons. First, the mode of transport will affect the calculations. A long journey by sea can be preferable to a shorter trip by road (although it is important to remember that there will also be a road journey before and following the sea crossing). Second, the efficiency of the supply chain is also important and the total energy use will depend on a range of factors including vehicle size, fuel efficiency, whether the vehicle is fully or only partially loaded, the way it is maintained and operated, and the route the vehicle takes. Our study found that one retailer trucks in

11 Mason R, Peckham C, Simons D and Wakeman T, *Wise Moves Modelling Report,* commissioned by the *Wise Moves* project, Transport 2000, June 2002

12 Ecologica, *Wise Moves Modelling Report: sourcing and distribution options for bread, and chicken,* report commissioned by the *Wise Moves* project, Transport 2000, June 2003

cheese from 470 kilometres away but in so doing clocks up fewer transport emissions than another who sources from only 300 kilometres away. It may also be the case that it is not possible to meet demand from within the nearby area. We may be able to meet half the demand for, say, cheese, from within the locality but the rest will still have to come from further afield. This may mean two trucks, each delivering cheese, instead of one fully loaded vehicle.

When it comes to imported foods, however, the importance of distributional efficiency relative to distance is much less. Indeed the research we commissioned into products involving an overseas transport leg (apples, cherries and lettuce) found that the majority of transport emissions were generated before the products even reached the UK. For air-freighted foods in particular, measures to improve distributional efficiency once the food reaches the UK will have a barely discernible effect on overall transport emissions, although this is no argument for inaction.

Finally there are other life-cycle energy impacts to consider. For processed foods the efficiency of the manufacturing plant may carry more weight than its location. It may be less carbon intensive to source fresh unseasonal produce (or produce which cannot readily be grown in our climate) from abroad. In all cases, the point beyond which other life-cycle advantages outweigh the transport disadvantages will depend on the specifics of the production process, the transport mode and other factors.

Importantly, however, we note that the 'trade-offs' work both ways. At times the growth in food transport can be a good benchmark of unsustainability in other areas. Longer supply chains can mean more time spent in refrigerated storage and more goods spoilage, both of which have implications for CO_2 emissions. Shortening the supply chain can help reduce emissions in these other areas.

We also need to consider the potential solvability of various life-cycle problems. There may be more technological scope for 'greening' UK glasshouse horticulture or refrigerated storage through the use of renewable energy than for doing the same with transport. Where this is the case, there will be synergies between reductions in production stage and transport emissions.

It is also important to emphasise that where it appears to be 'better' to source from far away, it may be preferable still not to source that product at all. Bringing winter lettuce in from Spain may use less energy than growing under glass here, but putting something else in our sandwich might be better. Many trade-offs would disappear if we ate more seasonally, suggesting that we need to look more closely at ways of encouraging a shift in consumer demand.

From our analysis then, we conclude that there appears to be some relationship between shorter supply chains and lower transport-related CO_2 emissions although the relationship is by no means simple and will depend on the product in question, the distances involved and the mode and logistical efficiency of transport. We also suggest that there is some correlation between shorter supply chains and lower overall life-cycle CO_2 emissions. For imported foods the relative importance of transport will be much greater than for foods produced in the UK.

In addition to the food miles question, this section also examined the relative efficiency of local shops compared with supermarkets. From the supply chains of the products we examined, the evidence suggests that for a given set of equivalent foods, supermarket transport systems tend to be less carbon intensive than those of local shops. This is not a reflection on the localness or otherwise of the food source, but rather on the question of distributional efficiency. Clearly the multiple retailers have invested large quantities of time, money and expertise in improving the effectiveness of their distribution systems. The supermarkets' logistical advantage lessens somewhat once the shopper trip is taken into account, although only in the case of one product (out of the three studied) does the advantage swing in favour of the local stores. We suggest that for perishable foods, including fresh produce, the advantages of shopping on foot at local stores (this can include multiple-owned local formats) may outweigh the disadvantages of greater logistical inefficiency.

Finally, as regards the cooking question, we highlight in our discussion a dearth of relevant research on this issue. While we explored some of the arguments for and against each mode of food preparation, our key conclusion was that much more research is needed here.

We suggest that the features of a lower carbon food system would include the following six elements:

- *Seasonal and indigenous:* Fresh produce grown during its natural growing season and well adapted to UK growing conditions will be less transport intensive and produce fewer overall CO_2 emissions than non-indigenous foods or those imported out of season.
- *Efficient manufacturing:* The processing plant needs to be efficiently operated and managed.
- *Minimal use of temperature controlled storage:* This should not, in the process, compromise safety standards or generate waste through spoilage.
- *Local clustering:* The inputs to the product in question must be situated near to the site of production. For processed foods, it is important that the constituent ingredients can be and are grown or produced near by. For livestock production a nearby source of (among other things) feed and fodder will be important. There are also downstream connections to consider – in the case of livestock this will be the location of the abattoir, the cutting rooms and so forth.
- *Journey distance:* The distance from point of production to point of retail to point of consumption should be minimised.
- *Logistical efficiency:* The fuel efficiency of a vehicle and the way it is managed and operated are very important. In addition loads must be consolidated and vehicles as full as possible while they are in use.

A lower carbon food system: Towards a way forward

The status quo is not sustainable. It is important to be very clear about this. Despite the gains in efficiencies that have been achieved, the magnitude of the problem we face dwarfs them.

We have identified the six elements, or characteristics of a lower carbon food system above. Developing a food system which contains these elements will be challenging, but not impossible. What might such a system look like in practice and what policy direction might we need to take in order to shape it?

We suggest that a more regionally focused approach to sourcing and distribution can help foster a lower carbon food system. Such an approach would rely upon the development of an invigorated farming sector which works with its regional manufacturing base to supply a regional population with much of the food it needs. Where supplies are not available from within the region, producers from elsewhere within the UK would largely be able to satisfy demand.

We would of course continue to import some foods, because they have come to be seen as essential and a part of our food culture, or because there are benefits, in terms of carbon reduction, from so doing. A sustainable (as opposed to simply low carbon) food system will also have to balance carbon reduction objectives against other wider social and environmental issues, such as support for developing countries through fair terms of trade. These considerations are, however, beyond the remit of this report.

In our view, a regional approach offers more CO_2-reducing potential than either globalised systems or very local ones. We highlight in the report some of the problems of globalised systems. As regards local systems, it will not always be possible to grow and produce a sufficient variety of foods locally in sufficient quantities to meet local needs. As a result, transport journeys from a number of different sources will be needed to meet demand, possibly leading to more transport mileage overall. It is also the case that for some manufacturing processes there are energy efficiency gains to be had from scaling up operations. In addition, we would argue that from a transport perspective at least, a reduction in overseas imports is perhaps the most significant challenge we have to address and as such we should concentrate on this rather than on the final thirty miles or so. This said, there are some particularly fertile and agriculturally varied parts of the UK where a fairly local approach may well be both achievable and environmentally preferable.

Supporting the agricultural supply base would be an efficient and co-ordinated distribution system, involving co-operation among suppliers and

retailers throughout the supply chain. Supporting it too would be a technological infrastructure specifically geared towards reducing carbon emissions and based on renewable or cleaner energy sources. This would enable goods to be grown, manufactured and produced in ways that do not create the potential trade-offs that we highlight elsewhere in the report. Information and Communication Technologies as well as intelligent transport systems would also provide decision makers with the information and other tools they need both to maximise distributional efficiencies and to make sourcing decisions based upon carbon life-cycle analyses of the goods in question.

We also envisage a more diverse retail structure, fostering different patterns of shopping and more seasonal approaches to eating.

This is a somewhat simplistic account of what would undoubtedly be a far more complex picture. It does however highlight the fact that a lower carbon food system is likely to look significantly different from the way things are right now.

To achieve a full 60–80% cut in food-related greenhouse gas emissions, we will need to make very substantial changes in our way of life. However some reductions are better than none at all – we can work towards this goal by making many small shifts in the right direction. Hence the measures we suggest are not intended to be absolutist.

Some indeed build upon policies that are already in place. None of them will work in isolation; a combination of policies is needed. All should of course be placed in the wider context of a sustainable food agenda.

In short, then, action to foster a lower carbon food system requires movement in the following direction:

1. A recognition that the food system needs to reduce the quantities of CO_2 it emits very considerably.
2. Policies and measures to reduce carbon emissions throughout the life-cycle of food so that trade-offs become synergies.
3. A stronger national and regional food base.
4. Measures to shift businesses away from long distance food transport and towards more nationally and regionally based sourcing.
5. Co-ordinated and co-operative methods of distributing goods both for the multiples and for local independent stores.
6. Information and Communication Technology which assists the development of less carbon-intensive systems.
7. Different retail structures.
8. Changes in the way we consume.
9. Ongoing research.

Finally, industry, government and consumers alike have a choice. We can seek to salvage elements of sustainability from the current system, in order to keep the system going as it is for a little longer. Or we can take a risk, look further into the future, and start to think and do differently. We believe the second route to be the only survivable option.

Introduction

This report focuses on food miles – what they are, whether and how it might be possible to reduce them and what the consequences of so doing might be.

Food miles is a phrase used to encapsulate concerns about the increasing distances our food travels, and the environmental and social consequences thereof.

The food miles debate is complex, straddling both the sustainable food and the sustainable logistics agendas, as Figure 1 shows.

Our report does not attempt to cover all the issues associated either with a sustainable food supply chain or with a sustainable logistics system. We have chosen to limit our discussion to a specific element of the food miles question – its role in generating climate changing emissions.

Some have argued that the long distances which food travels as it makes its way through today's global supply chains, has helped contribute (among other things) to an unsustainable increase in carbon dioxide (CO_2) emissions. These claims are contested by the food industry and by many policy makers.

As there is little by way of conclusive evidence on either side, we sought, in undertaking this piece of work, to shed light on the issue. **This report considers whether measures to shorten the food supply chain can lead to fewer CO_2 emissions from transport and, in so doing, can help achieve an overall reduction in greenhouse gas emissions from the food supply chain.**

The report is structured as follows:

Section one sets the food miles debate in context, highlighting the relationship between our globalised food system and the many social, economic and environmental concerns with which a responsible food business must engage.

Section two focuses more specifically on food journeys. We ask whether the supply chain is becoming more or less freight intensive over time. We look at where goods come from and

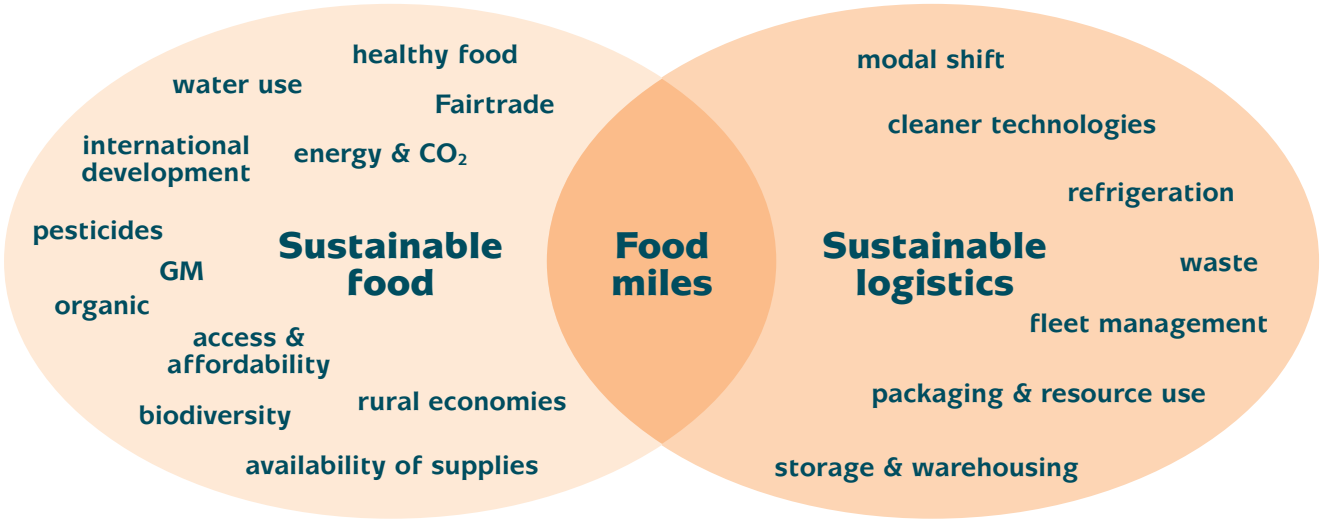

Figure 1

how they travel, and then discuss the impact that food movements have on climate change. We also touch upon other transport-related social and environmental concerns.

In section three we look at the scope for reducing CO_2 emissions from transport through, among other things, the application of greener technologies, modal shift and better fleet management. We ask whether a focus on improving efficiency is in itself sufficient to tackle the problem of transport generated greenhouse gas emissions.

Section four explores why things are the way they are. We look at the influences – from technological innovations, to trends in our eating habits, to wider economic and political developments – which have all shaped today's food supply chain.

Section five examines likely future trends. Taking a range of issues, from broad geopolitical trends to new directions in consumer demand we ask whether the next few years will see greater pressure on food industries to shorten their supply chains.

Section six is the core of the report. Here we address four questions:

- First, what contribution do the transport stages of the food chain make to the UK's overall greenhouse gas emissions?
- Second, how do measures to shorten the supply chain affect the generation of greenhouse gases both from transport and from elsewhere within the life-cycle of the product? For instance, if you cut mileage, might you increase emissions from agricultural production?
- Third, what difference does the type of retail outlet make to overall greenhouse gas emissions?
- Finally, what about cooking? Do processed convenience foods generate more or fewer carbon emissions than their home cooked equivalents, once energy use at all stages in the food life-cycle is considered?

In section seven we sketch out what a lower carbon food system might look like and discuss what policies we would need in order to realise it.

In section eight, we offer our recommendations.

Annex one summarises some of the arguments made for and against localism. Finally, a glossary is also provided.

Section one
Food in the supply chain

Few people go hungry any more in the UK. While some sections of the population cannot afford the cost of a nutritious diet, most of us have access to an abundance of cheap food, provided by a food industry which, once the farming, manufacturing and retail sectors are combined, collectively employs around 12.5% of the workforce, contributes 8% to the economy,[13] and is delivered by a logistics system that many claim to be the most efficient in the world.[14]

All this is a great achievement. However, precisely because it is so fundamental, the way in which food is produced, distributed, marketed and disposed of touches upon almost every aspect of our society and our environment. Figure 2 (overleaf) shows just some of the issues which affect and which are affected by our food system.

Some impacts are beneficial. Others are not. While cheap at the checkout, it has been argued[15,16,17] that our industrialised food system is almost incalculably expensive in many other ways.

As regards energy use and CO_2 emissions, the food industry is the UK's third largest industrial energy user, after the engineering and the metals and chemicals industries.[18] Indeed the Government's Working Group on Local Food,[19] cites one report which estimates the food system's contribution to greenhouse gas emissions to be 'at least' 22% of the UK total.[20] The Government's sustainable farming and food strategy, *Facing the Future*, puts agriculture's contribution to UK emissions at 7.5%[21] while the Department for Environment, Food and Rural Affairs (DEFRA) 2000 Climate Change report has it even higher, at 12%.[22]

Environmental and other critics of the food industry are increasingly advocating a food system based on the principles of localism.[23,24] They claim that such a system would help provide consumers with seasonal food produced mainly, but not exclusively, within a given locality, at prices which reflect the true (including socio-environmental) costs of production and which give farmers a fair return for their efforts. They also argue that a localised system would reduce CO_2 emissions from food transport and that this in turn would lead to an overall reduction in greenhouse gas emissions from the food system.

13 *The Strategy for Sustainable Farming and Food: facing the future,* DEFRA, 2002

14 *UK Retail Logistics Overview,* Factsheet, Institute of Grocery Distribution, January, 2003 www.igd.com/default.asp?/CIR/secondlevel_fs.asp|menuid=26

15 Jones A, *Eating Oil: food supply in a changing climate,* Sustain and Elm Farm Research Centre, London, 2001

16 Lawrence F (ed), *Food: the way we eat now,* three-part special report in *The Guardian,* London, 10, 17 and 21 May 2003

17 *Local Food Economies: the problems, costs and lessons,* keynote presentation by Jules Pretty at *Local Food – Global Experience,* conference organised by the Foundation for Local Food Initiatives, October 2002, www.localfood.org.uk/papers/local-global-conf-report.pdf

18 *Food and Drink Federation's Response to DTI Consultation on Energy Policy,* Food and Drink Federation, London, October 2002

19 *Local Food: a snapshot of the sector,* report of the working group on local food, DEFRA/Food Standards Agency, London, March 2003

20 *Achieving the UK's Climate Change Commitments: the efficiency of the food cycle,* e3 Consulting, 2002. Note: the author includes in his calculations CO_2 emissions from agriculture, food transport, refrigeration and so forth

21 *Facing the Future: the strategy for sustainable farming and food,* DEFRA (1990 figures)

22 *Climate Change: the UK programme*, DEFRA, 2000

23 *Local Food: future directions,* Friends of the Earth, London, November 2002

24 Hines C, *Localisation: a global manifesto,* Earthscan, London, 2002

Many, however, have criticised the localist position, believing it to be based on false premises, Utopian or simply unappealing. They also question, among other things, the assumption that a local food system would lead to the generation of fewer greenhouse gas emissions from the supply chain as a whole, or even to fewer transport-related emissions.

It is the uncertainty surrounding the debate that has given impetus to this *Wise Moves* project.

Annex one summarises some of the arguments for and against localism, for those not familiar with the detail of the claims and counterclaims.

Both sides would, however, acknowledge that food transport has grown, and continues to grow, in absolute terms. In the next section we look at how food journeys are generated along the supply chain and at the social and environmental consequences.

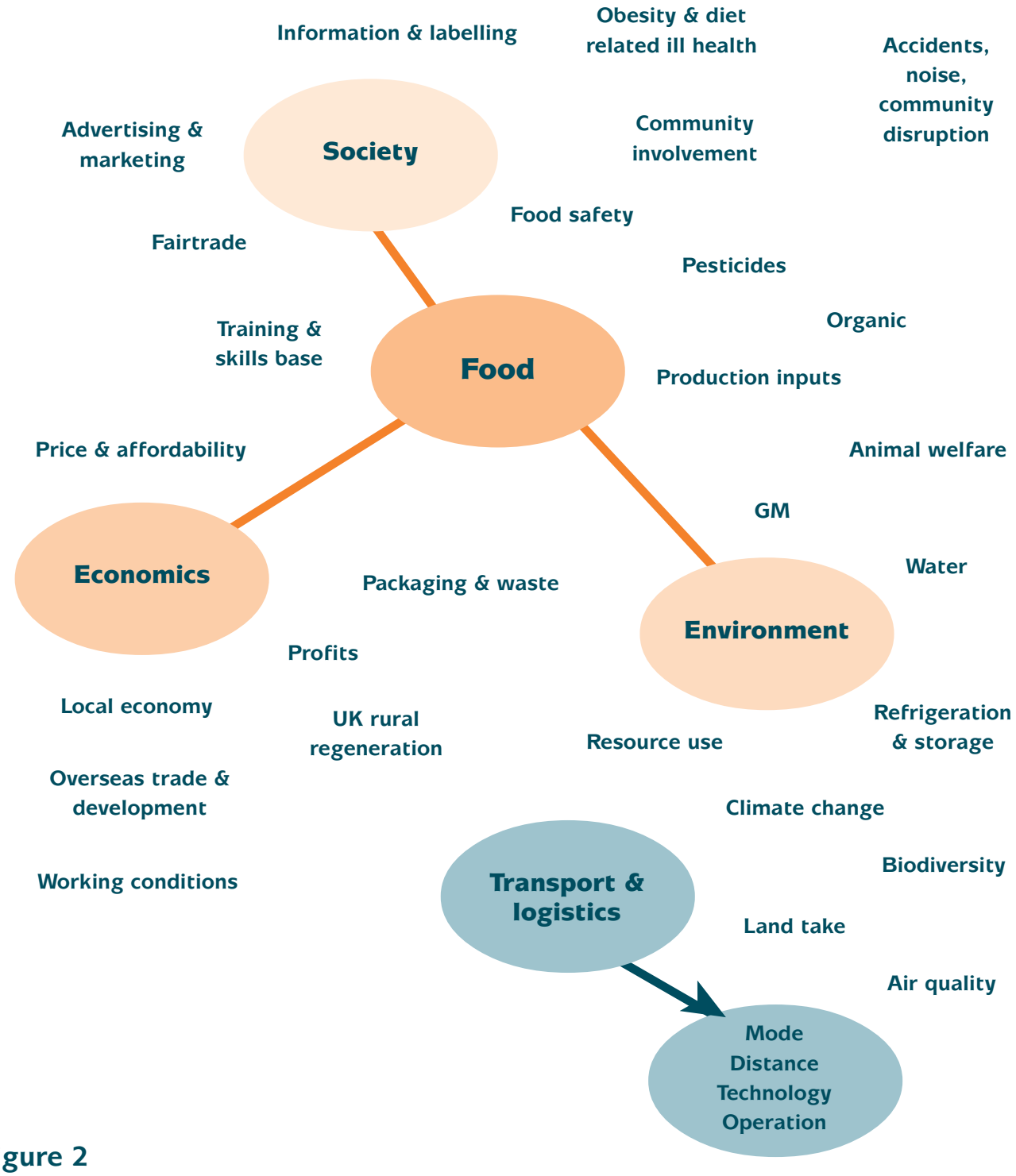

Figure 2

Section two
Food and freight: The trends and their impact

This section explores whether the UK food industry is becoming more or less freight intensive and how freight movements are generated in the supply chain. It goes on to discuss where our food comes from and travels to, and how it gets there. Finally, some of the social and environmental impacts of these movements are examined.

2.1 Food transport: Is the problem growing?

Recent years have seen our society as a whole becoming generally less transport intensive. Growth in UK transport measured in tonne-kilometres has grown more slowly than Gross Domestic Product (GDP).

But is this true of the food industry? Is the food sector becoming more or less transport intensive and what are the implications for CO_2 emissions? Unfortunately, data showing trends in CO_2 from food transport are unavailable. Instead we have to make do with approximations, such as growth in tonne-kilometres and in vehicle-kilometres.

Overseas miles

Perhaps the most important point to recognise is that food journeys taking place outside the UK are not included in UK Government transport statistics, nor are the emissions they generate captured in the UK's greenhouse gas inventory. Indeed, those produced by aircraft and ships are attributed to nobody,[25] meaning (as we discuss later) that there is little regulatory incentive to reduce them. Emissions generated by road vehicles overseas carrying food destined for British stomachs will count towards the host country's annual greenhouse gas bill, not the UK's. The reverse is also true; emissions produced trucking British products across the UK before they depart for foreign markets will be included in the UK's balance. However, since we import much more food than we export, the greenhouse gas imports/exports equation does not balance out.

It is striking that, in contrast with the UK, the growth in freight transport in the European Union (EU) is outstripping growth in GDP.[26] This is true also of the growth in global freight transport.[27] For food journeys, this discrepancy may suggest that we are driving our food on other nations' roads more than our own – and it is quite possible that we are driving them more than ever before.[28,29]

As the food industry continues to internationalise its supply chains,[30] it seems likely that our food supply system is in fact becoming increasingly transport intensive.

25 Unless the company responsible for these emissions wishes to report them – reporting is still voluntary

26 *Term 2002 13 EU: freight transport demand by mode,* European Environment Agency, http://themes.eea.eu.int/all_factsheets_box

27 Simms A, *Collision Course: free trade's ride on the global climate,* New Economics Foundation, London, 2000

28 Kearney A T, *Insight to Impact: results of the fourth quinquennial European logistics survey,* European Logistics Association, Brussels, 1999

29 McKinnon A, Forster M, *Full Report of the Delphi 2005 Survey: European logistical and supply chain trends, 1999-2005*, Heriot-Watt University Logistics Research Centre, Edinburgh, 2000

30 *The Future of Global Sourcing,* Institute of Grocery Distribution, Letchmore Heath, 2002

Food journeys in the UK

A comparison between growth in GDP and growth in food-related tonne-kilometres shows them to be on a par – over the last ten years the economy has grown by 32% while food freight tonne-kilometres has grown by 30%.[31] This is in contrast with the freight sector averaged out across all industries, where the rate of growth is only 24%.[32] In other words, although this particular set of data suggests that the growth in food transport is slowing off, it is not slowing off as fast as it is in other industries.

A more meaningful and industry-specific comparison might, however, be between growth in the grocery market (by value), and growth in freight tonne-kilometres, in order to assess whether food freight movements are increasing or lessening in proportion with the sector's economic growth.

This approach reveals (using a 1992 baseline) that the 30% growth in food tonne-kilometres is in fact only half the 60% growth in the value of the grocery market.[33] By this measure the grocery sector appears to have become quite significantly less freight intensive. However, once the 60% grocery economic growth figure is adjusted for inflation, the true level of growth reveals itself to be a far more modest 25%. According to this measure, the market has actually grown *more slowly* than the increase in food tonne-kilometres it generates.

Any conclusion is complicated, however, by the fact that like is not being compared with like. The comparison made above is – in the absence of more precise data – between growth in the turnover of the *grocery* sector and growth in *food, drink and tobacco* related tonne-kilometres. These two are not the same: the grocery sector includes more than food, drink and tobacco. It includes in its definition non-food goods, such as clothing, televisions and cookware. One important reason why the grocery sector has grown so rapidly is because the retailers have moved into selling non-food goods.[34] Tesco, for instance, has a 5% share of the UK's non-food retail market.[35] These non-food-related kilometres are not included in the food, drink and tobacco tonne-kilometre statistics quoted above. If non-food goods were removed from the calculation we could see a much slower rate of growth within the food industry, meaning again that the growth in transport kilometres outstrips this growth.

The analysis takes on an additional twist once a different measure of freight intensity is used. If, instead of measuring tonne-kilometres, we choose to look at transport growth in terms of vehicle-kilometres, we find that these have grown by only 12% between 1992 and 2002. Growth in vehicle-kilometres has in fact been slower than grocery market growth. This is because food manufacturers and retailers are using larger vehicles than they were before, enabling them to carry more goods for every lorry that travels.

Analysing the data

Which of the two measures is a better gauge of CO_2 emissions – tonne-kilometres or vehicle-kilometres? It is arguable that in this context, the latter is a better choice; while in absolute terms a larger lorry will generate more emissions than a smaller one, per tonne of goods travelled, it will be also relatively less energy intensive. For a given tonnage of goods then, lots of small vans will generate more emissions overall than fewer larger vehicles. A low rate of growth in vehicle-kilometres could therefore be seen as a good thing, from a carbon reduction perspective. One might also add that, in contrast with the freight industry as a whole, most of the multiple retailers have set themselves targets for improving the efficiency of their operations, measured either in terms of kilometres travelled per litre of diesel, or of kilometres travelled per case of product carried.

These factors taken together may in fact suggest (although sector-specific data is lacking here) that the growth trajectories of food transport within the UK, and the CO_2 emissions this transport

31 Figures supplied by the Department for Transport and taken from the *Continuing Survey of Road Goods Transportation* and the Office of National Statistics

32 The decline in manufacturing is probably the main reason for this slow rate of growth

33 Figures supplied by the Institute of Grocery Distribution, Letchmore Heath, 2003

34 *Non Food Retailing 2003,* Institute of Grocery Distribution, Letchmore Heath, 2003

35 *Tesco Annual Review,* 2003 http://81.201.142.254/presentResults/results2002_03/Prelims/Report/site/uk_review.htm

generates, may be diverging. This divergence will be modified by the growth in sales of non-food goods and the growth in tonne-kilometres. Clearly, more data collection and analysis needs to be undertaken before a conclusive answer can be reached.

It is important to stress, however, that whatever the *relative* transport intensity of the food industry, the fact remains that aside from a small, probably foot and mouth disease induced blip in 2001,[36] food transport in the UK still continues to grow in absolute terms, whether measured by tonne-kilometres or by vehicle-kilometres.

Moreover, this analysis only applies to UK-based food movements. It is crucial to re-emphasise the importance of including overseas-generated food transport in any assessment of greenhouse gas emissions from the food system. These overseas movements are, as highlighted above, growing rapidly. They also represent, as discussed below, a cause for serious environmental concern.

How is the transport generated?

Movements occur at many stages of the supply chain. For a supermarket, a typical series of food journeys might be as follows:

- Raw ingredients are taken from their source to their place of primary processing. This might include washing and cutting.
- The constituent elements of the end product (both ingredients and packaging) are brought to the manufacturing plant where they are processed and packed. This can involve a number of journeys. The more complex the end product (a ready-made lasagne can contain around 20 different ingredients which may have come from all over the world), the more transport is likely to be involved.
- The finished product may be taken to a consolidation centre where it is consolidated with other goods destined for a number of retailers.
- The consolidated load can travel on to a regional distribution centre (RDC) or a national distribution centre (NDC).
- A full load from the distribution centre travels on to stores.
- Returnable packaging may be backhauled to the distribution centre.
- Supplier products may be backhauled to a national or regional distribution centre during a delivery vehicle's return journey from a store.
- The customers may drive to and from the store, or in some cases the goods may be delivered by van directly to the customer.
- Unwanted goods and unrecoverable waste travel to landfill sites (or occasionally to incinerators), usually by road.

2.2 Food: Where does it come from?

British farmers can produce 62% of the food we eat, or 75% of indigenous type food.[37] This makes us – in theory at least – more self-sufficient than we were in the 1950s; for comparison, the figures for 1956 were 47% and 61%[38] respectively. However, these figures mask several points. The first is that potential self-sufficiency is on the decline again, since its peak in the late 1980s. The second is that although we may be *capable* of a large degree of self-sufficiency, this does not mean that we eat what we grow. On the contrary, we simultaneously import and export many of the foods we produce, from lamb to butter to carrots. We might export carrots, for instance, when we have a seasonal surplus and import them out of British season. Alternatively we may import marginally different varieties of the same thing, even when UK supplies exist.

The consequence is that the UK remains a net importer of food[39] because we are not actually eating the full 62% of what we grow and are capable of producing. In addition to these indigenous foods, we import increasing quantities of foods that cannot be grown or produced here.

36 *Transport Statistics Great Britain,* Department for Transport, London, 2002

37 *Agriculture in the United Kingdom,* DEFRA, London, 2002

38 *Agriculture in the United Kingdom 2000,* MAFF, London, 2001

39 *The Food Industry,* special supplement, *The Grocer*, William Reed Publishing, West Sussex, October 2002, www.grocertoday.co.uk/resources/marketreport.asp?r=410

In 2000 we exported 8.8 million tonnes of food, feed and beverages and imported 17 million tonnes. This compares with 2.9 million tonnes of exports and 6.3 million tonnes of imports in 1980.[40] In other words, both imports and exports, measured in tonnes, have roughly tripled in the last 20 years.

How much of our food is British?

Data from Sainsbury's reveals that only a third of sales by value were of British food – £6 billion[41] out of £18 billion in sales.[42] This is despite the company's stated commitment to buying British wherever possible, and its claim that of foodstuffs that can be grown in this country, it sources over 90% from Britain.[41] Sales figures are not entirely proportional to volumes sold or indeed to the calories (or any other nutritional measure) which the consumer ends up eating. On the one hand, it may be that the sales figures for British food are low because these tend to be cheaper commodities, such as bread or milk. The proportion of British food sold by volume may thus be greater than at first appears. On the other hand, the uncertainty works both ways – many foods are imported because they can be and are bought more cheaply from overseas. This is true even of luxury foods such as cherries which, while expensive, are still more cost-effective to import than their British equivalents, once the vagaries of British weather, as well as land and labour costs are taken into account.

When food is imported and exported, most trade is within EU borders, accounting for 58% of our imports and 77% of our exports.[43] This has implications for the argument that imported food may be produced in more energy-efficient ways, because unlike food produced in developing countries, European-origin food is more likely to produced using machinery and plants similar, and similar in their energy use, to UK equipment. This likelihood lessens for foods from Eastern or Southern Europe where manual labour and, in the latter case, climatic differences may substitute to some extent for fossil-fuel inputs. On the other hand, when fuel-consuming processes are involved, they are likely to be less efficient. A fuller discussion of life-cycle trade-offs can be found in section six.

As for animal feed, although the UK is largely self-sufficient in cereals, we still import soya, maize, molasses and other feedstuffs. These together account for roughly a quarter by weight of all animal feed consumed in the UK.[44] These inputs to our food system are very important since it is easy to forget that apparently 'British' beef will often have been sustained on feed imported from thousands of kilometres away.

2.3 Food imports and exports: How do they move?

The vast majority of food entering and leaving the UK will travel by ship, following a road journey in its country of origin.

In 2002, 94% (by weight) of the food we imported from non-EU countries arrived by sea, and 1.6% by air; 89% of our exports left by ship, and 1.03% by air. Although a breakdown for EU-origin imports is not available, the figures are likely to be similar because 2000 data for all imports, for all countries, shows that 91% of food (by weight) arrived and left by sea. Less than 1% travels through the Channel Tunnel.[45] Some of the imports which reach our shore by ship or through the Tunnel will have done so following a rail journey in their country of origin, but while the amount of food moved by rail on the Continent is likely to be higher than in the UK, road's share will still be vastly greater.

Food transport by air

In addition, 0.7% of EU food imports by weight arrived by air and 0.16% left for the Continent by this mode. A look at figures by value changes the

40 HM Customs and Excise. Data prepared by Statistics (Commodities & Food) Accounts and Trade Branch, ESD, DEFRA, 2001

41 See: www.j-sainsbury.co.uk/media/press_questions10.htm

42 Investor FAZQs: www.j-sainsbury.co.uk/investors/ir_questions.htm#9

43 HM Customs and Excise, 2002 data prepared by Statistics and Analysis of Trade Unit, for Transport 2000

44 *Raw Material Usage in Retail Production of Animal Feedingstuffs in Great Britain: May to July 2003*, DEFRA/ONS, 2003 http://statistics.defra.gov.uk/esg/statnot/mcompspn.pdf

45 HM Customs & Excise, 2002 and 2000 data prepared by Statistics and Analysis of Trade Unit, for Transport 2000

picture somewhat – obviously a greater percentage of high value goods will travel by air than by sea. But as demand for these high value products grows it is likely that we will see a very rapid growth in the volume of food transported by this mode.

Food is extremely important to the air freight industry. As the largest air-freighted sector it accounts for 13% by weight of air-freighted goods.[46] And in the last three years alone total imports of foodstuffs by air have grown by 47% (by value). Exports have grown by 10%.

Contrary to some claims, the vast majority of food flies in on dedicated freighters and not in the belly-hold of a passenger aeroplane.[47] The reasons for this are apparent. Food is a perishable, high value commodity, with special storage requirements.[47] Freighters provide a reliable service, flexibility of space (belly cargo is based around very defined container sizes that can not always accommodate pre-packed cargos) and, when properly managed, can work out cheaper than using belly cargo space.[47]

Air freight: Growth in all sectors

Air freight is growing rapidly: a growth aided by untaxed aviation fuel, by lower manufacturing costs overseas, and by sophisticated communication networks including, recently, the rapid growth in e-commerce.

Although globally 50% of air-freighted goods are carried in the belly of passenger planes that would be flying anyway, the growth in the use of freighters has been significantly higher than the growth in the use of aircraft belly-hold – compare 12.11% per annum growth for freighters with 7.94% for belly-hold.

Furthermore, overall growth in the air freight sector as a whole (particularly to and from Asian markets) is even more rapid than that of passengers, and is predicted to grow at about 6.4% during the next two decades.[48] Air-freighted goods are worth an enormous amount to the UK economy: while the two million tonnes of air freight that pass through UK airports each year is equivalent to less than 1% of the UK's ocean freight volumes, by trade value it represents around a fifth of British exports.[49]

We are likely to see a global air freight fleet of about 3100 by 2021,[48] many of which will be retired (and hence less efficient) passenger aircraft. By 2050, freight aircraft could make up nearly a third of the total commercial fleet.[50]

2.4 Food: How does it travel in the UK?

Within the UK, the vast majority of food, whether home-grown or imported, travels by road. Every year we truck 300 million tonnes of food, drink and agricultural products around the country.[51] These movements generate 41 billion tonne-kilometres[52] and account for 28% of the total tonne-kilometres travelled by freight in the UK. Since 1991 food-related tonne-kilometres has grown by 26.6% compared with an average 20% across all freight sectors.[53]

This 28% share of total tonne-kilometres is despite the fact that food only makes up a fifth, by tonnes-lifted, of all UK goods,[52] a disparity which has several explanations.

First, food tends to travel further than any other type of good. Food's average length of haul, at 129km, is substantially further than the average

46 *UK Air Freight Study Report,* Department for Environment, Transport and the Regions, December 1998

47 Dawson J, Exel Logistics, personal communication October 2002

48 *World Air Cargo Forecast,* 2002-2003, Boeing www.boeing.com/commercial/cargo/exec_summary.html

49 Wilmott K, *Understanding the Freight Business,* British International Freight Association, 2001

50 Whitelegg J and Williams N, *The Plane Truth: aviation and the environment,* Transport 2000 and Ashden Trust, London, 2001

51 Defined according to the DETR's commodity groups in *Transport of Goods by Road in Great Britain 2001,* DTLR, 2001. There are three sub-groups: agricultural products (bulk cereals, potatoes, other fresh and frozen fruit and vegetables, sugar, live animals and animal foods); beverages (alcoholic and non-alcoholic except tea, coffee and milk); other foodstuffs (meat, fish, dairy products, fruit, cereals, other foods including tea and coffee, tobacco)

52 *Transport of Goods by Road in Great Britain,* 2001, DTLR, 2001

53 *Freight Transport by Road: goods moved by vehicles over 3.5 tonnes 1991-2001,* Department for Transport, www.dft.gov.uk/stellent/groups/dft_control/documents/ contentservertemplate/dft_index.hcst?n=7001&l=3

of 94km. A fifth of food (by weight) moves more than 200km.[54]

Second, as one European Commission (EC) report points out[55] the distance goods travel is partly because the supply chain has become more complex. Not only are we sourcing from further afield, but we also move goods about more for various kinds of processing. This has led to the creation of more transport stages or links in the supply chain, otherwise known as an increase in the 'handling factor.' Indeed in the ten years between 1985 and 1995 there has been an 18% increase in this handling factor for freight of all kinds. The report does not provide a sectoral breakdown but, given the growth in processed foods, it is likely that this trend applies to the food sector too and has contributed to the increase in food-related tonne-kilometres.

Some food is still moved by rail, but not much. Rail accounts for around 6% of freight moved in the UK, expressed in tonne-kilometres.[56] Reliable data for food movements by this mode are no longer available – following the privatisation of the rail industry, such information is no longer held publicly. However, one rail expert from the Institute of Transport Studies estimates that around 1–1.5 million tonnes are likely to move in

Freight in the UK: The general picture

Over 1.5 billion tonnes of goods move around the UK each year.[64] The logistics industry is a major employer, providing around 1.2 million jobs in transport, warehousing, handling and other activities[65] and accounting for around 4% of those in employment.[66]

Road freight traffic grew by 67% between 1980 and 2001 (by 20% since 1991),[64] broadly in line with economic growth, although recent years have seen the economy becoming slightly less transport intensive. Over the same period the average length of haul has increased by around 40%.[64]

There are also light goods vehicles (LGVs) to consider. The total size of the LGV fleet in Britain is already about five times that of heavy goods vehicles (HGVs) and is growing faster than both HGVs and cars. Vans also cover approximately 75% more vehicle-kilometres each year in Britain than the total HGV fleet.[67] Many of these vehicles will be owned by plumbers and electricians but many will be carrying goods. A breakdown by sector of the LGV fleet does not exist but a 1994 Department of Transport Survey[68] did find that LGVs accounted for 5.9% of total tonnes lifted and 4.6% of total tonne-kilometres on our roads, and that they were responsible for considerably higher rates of empty running than HGVs.

Most projections suggest that freight and light van traffic will grow faster than private car use, particularly if road pricing schemes become more widespread. One estimate predicts a 50% growth in commercial traffic by 2050, compared with 33% for cars.[69]

At present HGVs account for 35% of emissions from all vehicles.[70] Government aims to reduce CO_2 emissions from freight by 0.7 million tonnes by 2010 relative to what the growth in emissions would have been had no measures to reduce their growth been put in place.[71] Achieving the target would lead to an overall reduction in CO_2 but one that is less that the 0.7 million tonnes quoted.

54 *Transport of Goods by Road in Great Britain 2001,* DTLR, 2001

55 *Redefine: relationship between demand for freight transport and industrial effects,* final report, Contract No. RO-97-SC.1091, European Commission, Brussels, February, 1999

56 *Domestic Freight Transport by Mode 1991-2001,* Department for Transport, www.dft.gov.uk/stellent/groups/dft_transstats/documents/page/dft_transstats_506359.xls

57 Fowkes T, Senior Lecturer, Institute for Transport Studies, University of Leeds, personal communication, August 2003

58 *Travel to the Shops in GB,* Personal Travel Factsheet 6, Department for Transport, 2003

59 Figures supplied on request from Department for Transport. Source: *National Travel Survey,* 1999/2001

60 *Continuing Survey of Road Goods Transport,* DTLR, 2001

61 *Waste not Want Not: a strategy for tackling the waste problem in England,* Strategy Unit, London, 2002

62 *Towards Greener Households: products, packaging and energy*, INCPEN, London, 2001

63 *The Environment in your Pocket 2002,* DEFRA, London, 2002

64 *Transport of Goods by Road in Great Britain 2001,* DTLR, 2001. Note: figures apply to goods carried in vehicles weighing over 3.5 tonnes

65 *Solving the Skills Shortage,* Freight Transport Association, Tunbridge Wells, October 2001

this way, accounting for approximately 0.3 billion tonne-kilometres[57] – equivalent to around 0.75% of road movements. He bases this figure on a review of historical data.

Of course the journey does not end once the food reaches the store – the food needs to be taken home. All the signs are that people are now travelling further to shop. Shopping accounts for a fifth of all personal trips (216 trips a year) 55% of which are food-related.[58] Of the average 893 miles an individual travels for shopping, over a third (349 miles) are for food. The majority of these trips (60%) are by car. Food shopping accounts for 5% of all car mileage, an increase from 2% in 1996/98.[59] We discuss the contribution these trips make to the UK's CO_2 emissions in section six.

Finally, after the food has been eaten, there is the waste to consider. In 2001, 31 million tonnes of household waste were removed for disposal, accounting for 720 million tonne-kilometres.[60] Nearly 17%[61] of this was kitchen waste – in other words, food. Packaging makes up around a quarter[62] of household waste. Nearly 70% of this is food-related[62] – working out as 17.5% of household waste. In total, then, 34.5% of household waste is associated with the food supply chain. Although domestic waste contributes only 7%[63] to the overall waste stream its relatively high organic content means that it has a particularly significant impact on climate. Decomposing organic matter produces methane, a far more potent greenhouse gas than CO_2. One should of course note that waste occurs at all stages in the food supply chain. Agriculture alone accounts for 20% of all waste generated in the UK[63] although much of this will be organic matter which is simply applied to the fields. Figures for the tonne-kilometres generated during the course of removing and disposing of food waste from processing plants are, unfortunately, not available.

2.5 Food transport: The social and environmental impacts

The impact of our food transport system upon society and the environment is a function of the overall distances involved, the mode of transport chosen, the route the vehicle takes, the fuel the vehicle uses and the way the vehicle is maintained, managed, loaded and driven.

Of all transport's impacts, perhaps the most significant is the CO_2 emissions it generates. Worldwide, transport (both freight and passenger travel) accounts for nearly a quarter (23.8%) of total human-generated CO_2 emissions.[72] Freight transport is responsible for a considerable share of this: one estimate puts it at 43.4%[73] of total transport energy while another sets it at an even higher 55%.[74] From averaging these estimates, one can roughly calculate[75] that freight movements account for over a tenth of world CO_2 emissions. In the UK, freight transport's contribution amounts to around 8.4% of the country's CO_2 emissions.[76] Both these figures are for freight movements in general, not just those related to food.

In addition to CO_2 emissions, goods movements create other serious social and environmental problems. The major concerns associated with each of the four main modes of transport, road, sea, rail and air are summarised next.

66 Office of National Statistics, Census 2001

67 *Transport Statistics Great Britain 2002,* Department for Transport, 2002

68 Department of Transport 1994, cited in: Browne M, Allen J, Anderson S and Wigan M, *The Growing Importance of Light Goods Vehicles in the UK,* paper presented at the Logistics Research Network annual conference 2002, published by the institute of Logistics and Transport, Corby, Northants, 2002

69 Eyre N, Fergusson M and Mills R, *Fuelling Road Transport: implications for energy policy,* Institute for European Environmental Policy and Energy Saving Trust, London, 2002

70 *Focus on Freight*, Department for Transport, June 2003

71 *Transport Ten Year Plan: background analysis,* Department for Transport, London, 2000

72 *CO_2 Emissions from Fuel Combustion,* International Energy Agency, Paris 2001 (1999 data) http://climate.volpe.dot.gov/present/oecd0101.pdf

73 *Global Transport and Energy Development: the scope for change,* Annex 2.4, World Energy Outlook (1995 figures), www.worldenergy.org/wec- geis/publications/reports/etwan/ supporting_publications/annex_2_chap4_transport.asp

74 Simms A, *Collision Course: free trade's ride on the global climate,* New Economics Foundation, London, 2000

75 The relationship between energy use and CO_2 emissions is not an exact one but the calculation gives an indication of the figures involved

76 See section six for details of the calculations

Climate change: The likely impacts

Climate change, accelerated by emissions of CO_2 and other greenhouse gases, is arguably the most pressing environmental concern we face today.[77] The Intergovernmental Panel on Climate Change (IPCC) warns that we need to cut greenhouse gas emissions from human activities by 60–80% by 2050 in order to avoid the worst impacts of climate change.[78] If we are to achieve this goal, all sectors of industry and society will have to play their part.

Global temperatures have risen by around 0.6 ºC over the last century. Meteorologists are cautious of making a direct link to the heat-waves and severe floods which have affected Europe with increasing frequency over the last few years. They do, however, point out that these events are consistent with climate change model predictions. Future years are likely to bring higher temperatures, rising sea levels and coastal flooding, extreme weather events including flooding, storms, forest fires, die-back of tropical rainforests, desertification, loss of farmland, species loss, and the spread of tropical diseases such as malaria to areas not previously affected.[79]

There is also the possibility that beyond a certain critical point we will see a 'runaway' effect of spiralling forest die-back, leading to more CO_2 emissions, higher temperatures causing more forest die-back and so on, with potentially disastrous prospects both for the human race and for many other forms of life.

Furthermore, new research suggests that previous estimates of the growth in temperature are too low. Scientists are now warning that the smoke and aerosol particles (another industrial legacy) which we have also been emitting into the atmosphere have had a cooling effect, slowing down previous rates of temperature rise. And while this effect was known before, new research suggests that this cooling influence may be much greater than previously estimated. As we cut down on these other emissions (for good social and environmental reasons), the effect disappears and we are left to face, unprotected, the full effects of climate change. Some estimates now put the possible rise in temperature as high as 7–10º C by the end of the century.[80]

While the most catastrophic impacts of climate change are likely to be – as so often – felt by the poorest countries, we in the UK will not escape the effects.

As regards the more direct impacts on human health, a report by the Department of Health[81] points out that while cold-related winter deaths are likely to decline we will see more cases of heat and ozone related deaths, food poisoning, vector-borne[82] and water-borne diseases. The risk of major casualties occurring as a result of severe gales, coastal flooding and other extreme weather events will increase substantially.

77 *'Concerted international effort' necessary to prevent climate change,* speech by Tony Blair at event organised by the Sustainable Development Commission, London, 24 February 2003

78 *First Assessment Report,* Intergovernmental Panel on Climate Change, Geneva, 1990

79 *Climate Change: the UK programme,* DETR, November 2000

80 *New Scientist,* 4 June 2003, www.newscientist.com/news/news.jsp?id=ns99993798

81 *The Health Effects of Climate Change,* Department of Health, 2001

82 Such as malaria

83 *Redefine: relationship between demand for freight transport and industrial effects,* final report, Contract No. RO-97-SC.1091, European Commission, Brussels, February 1999

84 Emissions for agricultural products are lower than in France, which can be explained by the fact that the agricultural sector is less important to the UK economy than to France

Road

Figures in one European Commission (EC) report[83] suggest that the UK generates considerably higher levels of CO_2 emissions in the course of transporting foodstuffs than any of the other sample European countries.[84] Tables 1 and 2 illustrate this.

Although at the raw commodities level, the UK performs better than France and only marginally worse than the Netherlands, its CO_2 count is much worse later on in the food chain. The reasons for this will be various but an important factor is the high proportion of processed food, involving longer and more elaborate distribution processes, which the UK consumes relative to other European countries. Section six shows calculations of food transport's contribution to total UK CO_2 emissions.

Table 1 Total transport emissions CO_2 and NO_x in 1000 tonnes

REDEFINE group	Year	France	Netherlands	United Kingdom
CO_2 emissions			*1000 tonnes*	
Agricultural products	1995	1247	991	1057
	2005	1505	1275	1100
Beverages and other foodstuffs	1995	1416	856	2489
	2005	1482	812	2904
NO_x emissions			*1000 tonnes*	
Agricultural products	1995	18.1	14.5	15.4
	2005	10.9	9.4	8.2
Beverages and other foodstuffs	1995	20.4	12.4	35.9

Table 2 CO_2 per million population[85]

	2001	*Agricultural products*		*Beverages/other food*	
	Population	**CO_2 1995**	**CO_2 per 1m pop**	**CO_2 1995**	**CO_2 per 1m pop**
UK	58.8	1057	17.98	2489	42.33
France	59.2	1247	21.21	1416	24.08
Netherlands	16.0	991	16.85	856	14.56

Other forms of air pollution have a more noticeable and immediate impact on our health and the environment than the longer-term climatic effect of greenhouse gases. Although improvements in vehicle technology mean that lorries produce far fewer air pollutants than they did ten years ago, road transport, including freight, is a significant emitter of air pollutants.

Road traffic also accounts for 56% of black smoke, to which lorries make a substantial contribution, although specific data was not available.

The health consequences are severe. It is estimated that around 24,000 deaths may be hastened each year in the UK by periods of high air pollution, and a further 24,000 hospital admissions may also be triggered.[86] To this can be added an unspecified number of people suffering from chronic pollution-related ill health. Particulate emissions (mostly produced by lorries) have also been linked with the development of

Table 3 The contribution of HGVs to air pollutants, 2001

Pollutant	HGV share of road transport emissions %	HGV share of emissions from all sources %
Nitrogen oxide (NO_x)	48.8	20.9
Particulates (PM_{10})	5.7	35.6
Volatile organic compounds (VOCs)	2.2	14.1

Source: National Atmospheric Emissions Inventory (2001 data).

85 Figures supplied by Professor Alan McKinnon, Heriot-Watt University, personal communication, Edinburgh, May 2003

86 *Quantification of the Effects of Air Pollution on Health in the UK,* Committee on the Medical Effects of Air Pollutants, Department of Health, London, 1998

cancer as well as with respiratory and cardiovascular diseases.[87]

Road deaths are the most forceful reminder of the damage road transport can cause. In 2002, of the 3431 deaths and 35,976 serious injuries on Britain's roads,[88] lorries were involved in 532 and 2374 of these respectively; for LGVs the figures were 311 fatalities and 2585 serious injuries.[89] Although there is a smaller chance of being involved in an accident with a lorry than with another vehicle, the chance of dying if this does happen is about twice as high. Put another way, although HGVs account for 6% of all vehicle mileage, they are involved in 15% of road deaths.[89]

A range of other, less quantifiable impacts are also associated with road transport, and freight distribution is implicated in these. While less easy to measure, they nevertheless have damaging effects upon the lives of many people. These include noise and a decline in the quality of community life and the street environment.

87 *Particles – PM10 factsheet,* National Society for Clean Air, www.nsca.org.uk/

88 *Road Casualties Great Britain: main results, 2002 data*, Department for Transport, 2002, www.dft.gov.uk/stellent/groups/dft_transstats/documents/page/dft_transstats_022247.hcsp

89 Supplied by Department for Transport, 2002 data

90 *GHG Emissions for International Shipping and Aviation,* study commissioned by the Swedish Environmental Protection Agency, ECON Centre for Economic Analysis, Norway, January 2003, www.environmentdaily.com/docs/swedeepa3.pdf

91 *A European Strategy to Reduce Atmospheric Emissions from Seagoing Ships,* Communication from the EC to the European Parliament and the Council, Brussels, November 2002

92 The following are classed as contaminants: sewage, persistent organic pollutants, heavy metals, oils, nutrients, sediment mobilisation and litter

93 GESAMP, *The State of the Marine Environment*. IMO/FAO/UNESCO/ WMO/IAEA/UNEP/ UN Joint Group of Experts on the Scientific Aspects of Marine Pollution. UNEP Regional Seas Reports and Studies 115, UNEP, Nairobi, 1990. Note: More recent figures are not available

94 International Maritime Organisation, http://imo.org/Environment

95 Capaldo K, Kasibhatla P, Fischbeck P, and Pandis S N, Effects of Ship Emissions on Sulphur Cycling and Radiative Climate Forcing over the Ocean, *Nature,* 10 August 1999, Macmillan, London

96 Huggett D, *Ten years of developing ports policy in the UK,* RSPB, London, February 2003

Sea

Shipping accounts for 2% of annual global CO_2 emissions.[90,91] Bunker fuel used for shipping is not subject to fuel duty, and while the CO_2 emissions are relatively small, shipping's environmental performance is extremely poor in other respects. Marine transport accounts for around 12% of contaminants[92] entering the world's oceans[93] causing damage to the marine ecosystem. It also produces 7% of global nitrogen oxide emissions. These emissions cause acid rain and human health problems.[94]

In addition, shipping produces large quantities of sulphur dioxide (SO_2) emissions. The EU predicts that if nothing is done to reduce them (and a proposal putting policy measures in place is now undergoing consultation in Member States) by 2010, shipping will produce emissions equivalent to 75% of all EU land-based SO_2.[91] This will mean that by 2010 shipping could be responsible for around 40% of EU-generated sulphur emissions. Sulphur emissions are not only responsible for acid rain but can also cause respiratory problems and heart attacks.

The problem of emissions on specific routes has been acknowledged by the International Maritime Organisation.[94] Moreover, there is increasing evidence to suggest a link between sulphur emissions and the greenhouse effect. Research reported in *Nature* magazine[95] suggests that marine emissions trigger the creation of localised clouds (particles from exhausts act as nuclei around which water vapour condenses) which in turn lead to radiative forcing (see glossary), and hence a greenhouse effect.

For many foods, refrigerated storage during the journey will also have produced considerable quantities of greenhouse gases. Refrigeration units in transit tend to be less energy efficient than stationary ones.

It must also be remembered that lorry journeys will still be involved at either end of the journey and as such shipping is implicated both in the growth in road transport, and in the road infrastructure that serves it. The ports that serve the freight industry come with significant environmental downsides of their own. These include the loss of coastal land, the dredging of channel waters, noise, and the loss of wildlife.[96]

Rail

Rail transport[97] accounts for just 1% of the UK's CO_2 emissions, in comparison with the 24% generated by road transport.[98] While not as energy efficient as shipping, recent years have seen the rail freight industry investing in cleaner engines, such as Class 66 locomotives. As with shipping, road transport will still be needed at both ends of the journey and there will also be land use and community impacts at the site of rail freight terminals and sidings.

Air

The rapid growth in air freight has already been highlighted. The environmental consequences of this are very serious. In addition to CO_2 (around 2% of all human-generated sources),[99] aviation produces oxides of nitrogen, which lead to the formation of ozone, particulates and water vapours, the latter creating the familiar contrails we see on a clear day. This vapour has an additional greenhouse effect by trapping heat within the atmosphere. Once these effects are included, estimates put the contribution of the aviation industry to human-generated climate change at a higher 3.5%.[100] However this still does not include the warming effect of the extra cirrus cloud which is formed from aviation-derived soot and sulphates. While this effect has not yet been quantified, experts believe it could be much more significant than the warming effect of contrails. If so, then aviation's contribution to climate change could be considerably higher than present estimates suggest.[99]

As it stands, forecasts suggest that by 2050 aviation is likely to be a major contributor to climate change, accounting for as much as 15% of greenhouse gas emissions.[101] The majority of those emissions will, as now, result from passenger movements but it should be noted (see *Air freight: growth in all sectors*) that the growth in air freight is even more rapid than that of passengers.

2.6 Conclusion

The transport of food by air, sea and land is responsible for significant quantities of greenhouse gas emissions. In addition, such transport creates a number of other social and environmental problems, including air, land and sea pollution, human health problems, road injuries and deaths, land-take and consequent loss of biodiversity, and a less quantifiable but nevertheless important decline in the quality of life for many people.

Section four looks at why the growth in food transport has come about. First, however, the following section examines what is being done to improve the environmental performance of the freight industry.

97 Of all kinds: a breakdown by freight and passenger trains is not available

98 *Transport Statistics Great Britain,* 2002 edition, Department for Transport, 2002. Note: this figure includes the source category (ie for trains running on electricity this would include the CO_2 emitted during the process of producing the electricity. Most freight trains in any case run on diesel, but the source category is also included here, as it is for road transport

99 Whitelegg J and Williams N, *The Plane Truth: aviation and the environment,* Transport 2000 Trust and Ashden Trust, London, 2001

100 IPCC Special Report, *Aviation and the Global Environment,* Intergovernmental Panel on Climate Change, Geneva, 1999

101 *Aviation and the Global Atmosphere,* Intergovernmental Panel on Climate Change, Cambridge University Press, 1999

Section three
The technological approach: How far will efficiency get you?

Government policy places great emphasis on improving efficiency and achieving modal shift as ways of achieving sustainable distribution systems.[102] This section briefly explores the extent to which gains in these areas can help reduce emissions from food transport.

The discussion begins by considering how better fleet management can reduce emissions; it goes on to look at the role information technologies can play in cutting unnecessary travel; at the scope for modal shift to rail; and at the case for alternative fuels. It then assesses how far we can and should rely upon technological solutions to reduce transport's contribution to climate change.

3.1 Fleet management

The energy efficiency of a vehicle will depend both on its design (including the type of fuel it runs on, and its weight relative to that of the contents being carried), and on the way it is operated; in other words, how the driver drives it, the route it takes and how the manager runs and maintains the fleet. Research conducted at the University of Huddersfield[103] concludes that the most successful interventions, in order of effectiveness, are:

- Driver training / driver's fuel efficiency skills.
- Vehicle specification / choosing the right vehicle manufacturer.
- Transport efficiency management / routeing and scheduling.
- Design features aimed at improving the vehicle's aerodynamicity.
- Loading factors, empty running and payload weights.

Training for drivers

Training drivers to drive in ways that reduce fuel consumption can achieve significant results. Fuel efficiency can vary by as much as 45% between different drivers using identical vehicles.[104] Training, aided by in-cab displays indicating, for example, the correct gear to use, can cut fuel consumption by about 10–15%.[105] Enabling drivers to see how much fuel they use also helps. A large scale trial of 'econometers' in the Netherlands found that motorists could reduce fuel use by 15%. Predictably, results were better for private motorists than for employees who did not pay for the fuel.[106]

As part of its sustainable distribution[102] implementation strategy, the Department for Transport[107] has awarded funds for a £1.7 million driver training scheme. Drivers in the Department for Transport (DfT) pilot trial averaged 6% reductions in fuel use.

102 *Sustainable Distribution: a strategy,* Department for the Environment, Transport and the Regions, London, 1999

103 Coyle M, *Fuel Saving Interventions: facts and fictions,* Transport and Logistics Research Unit, University of Huddersfield, 2002

104 Novern, Netherlands Agency for Energy and the Environment 1996, cited in *Fuel Efficiency Fleet Management: good practice guide* 218, DETR, London, 1998

105 Transport and Logistics Research Unit, *Reducing the Environmental Impact of Road Transport Operations: a review of inventions that can be applied by fleet operators,* presented at the CANTIQUE Workshop, Rome, 24th, 25th January 2000, University of Huddersfield, Huddersfield, 2000

106 *Econometer and Cruise Control: report of field trials*, Novern, cited in *Fuel Efficiency Fleet Management: good practice guide* 218, DETR, London, 1998

107 *£1.7 million for Lorry Driver Training,* news release, Department for Transport, London, 3 June 2003

Vehicle design

Using the right vehicle for the job can also make a difference. For instance, vehicles operating in hilly areas will need a different power-train specification from those operating in a flat part of the country. Similarly, the body for a vehicle transporting high density products will not need to be as large as one for low density products.[108] Recognising this, Marks & Spencer, in partnership with its logistics provider Joint Retail Logistics, has developed a vehicle for transporting clothing with scaled-down mechanicals, meaning that it is lighter than normal. The use of this vehicle has improved fuel efficiency by around 40%.

In addition, design features to improve aerodynamic performance can cut fuel use by about 16%.[109] Even apparently insignificant factors can have an effect – a white refrigerated trailer will be more energy efficient than a coloured one, as it reflects, rather than absorbs sunlight and heat.

Efficiency in the freight industry

The road haulage industry as a whole is doing little to improve its fleet efficiency. According to the Freight Transport Association there are over 65,000 road haulage operators in the UK, driving nearly half a million vehicles of 3.5 tonnes and over. Notwithstanding the industry's vociferous complaints about the cost of fuel, a series of National Road Show Seminars in 2001 demonstrating how fuel can be saved barely attracted 200 delegates. And a study into the UK haulage industry showed that while 88% of fleets kept information on their fleet mileages, only 30% knew their total fuel expenditure and even fewer (20%) knew how much fuel their fleet consumed.[110] Unsurprisingly, the larger operators are more likely than the smaller ones to have strategies in place to monitor, manage and improve fuel efficiency.

To improve efficiency throughout the industry, the Department for Transport runs initiatives such as the Road Haulage Modernisation Fund, and associated programmes including CleanUp and the Transport Energy Best Practice Programme.[111] A number of other bodies also provide information and advice.[112]

Load optimising

Another useful approach is to maximise the vehicle's load, so that the vehicle is carrying as much as possible. Combining light with heavy products, to ensure the vehicle is filled to the maximum both by volume and by weight is one approach; double-deck trailers that make use of empty headroom space is another. Within the UK, the level of empty vehicle running in the food supply chain tends to be lower than in the freight industry as a whole – 22.7% for foodstuffs compared with 26.4% for the average across all sectors.[113] One survey puts the figure even lower at 20%.[114] This means vehicles are carrying loads 80% of the time. Moreover when they are carrying loads, the vehicles tend to be filled to around 70% of their deck-area,[114] which is fairly good compared with the goods distribution industry as a whole.[115]

However on approximately a third of loaded journeys and a fifth of the total distance travelled (which includes the return journey) the vehicles were less than half full, when measured either by volume or weight. On average, around half the time vehicles were between 50%–90% full, which means that for the remaining time they were very underused indeed. One article concludes: '*There remains considerable potential for improving load factors on laden vehicles. This has been illustrated by two studies undertaken for ECR Europe, which revealed serious under-utilisation of space in trucks carrying grocery products*.'[116]

108 Coyle M, Whiteing A E and Murray W, *Fuel Saving Interventions: facts and fiction,* University of Huddersfield, Huddersfield, 2002

109 Transport and Logistics Research Unit, *Reducing the Environmental Impact of Road Transport Operations: a review of inventions that can be applied by fleet operators,* presented at the CANTIQUE Workshop, Rome, 24-25 January 2000, University of Huddersfield, Huddersfield, 2000

110 *Freight Industry Times,* Issue 4, McMillan-Scott plc, Manchester, Spring 2001

111 See: www.transportenergy.org.uk

112 See for example the University of Huddersfield's Transport and Logistics Research Unit www.hud.ac.uk/sas/trans/

113 *Transport of Goods by Road in Great Britain 2001,* Department for Transport, Local Government and the Regions (DTLR), London, 2001

114 McKinnon A and Leuchars D, *Vehicle Utilisation and Energy Efficiency in the Food Supply Chain,* Logistics Research Centre, Heriot-Watt University, Edinburgh, 2002

115 *Key Performance Indicators in the Food Supply Chain,* Benchmarking Guide 78, Department for Transport, London, April 2003

116 Braithwaite A and McKinnon A, *Retail Trends Affecting Sustainable Distribution,* in *Logistics and Transport Focus,* Institute of Logistics and Transport, Corby, Northants, April 2003

One of the article's authors, McKinnon, also notes inefficiencies in other areas. For around 15% of the vehicle's working time it is loaded and ready to go but not moving.[115] With a temperature-controlled load, this represents a significant use of energy since mobile refrigeration units tend to be much less efficient than the warehouse-based units.[115] These inefficiencies occur at all stages in the food chain, including from manufacturer to RDC and from RDC to store. There is also wide variation among retailers in their levels of efficiency.

3.2 Information and Communication Technology

Most of the multiple retailers now rely heavily on Information and Communication Technology (ICT) systems such as Paragon, Logiq, Manugistic, and Safeway's 'Integrated Transport System', which enable fleet managers to plan routes to minimise unnecessary or empty journeys, change plans as unexpected events arise, and communicate with drivers in their lorries. The control room, hearing of a road blockage, can then warn drivers and advise on an alternative route, so reducing the time and fuel the drivers waste sitting in a traffic jam. The fleet manager can also tell the driver to pick up an unplanned extra load on the way, eliminating the need to send out an extra vehicle. One of the ICT manufacturers (Paragon Software Systems) claims that the technology has enabled one fleet to cut out two vehicles in nine, and another to cut mileage by 20%.[117] University of Huddersfield research puts the savings from the installation of ICT systems at 25%.[118]

Section seven explores the potential contribution that ICT systems can make to achieving less carbon-intensive patterns of sourcing and distribution.

3.3 Modal shift

'Why don't they send more stuff by rail?' is a common refrain. In fact ASDA, Marks & Spencer and Safeway all use rail to transport some of their goods. Marks & Spencer receives at least two deliveries a week in this way, although security concerns over the use of the Channel Tunnel for freight are disrupting plans to build on this. The company also uses rail for daily deliveries to its distribution centre in Scotland. ASDA has made an entrance onto the rail freight scene, and now commissions six trains a week to carry goods (including food) from Daventry to Grangemouth. It has called its experience to date a 'massive success,'[119] praising in particular its reliability, and there are plans to extend the use of rail to deliver from ports to distribution centres.

Safeway is the only retailer that uses rail daily to take goods from depot almost directly to the store.[120] It now wants to use the rail network to deliver into city centres at night. According to supply effectiveness controller Dave Timson, the aim is to '*deliver by train into stations like London's King's Cross overnight and have smaller vehicles collect the load. That would save us having to take lorries into cities, but first we need to persuade local authorities to relax curfews that ban out of hours deliveries to 40% of our stores*.'[121]

However, for all these retailers the quantities are negligible compared with the amount they truck. Safeway, the leader in its support for rail freight, still only distributes a minimal amount by this mode. In 2002/3, rail made up 1.2% of total product-kilometres travelled and the target is to increase the share to 1.5% in 2003/4.[122] This, in fairness, reflects less on their interest in rail and more on the financial, infrastructural and other difficulties associated with making the modal shift.

The prognosis for the future is somewhat uncertain. Government's progress report on its

117 Dennis R, *Why the Apathy to a Fuel Saving Culture?* in *Freight Industry Times,* issue 4, McMillan-Scott plc, Manchester, Spring 2001

118 Transport and Logistics Research Unit, *Reducing The Environmental Impact of Road Transport Operations: a review of inventions that can be applied by fleet operators,* presented at the CANTIQUE Workshop, Rome, 24-25 January 2000, University of Huddersfield, Huddersfield, 2000

119 *ASDA plans increase in rail use to cut three million lorry miles, Rail,* issue 468, EMAP, Peterborough, August 2003

120 The train delivers goods into Inverness and Georgemas Junction respectively, from where trailers are transferred to trucks for a final short journey to nearby stores

121 *The Grocer,* William Reed Publishing, West Sussex, 22 September 2002

122 *CSR Report,* Safeway 2003 www.safeway.co.uk

Ten Year Transport Plan acknowledges that many targets will probably not be met. The Strategic Rail Authority has suffered major funding cuts, resulting in reduced investment in rail freight – the consequence being that the promised 80% increase in the movement of goods by rail is highly unlikely to happen. Compounding this is a general feeling among logistics experts[123] that the rail industry's somewhat dated approach to doing business presents a major barrier to an increase in modal shift. Whether this impression is accurate or not, the consequence is a reluctance to shift to rail. In addition, there will always be a tension between the need to shift as many people off the roads and onto rail as possible, and the need to do the same for freight, while still planning in time for maintaining the rail network.

Nevertheless, given the right support and investment there is certainly potential for far more food and other goods to go by rail than is currently the case, particularly if greater co-ordination and co-operation were achieved with rail operators in mainland Europe. The European Commission has in fact proposed a new programme of EU subsidies designed to shift growth in freight transport away from roads and onto other modes.[124] The 'Marco Polo' scheme channels a modest €117m over a four-year period, towards the goal of removing 12 billion kilometres of freight per year away from roads and making it easier for businesses to bring goods in from Europe by rail.

Technological improvements have a role to play here. Longer and faster trains that enable more goods to travel without clogging up the track and slowing down passenger services will also help, as will more intelligent timetabling, signalling and scheduling. New wagon design, such as the SRA prize-winning mini-modal wagons, which enable smaller quantities of goods to be lifted on and off the track, also provide some of the flexibility that the food distribution industry needs.

3.4 Cleaner and alternative fuels

The development and application of lower and zero carbon fuel technologies remains the holy grail for the transport industry. Since October 2001, all new large goods vehicles must be fitted with engines meeting Euro III standards, resulting in fewer local air pollutants. Unfortunately, they have also made engines less efficient (by up to 3%[125]), thereby increasing the output of CO_2 relative to older Euro II engines.[126] At the moment, these technological and legislative constraints mean that there is a trade-off between the two environmental objectives. However, it is likely that this matter will be resolved over the next few years, with Euro V standards achieving cuts both in air pollutants and CO_2.

Compressed natural gas

Some retailers now use compressed natural gas (CNG), which produces far fewer local air pollutants. Vehicles running on gas are also much quieter, thereby bolstering retailers' arguments for lifting night-time delivery curfews. Companies converting to gas also avoid incurring the London congestion charge. Safeway has a fleet of 85 CNG vehicles – the largest fleet of its kind world-wide representing 11.5% of the Safeway fleet and 2.5% of its total HGV kilometres.[127] To service this it has three refuelling sites,[127] which are open to other bodies wishing to trial the use of CNG vehicles.[128] The 2003/4 target is to increase the number of CNG vehicles to 14% of the total fleet, accounting for 5% of total HGV kilometres.

However while CNG may be good from an air pollution perspective, it does not offer much at all by way of greenhouse gas savings, performing around 12% better than petrol-fuelled vehicles, and 2% better than diesel.[129]

123 McKinnon A and Forster M, *Full Report of the Delphi 2005 Survey: European logistical and supply chain trends, 1999-2005*, Heriot-Watt University Logistics Research Centre, Edinburgh, July 2000

124 *EU Boosts Funds for Greener Freight Transport,* Ends Environment Daily, 7 February 2002, www.ends.co.uk

125 Coyle M, *Fuel Saving Interventions: facts and fictions,* Transport and Logistics Research Unit, University of Huddersfield, Huddersfield, 2002

126 *Safeway CSR Report,* 2002, www.safeway.co.uk

127 *Safeway CSR Report,* 2003, www.safeway.co.uk/cgi-bin/ search.cgi?000012000007&location=000012

128 *The Grocer,* William Reed Publishing, West Sussex, UK, 16 November 2002

129 *Energy Saving Trust Welcomes Government Consultation on Road Fuel Gases,* news release, Energy Saving Trust, London, 18 June 2003 www.est.org.uk

Hydrogen fuel cells

The hydrogen fuel cell is sometimes hailed as the ultimate free-lunch, something-out–of-nothing solution to our energy and environmental problems. However, while fuel-cell technology could in the long term eliminate our dependence on fossil fuels, existing prototypes unfortunately do not. Hydrogen, the energy carrier, can be produced from a number of different sources and methods, provided, of course, that the source contains hydrogen. While it is possible to produce hydrogen from pure water or from another 'clean' renewable source, developing the infrastructure for this has proved difficult. At the moment a more feasible option is to produce it from hydrogen-rich fossil fuels. Thus, while a fuel-cell vehicle will produce no tail-pipe greenhouse gas emissions, once the production of hydrogen is taken into account the story is rather different. A number of studies have compared CO_2 emissions from a typical petrol vehicle with those from a fuel cell, based on various different systems.[130] These found that the CO_2 savings from a fuel-cell vehicle ranged between 25% and 80%. There are, then, still impacts, and substantial ones at that.

It is possible to power a fuel-cell vehicle using electrolytic hydrogen derived from renewable energy sources, but it has been argued that this may not be the best use of limited existing supplies.[131] Turning renewable energy into electricity and then turning that into hydrogen for road transport is very inefficient, and, given its current limited practical availability, it may be better to use that renewable energy directly to reduce emissions elsewhere. As discussed in section seven, this might mean applying renewables technology more widely within the protected horticulture sector.

The use of biofuels

There are a number of other experiments underway which vary in size and importance. ASDA, for instance, is trialling biodiesel in its logistics fleet.[132] This mix of 95% diesel and 5% recovered vegetable oils achieves a 2.5% reduction in CO_2 emissions.

One study of low carbon transport options concludes that woody biomass (particularly willow) might offer the most hopeful source of future transport energy. This biomass could be used to produce methanol and ethanol or hydrogen, depending upon which technology proves to be most feasible. Indeed the study suggests that the UK could meet all its transport fuel needs through the cultivation of woody biomass on 25% of agricultural land, provided that road transport technology shifts to high-efficiency hybrid or fuel-cell vehicles, and provided too that we put policies in place that keep the growth in demand to the lower end of plausible projections.

Of course this raises questions as to what we use our land for, not least because there may be a trade-off between the twin goals of increasing self-sufficiency in our food and in our fuel supplies. It need not, of course, be a question of absolutes; it may be possible to achieve a balance between the two, based on a range of agricultural, geographical, economic and other factors.

Whatever the technology applied, it is likely that lorries will benefit less, and less rapidly from new developments than other vehicles. To quote the willow biomass report: '*Our modelling reflects the widely-held view that technical progress in heavy goods vehicles will be less rapid than elsewhere… as a result, fuel demand and carbon emissions from HGVs may well remain large and growing, and could do much to counteract the improvements which are possible in other vehicle classes*.'[131]

As a result, the efficiency of smaller delivery vehicles may well grow relative to heavy goods vehicles, although this is partly because smaller vehicles are starting from a lower base in terms of efficiency. However, even if the efficiency balance between large and small vehicles were to shift only modestly, this would nevertheless have implications for our sourcing and distribution systems.

Cleaner fuels for aircraft

A last word here goes to air freight. According to the Royal Commission for Environmental Pollution, operational improvements such as improving load factors, reducing delays at landing and allowing aircraft to fly on more direct routes

130 Pridmore A and Bristow A L, *The Role of Hydrogen in Powering Road Transport,* Tyndall Working Paper No.19, Tyndall Centre, Norwich, 2002

131 Eyre N, Fergusson M and Mills R, *Fuelling Road Transport: implications for energy policy,* Institute for European Environmental Policy and Energy Saving Trust, London, 2002

132 *The Grocer,* 16 November 2002, William Reed Publishing, West Sussex, UK, 2002

could reduce emissions by about 10%.[133] The commission, however, discounts the feasibility of using hydrogen for aviation for many decades, and certainly after it has been applied to surface vehicles. It endorses the aviation industry's own targets for reducing CO_2 emissions[133] per aircraft mile by between 10%–20% by 2008–2015,[133] but warns that efficiency alone will not be enough to curb the serious growth in greenhouse gas emissions from aircraft. Rolls Royce, a major manufacturer of aircraft engines for the world's airline industries is working to ACARE's[134] target of achieving a 50% reduction in CO_2 emissions by 2050. Nevertheless it points out that this will be an enormous challenge; as 'all the easy things have been done already.'[135] In addition, there is a trade-off between CO_2 reduction and an increase in other emissions which have a radiative forcing effect (see glossary).[135]

However, according to Government's own air traffic growth projection figures, whatever greenhouse gas emission reductions are achieved in the air industry, they will in any case be cancelled out and superseded by the growth in demand from both passengers and freight.[133]

3.5 Conclusion

The thoughtful and ingenious use of new transport technologies could help achieve enormous reductions in greenhouse gas emissions. Important savings are already being made, as this section highlights.

The fact remains, however, that whatever the gains in efficiency, more goods are being transported further and more frequently than ever before, leading to an absolute increase in tonne-kilometres. Despite the efficiencies achieved, existing technology still falls significantly short of mitigating this growth and delivering the 60–80% cuts in CO_2[136] that are needed by 2050.

It is also the case that technological improvement, while improving relative fuel efficiency, has at the same time contributed to an absolute growth in CO_2 emissions from transport. For a given amount of fuel, better transport technology has enabled us to move more goods than before, further and for the same price. As such the cost per product moved has been lowered, thus meeting both existing demand for these goods and enabling business to invest in developing new and different products – products which consume energy in their production and distribution.

The growth in air-freighted foods provides an illustration. Where air-freighting produce might once have been simply an efficient use of spare space in the belly-hold of the aeroplane, this efficiency has spawned a new and environmentally highly damaging sector of the food industry. Although still relatively expensive, air-freighted foods are now a common sight in the average supermarket store. As our familiarity with such foods grows, so does demand, leading to the now standard use of dedicated freighters to deliver it. Soon, customers begin to regard such air-freighted products not as occasional luxuries, but as necessities, and in response the food industry builds a business strategy for expansion around it. A combination of greater supply and improved technological efficiency drives down costs and, true to classical economic theory, stimulates demand. The consequence is an ever more efficient air freight industry which nevertheless generates ever more greenhouse gas emissions.

Technology has both aided and driven growth since the beginning of society. The solution is most certainly not to go back to old technology or to stop innovating. In order to tackle the challenges of climate change we will need to use all the technological wizardry we possibly can. The options discussed in section seven place a very strong emphasis on technology. We suggest, however, that while technological improvement may be essential, it is not in itself sufficient. Technology is a tool, not a solution, a truism which is sometimes forgotten.

Section six asks whether or not measures to shorten the supply chain lead to a reduction in CO_2 emissions from transport and from the food life-cycle as a whole. The following section examines some of the social and economic influences that have helped lengthen them.

133 *The Environmental Effects of Civil Aircraft in Flight,* Royal Commission on Environmental Pollution, London, 2002

134 Advisory Council for Aerospace Research in Europe

135 *An Industry Perspective,* presentation given by Colin Beesley, Head of Environmental Strategy at Rolls Royce plc at *Sustainable Aviation: is the sky the limit?* conference organised by the Institute of Public Policy Research, London, 3 July 2003

136 *First Assessment Report,* Intergovernmental Panel on Climate Change, Geneva, 1990

Section four

Why things are the way they are: The influences shaping the food supply chain

The British food industry supplies the collective British stomach with over 40,000 different products, sourced from around the world, seven days a week, 24 hours a day. Reasonably enough, the industry rates its logistical infrastructure as the most efficient in the world.

However, with food-related greenhouse gas emissions continuing to rise, 'efficiency' has its limitations. The purpose of this section is to examine the forces which have shaped and which are continuing to shape the logistical status quo. This provides a context both for the life-cycle discussion in section six and for the carbon-reducing policy options outlined in section seven. The starting point is to understand why things are the way they are.

4.1 Shops

Most of us buy most of our food from supermarkets. The top four multiples (Tesco, Sainsbury's, ASDA and Safeway) together have nearly 50% (by value) of the food market.[137] In 2001 this represented half of £103.8 billion.[138]

How has this come about? The following paragraphs trace the rise to power of the major multiples and the knock-on effects on smaller retailers, before examining the impact these changes have had on our eating habits, and on the sourcing and distribution of food.

137 *Retailer Performance Index*, Institute of Grocery Distribution, Letchmore Heath, June 2001. www.igd.com/analysis/ Note: this is based on market share rather than till-roll data. More recent data using this method is not available

138 *UK Grocery Retail Structure Update 2002*, *The Grocer*, William Reed Publishing, West Sussex, 2002

139 *Major Events that have Shaped UK Grocery Retailing*, Factsheet, Institute of Grocery Distribution, Letchmore Heath, 2002, www.igd.com/default.asp

Supermarket history

The first self-service supermarket opened in the 1950s,[139] soon after the end of war-time rationing. A few years later, in 1960, the Common Agricultural Policy (CAP) was founded and the next few years saw a massive growth in farm yields. The national motorway-building bonanza of the ensuing decade, and a growing public enthusiasm for imported foods acquired on increasingly affordable holidays abroad, set the pattern for a food retail system founded on cheap transport, cheap farm-gate prices and a highly receptive, convenience-enamoured public.

The supermarkets' popularity and power continued to grow in the 1970s and 1980s as they extended their range beyond packaged offerings, opened new and larger stores and took advantage of their increasing influence to bypass the wholesale sector completely, instead doing business directly with the manufacturers. This allowed them to cut prices further still. In addition, the supermarkets began to sell very competitively priced own-brand product ranges, adding to their now considerable appeal. To streamline the highly complex ordering and delivery process the supermarkets began to purchase centrally and invested in a network of regional and national distribution centres to which supplies were delivered. We describe this system in more detail below.

On the wider economic front, the 1980s was a period of huge growth in international trade. Cheaper products from the developing world and – for the red meat sector – the damaging impact of BSE, further reduced the competitiveness of British farming, and meant that the shelves of supermarkets and independents alike were stocked with more imports than ever before.

Concurrent with the supermarkets' stellar growth this period saw a major decline in local

independent stores, a decline that continued into the 1990s (see box below: *The decline of the small players*).

The decline of the small players

One study estimates that during the period 1994 to 1999, there was a 17% fall in independent and co-operative stores.[140] More recent research shows that there were 953 fewer convenience stores in the UK in 2001 than in 2000, and that another 3700 shops were set to close in the five years after that.[141]

There has also been a decline in small food manufacturing businesses. Between 1997 and 2002, for instance, the number of food manufacturing enterprises registered for VAT fell by 11.9%.[142]

Supermarkets have been implicated in this decline. Critics have accused them of exerting undue control over the supply chain and forcing many smaller players to operate on the smallest of margins.[143] An investigation by the Competition Commission in 2000[144] concurred with this judgement and, to remedy the situation, recommended the setting up of a Code of Practice for major retailers. However many suppliers do not feel that the code has improved the situation[145] and as a result the food manufacturing sector continues to be dominated by a handful of big players, while the 5000 or so manufacturers who account for 80% of our total food and drink businesses take only 10% of the sector's turnover.[146]

The introduction of planning restrictions in the 1990s, a move aimed at curbing shopping-related car trips and which, logically, should have favoured smaller, independent retailers situated in urban areas, did not halt the decline. Food-related car trips kept increasing[147] while the supermarkets simply expanded their existing stores – a trend that continues today. Despite planning restrictions, the trend is still towards ever larger store formats, with the leading retailers now operating 5413 spaces of 25,000 square feet or more.[148]

In addition, the supermarkets began to invest more heavily in city-centre locations by developing smaller 'Local' and 'Metro' style formats. These cater to the everyday top-up and on-the-way-home-from-work shopper, a market where the independents have hitherto had an advantage. This approach has proved very successful and Tesco is on course to open 1000 more Express stores over the next five years,[149] in addition to the 100 or so that it currently operates.[150]

The supermarkets are also gaining strength and influence in other areas, such as home deliveries. Once again, Tesco is the leader here, reporting sales of £447 million in its 2003 Annual Review[150] delivering to 110,000 homes a week and logistically capable of serving 96% of the population. The multiples have also moved into non-food retailing, ASDA's clothing range, 'George', being a particularly successful example. In addition, they are exploring new business areas such as finance.

More products, more choice, longer supply chains

The supermarkets' successful dominance of the grocery market has, however, helped lengthen the supply chain. The reasons are complex and various, perhaps the most obvious being the supermarkets' ability to satisfy the every whim of our increasingly well-travelled tastebuds. We are

140 Study by A C Nielsen, cited in *Ghost Town Britain: the threat from economic globalisation to livelihoods, liberty and local economic freedom*, New Economics Foundation, London, 2002

141 Institute of Grocery Distribution figures, cited in *Ghost Town Britain: the threat from economic globalisation to livelihoods, liberty and local economic freedom,* New Economics Foundation, London, 2002

142 *The Food Industry,* special report, *The Grocer,* William Reed Publishing, West Sussex, October 2002, http://grocertoday.co.uk/resources/marketreport.asp?r=410

143 See virtually any issue of *The Grocer* trade magazine, William Reed Publishing, West Sussex

144 *Supermarkets: a report on the supply of groceries from multiple stores in the United Kingdom,* Competition Commission, London, 2000

145 *Suppliers Plan Appeal Over Code to Sir Don, The Grocer,* William Reed Publishing, West Sussex, 5 October 2002

146 *Small Food Producers in the UK,* Factsheet, Institute of Grocery Distribution, Letchmore Heath, 2002, www.igd.com/default.asp

147 Data supplied by Giselle Hillman, Department for Transport, from the National Travel Survey 1999/2001

148 *UK Grocery Retail Structure Update 2002, The Grocer,* William Reed Publishing, 2002

149 *In the Express Lane, The Grocer,* William Reed Publishing, West Sussex, July 6 2002

150 *Tesco Annual Review,* 2003 http://81.201.142.254/presentResults/results2002_03/Prelims/ Report/site/uk_overview.htm#storedev

no longer surprised to see strawberries on the shelves in December and indeed have come to expect them to be available. The consequence has been the development of international supply chains designed to provide us with these foods.

Giving people what they want is the mark of any thriving business. Many independent retailers do just the same; an ethnic store will sell yams and callalloo to its local Caribbean customers, an organic retailer will offer wheat-grass juice to health-conscious Bayswater residents. Supermarkets differ only in the scale and range of their offerings, in the size of their customer base and in the sophistication of their supply chain operations.

However it is also the case that by anticipating what we might want if it were marketed to us appropriately – anything from Cheestrings to pre-prepared Caesar salads – supermarkets, together with manufacturers, have also very effectively created demand, and they continue to do so. Most of us do not actively need many of the goods on offer, but once we see them in store, we try them, buy them and a need is created. Their efficient management of supply chains across the world and hence their ability to provide almost anything, always, anywhere, means that supermarkets and major manufacturers combined, have created consumer expectations of consistency and availability which they are now bound not just to fulfil but also (if they want to remain competitive) exceed. The consequence again, is more transport.

Demand creation is as old as commerce. However the pace of it is greater now than ever before. Due to their size and influence, supermarkets are able to offer us new products on a regular basis. Manufacturers, for their part, can gain access to consumers nationwide via the supermarkets' comprehensive distribution network. New products, if successful, can be quickly rolled out nationally[151] and rapidly generate profits. This synergy between manufacturers and supermarkets has helped drive the rapid growth in the grocery industry, as the box below highlights. However, since each of these new products will involve often highly complex, and lengthy supply chains, and will for the most part need to be distributed to all the retailer's stores across the country, the consequence is inevitably more transport.

The multiples and the major manufacturers: A successful partnership

Some of the most well-known food manufacturing brands have been around for over 100 years. Brands originally developed as a means of guaranteeing to the customer that a product, such as soap or sugar, was consistent in quality; that it was not adulterated and would be the same tomorrow as it was today.[152] However, the meaning of brands has now grown beyond these original qualities; the brands a person chooses have now become a way of defining that person's identity.[152]

Reliability, uniformity and predictability are core to the supermarkets' brand identity. The best way of ensuring consistency is for a retailer not only to build up and centralise the sourcing and manufacture of its own-brand products (often made by large manufacturing companies that also make branded foods) but also to buy from global manufacturers such as Unilever and Nestlé. Sometimes the relationship between retailer and manufacturer is deliberately emphasised, one example being the marketing tie-in between Tesco and Hovis, whose flour is used to make in-store bread.[153]

For the supermarkets, this partnership represents a risk-reducing approach. The retailers are never more than a tampered bottle lid away from a major food scare and subsequent commercial armaggedon. Doing business with the big players, who have more formal processes in place to ensure quality control, is logistically easier than checking the quality control procedures of a myriad of small businesses. It also enables retailers more readily to meet legal Due Diligence requirements (see glossary) and hence fortify themselves against charges of liability should something go wrong. This, in turn, is true of big manufacturers buying raw materials from their suppliers; working with larger suppliers is simpler. Big brands are also popular with customers who like the reassurance that a well-known name is perceived to offer.

151 Obviously this trend can be taken too far and many manufacturers, including Unilever, are now slimming down their product ranges

152 Lury G, *Adwatching,* Blackhall Publishing, Dublin, 2001

153 *Hovis Links with Tesco, The Grocer,* William Reed Publishing, West Sussex, 28 June 2003

Future trends

The signs are that future years will see further concentration within the retail sector as well as expansion by British multiples into overseas markets. Tesco, the UK's market leader, is also the world's seventh largest retailer by turnover (behind Walmart at number one)[154] and is particularly strong in Thailand and Eastern Europe. This general UK trend towards concentration reflects in miniature the global picture. The Institute of Grocery Distribution (IGD) forecasts that the top ten European retailers will increase their combined global share from 22.7% to 36.8% between 2000 and 2010.[155] The global food retail market will grow 21.8% from 2001 to 2006 to reach $3543 billion. Much of this growth will come from expansion into Asian Pacific markets.[156]

However this prognosis requires some qualification. It may be that future years will see supermarket power challenged, largely by the restaurant and take-away sectors, as more and more of us choose not to cook at all. There are also slight but nevertheless discernable signs that some consumers would like a return to locally focused or alternative systems of sourcing and distributing foods. One industry analysis highlights the fact that *'Although food retailing continues to be dominated by the big four supermarket chains, the long term decline in sales through specialist food outlets was halted in 2001. Greengrocers, in particular, showed healthy sales growth.'*[157]

How far this trend is likely to become more mainstream is discussed further in section five.

4.2 Shoppers

There have been huge demographic changes in our population over the last thirty years. These have had, and continue to have, a major impact on the way we eat.[158]

The way we live

For a start, we are becoming more solitary. Nearly a third of us (29%) lives alone, twice the number compared with 1961. Nearly two thirds (61%) of homes are childless. Those of us who do have children are having fewer of them; the proportion of families with three or more children declined from 41% in 1972 to 26% in 1998/9.

The average population make-up is now older than it has ever been. Just over a fifth (21%) of us are under sixteen and this figure is expected to fall to 18% by 2021. By 2008 there will probably be more pension-aged people than children.[158]

We are also, on average, richer than past generations. Disposable income doubled between 1972 and 1998 although income disparities grew too.[158] This wealthier, older generation is extremely busy. We now work, on average, the longest hours in Europe.[159] Women make up nearly half the workforce and account for more than a third of full-time employees.[160] They have far less time to cook and prepare meals for the family than before even though they may still, on the whole, be responsible for food provision within the family.

Cultural expectations

We may be working hard but we are also taking more holidays than ever before, often taking advantage of cheap flights to travel abroad, where many of us acquire a taste for the local food. Almost half of us (49%)[161] flew in 2001, mainly outside the UK and for holiday. The British population is also more ethnically diverse than it has ever been. Nine per cent of the English (as opposed to British) population is of mixed or

154 *Global Retail Index:* Factsheet, Institute of Grocery Distribution, Letchmore Heath, February 2003, www.igd.com/default.asp

155 *European Grocery Retailing 2002,* Institute of Grocery Distribution, Letchmore Heath, 2002

156 *Global Retailing 2003,* Institute of Grocery Distribution, Letchmore Heath, 2003

157 *The Food Industry,* special report, *The Grocer,* William Reed Publishing, West Sussex, October 2002 http://grocertoday.co.uk/resources/marketreport.asp?r=410

158 *Food Consumption 2000: the one-stop guide to the food consumer,* IGD Business Publications, Institute of Grocery Distribution, Letchmore Heath, August 2000

159 *UK Staff Work Longest Hours in Europe, says TUC,* Ananova Ltd, 27 August 2001

160 *Labour Market Statistics,* August 2003, Office of National Statistics www.statistics.gov.uk/pdfdir/lmsuk0803.pdf

161 *Attitudes to Air Travel,* Department for Transport, 2001, www.dft.gov.uk/stellent/ groups/dft_transstats/documents/pdf/dft_transstats_pdf_505963.pdf

non-British ethnic origin, with this rising to 29% in Greater London.[162]

In other words, we are now more independent in our living arrangements, wealthier, busier, older, and either from, or acquainted with, a variety of different cultures.

These changes have had a drastic effect on the way we eat and on the supply chains that deliver our food. Many of us have little time, inclination or knowledge of how[163] to prepare a meal from scratch, for all to share. The proportion of people agreeing with the statement 'I love/really enjoy cooking' fell from 46% in 1989 to 41% in 1999 and the average time spent making a meal fell from an hour in 1980 to 20 minutes in 1999.[164] Women in particular have enthusiastically embraced the convenience of the one-stop supermarket shop, and the prepared foods on offer.

People are more likely to eat what they like, when they like, and pre-prepared or partially prepared foods provide a solution for which they are increasingly willing and able to pay. This is especially true of people who work – those of us who do spend on average 40% less time cooking than those who do not.[165] Nearly two thirds of households buy ready-meals, a growth of 8% since 1995, and around 10% of us eat them more than once a week.[165] Ethnic foods, often made from ingredients trucked, shipped and flown in from around the world, are ever more popular – as is exotic fresh produce, much of which will have been air-freighted.

However, the high price of convenience notwithstanding, the relative amount we spend on household food is actually lower than ever before; the cost of food in real terms fell between 1989 and 1999 by 9.4%.[166] At £17.64 per person a week,[167] household food accounts for a mere 10% of household spending.[168] There are of course wide variations depending on socio-economic class, age group and region but the fact remains that for the most part, we expect our food to be cheap. Foods that 20 years ago, were impossibly exotic and expensive, are now abundant and affordable; we can have our avocados four for a pound now. This emphasis on driving down costs has implications for how and where our food is sourced, it often being cheaper to import from overseas, as we discuss below.

In addition, we no longer eat (or expect to eat) seasonal, British food, partly because we know so little about how and where food is produced. One survey revealed that nearly 90% of British people do not know that beer is made from barley, 20% do not know that yoghurt is made from milk and a tenth of us think that rice is grown in the UK.[169] Another revealed that 86% of the population have no idea when favourite British foods, such as strawberries, are in season.[170] This ignorance is even greater among younger people. Often we prefer imported food over equivalent UK products, favouring cosmetic perfection and exotic flavours over the provenance of food.[171]

Although an aging population evokes images of scone-baking and jam-bottling, and perhaps a greater emphasis on seasonal, traditional foods, for tomorrow's older generation this impression is likely to be highly inaccurate. Elderly people today are far more likely than younger people to take time to cook 'properly,' but the elderly of tomorrow are simply today's children grown old, many of whom, as we have seen, cannot cook.[172]

162 Office of National Statistics, 2001, www.statistics.gov.uk/cci/nugget.asp?id=263

163 Caraher M and Lang T, *Can't Cook, Won't Cook: a review of cooking skills and their relevance to health promotion,* Int.J Health Prom & Educ. Vol 37, No.3, 1999

164 Taylor Nelson Sofres survey cited in *Food Consumption 2000: the one-stop guide to the food consumer,* IGD Business Publications, Institute of Grocery Distribution, Letchmore Heath, August 2000

165 *Food Consumption 2000: the one-stop guide to the food consumer,* IGD Business Publications, Institute of Grocery Distribution, Letchmore Heath, August 2000

166 *Supermarkets: a report on the supply of groceries from multiple stores in the United Kingdom,* Competition Commission, 2000

167 *National Food Survey 2000,* Office of National Statistics, 2001

168 *Expenditure and Food Survey 2001–2,* Office of National Statistics 2003

169 Taylor Nelson Sofres survey reported in Food & Drink Europe, www.foodnavigator.com/news/news.asp?id=7459

170 *Safeway Champions Seasonality Within its Premium Range – The Best*, news release, Safeway, 28 February 2003

171 *Consumer Watch 2001: consumer attitudes to food and grocery issues,* Institute of Grocer Distribution, December 2001; *Food Consumption 2000: the one-stop guide to the food consumer,* IGD Business Publications, August 2000

172 *Winning the Mature Vote,* Institute of Grocery Distribution, Letchmore Heath, 2001

Hence tomorrow's pensioners will be much less likely to cook meals from scratch, choosing instead to eat convenience foods.

The consequences of this shift towards eating internationally sourced, complex manufactured foods is that food is travelling further than ever before. There are, however, also signs of a small but growing interest in how and where food is produced, leading to increasing sales of organic, local and Fairtrade produce. The Institute of Grocery Distribution comments: '*While the pace of globalisation has undoubtedly risen, there has been a corresponding revival in local heritage. This is partly a result of recent food scares such as BSE and a perception that local means higher quality and trustworthiness, with consumers often prepared to pay a premium. Global branding could risk minimising choice at a time when consumers want more, not less*.'[173]

4.3 The global supply chain

Globalisation affects almost every aspect of our personal and public lives. It is happening across all sectors and the food industry is no exception. Manufacturers, located more in our minds and on our billboards than in any specific physical place, are now sourcing from one side of the world and selling to another. Many British retailers, having built up a strong customer base at home, are now expanding into Europe and further afield, while European and American retailers, such as Lidl, Netto and Walmart, are establishing footholds here in the UK. This process has been made possible by the removal of trade barriers, lower labour costs in the developing world, rapid developments in ICT (discussed below) and transport costs which, relative to the overall cost of the product, are very low. The wave of large-scale mergers and acquisitions in the late 1990s provided added impetus for globalisation, as has the streamlining and rationalisation of major companies' brand portfolios[173] – the kind that has turned Marathon, a UK chocolate brand, into the globally marketed Snickers. Consumers, as we have seen, with their desire both for cheap, and for exotic food, are also driving the trend.

Most of the signs suggest the food industry will continue in this globalising direction.[174] The launch of the Euro in 2002 has given the process a strong boost; increased price transparency reduces currency risk and helps retailers source the same products at lower cost from new suppliers. This process is repeated by manufacturers further down the supply chain.[173] Logistics specialists responding to a pan-European Delphi survey by Heriot-Watt University felt that the retail sector will continue to become more concentrated both in Europe and in the UK and that the influence and market share of international retailers will grow.[175]

The global food retail market

At the global level, the food retail market is worth an estimated $2.8 trillion. Most of the market for global food retailers – 70% – is in ten countries, with the US (18%), Japan (15%) and China (8%) the three largest consumers.[174] However the IGD predicts that for global retailers, the most promising opportunities for the future are in China, Russia and Italy, closely followed by Japan, Hungary and India.[176] Tesco indeed already has a presence in Japan and Hungary.

The IGD also forecasts that the top twelve European retailers will increase their share of the global food retail market from 37.4% to 60.5% although retail will still remain one of the least global industries; as a perishable product, food is unlikely ever to be as globalised as, say, pharmaceuticals or automotive parts.

Global food manufacturing

The more that retailers globalise their markets, the more they globalise their supply chains. For food manufacturing, Delphi survey respondents[177] anticipated that production would become even

173 *Future Focus: the future of global sourcing,* Institute of Grocery Distribution, Letchmore Heath, March 2002

174 *Global Retailing: the future,* IGD Business Publications, Institute of Grocery Distribution, Letchmore Heath, November 2000

175 McKinnon A and Forster M, *Full Report of the Delphi 2005 Survey: European logistical and supply chain trends, 1999-2005*, Heriot-Watt University Logistics Research Centre, Edinburgh, July 2000

176 *The IGD Global Market Index,* Institute of Grocery Distribution, Letchmore Heath, 2003

177 McKinnon A and Forster M, *Full Report of the Delphi 2005 Survey: European logistical & supply chain trends, 1999-2005*, Heriot-Watt University Logistics Research Centre, Edinburgh, 2000

more concentrated, perhaps by as much as a quarter between 1999 and 2005, particularly at European and global levels.[177] Eastern Europe emerges as the most appealing region for setting up factories, followed by Southern Europe; the appeal of Northern and Western Europe is likely to dwindle.

Other surveys[178,179] also show that European firms are sourcing less from within their home markets, while the Delphi survey also predicts that industry is likely to buy more and more from manufacturers operating multinationally. Indeed the share of purchases from suppliers who trade only in the home market is anticipated to decline by 13%, and the proportion sourced from enterprises with European or global reach to increase by 11% and 23% respectively. This trend is expected to continue at least until 2005 with more and more supplies being sourced particularly from Eastern Europe (21% growth) and the Far East (14% growth).

A general pattern is thus emerging: big companies will get bigger and stronger, and the small ones smaller and weaker.

Centralised distribution

Warehousing and storage trends also point in the direction of fewer and bigger, consistent with the centralisation and consolidation process of the last 30 years. Other research bears this out. In their efforts to reduce costs throughout the supply chain,[180] many of the supermarkets are adopting the fewer but bigger approach – not so many, but larger, distribution centres – served by a network of local consolidation centres which initially consolidate the goods before they make their way to regional and national distribution centres. This does not, however, mean that direct deliveries are made from the local consolidation centres to nearby stores.[180]

Fewer warehouses and processing plants mean longer distances to be travelled between them, a trade-off which makes economic sense given the high cost of land and the difficulties of securing planning permission, relative to the low cost of transport. This said, a significant minority of the Delphi panel (15%) felt that firms would start to decentralise the way they held stocks, so leading to an increase in storage points[177] and hence to shorter journey distances. We discuss the implications for CO_2 emissions in section six.

Just in time and other supply chain innovations

A major logistical development over the last 20 years has been the emphasis on more frequent, timely, and reliable deliveries which seek to minimise stocks at all stages in the supply chain. There is a plethora of jargon to describe this goal – 'lean' and 'agile' logistics systems, quick response, Efficient Consumer Response and so forth. Just in time (JiT), the grandfather of all such philosophies, is ultimately about achieving a stockless, waste-free supply chain, although not all JiT systems match the ideal. Such systems seek, among other things, to reduce storage and other costs, minimise waste at every point in the supply chain (including by not delivering unwanted goods), and to supply goods only when – not before or after – they are needed. The glossary at the back provides a few definitions.

In the food industry, this pressure to go down what is in effect the mobile warehousing route has come mainly from the supermarkets. According to research by McKinnon and Campbell,[181] suppliers in the frozen food sector face intense pressure to reduce their order lead times and deliver smaller quantities of goods more frequently. The pressure comes less from the wholesalers than from the supermarkets, who accounted for 61% of the total sales of firms in a sample taken in 1998.

The supermarkets for their part are anxious to keep stockholding rates to a minimum and to increase the rate at which it turns over – in other words to achieve a bulge-less flow of goods, ready and available as and when wanted rather

178 Kearney A T, *Logistics Excellence in Europe,* European Logistics Association, Brussels, 1993

179 Kearney A T, *Insight to Impact: results of the fourth quinquennial European logistics survey,* European Logistics Association, Brussels, 1999

180 Finegan N, *Backhauling and Factory Gate Pricing: evolution or revolution?* Institute of Grocery Distribution, Letchmore Heath, UK, February 2002

181 McKinnon A and Campbell J, *Quick-Response in the Frozen Food Supply Chain: the manufacturer's perspective,* Christian Salvesen Logistics Research Paper 2, Heriot Watt University, Edinburgh, June 1998

than accumulating in expensive and limited storage centres. In the years 1996 to 2002 the top four supermarkets reduced their average stockholding of fast-moving grocery products from 10.61 days to 9.6 days.[182] Planning restrictions and cost have played an important part here. The supermarkets have limited cold-storage capacity at RDCs. This means they have had to improve their use of the very expensive space available; the McKinnon-Campbell study found that the top four retailers increased their average warehouse space utilisation from 82.7% to 85.8% between 1994 and 1997. Taking into account seasonal fluctuations, this means that RDCs are working very close to capacity[181] and therefore, in terms of energy use, fairly efficiently.

The elimination of waste also has clear environmental benefits, including a reduction in physical resource use and in the pointless transport of goods which are not used because they are lost as waste. However as with all things there will be trade-offs, some of which could outweigh the environmental gains. It has, for instance, been suggested that JiT-type systems lead to increased transport[183] because smaller quantities of goods are delivered more frequently, in smaller and less efficient vehicles. This, it is argued, has been one of the main drivers of freight growth.

For example, the European Commission's 2001 Transport White Paper[184] partly attributed the growth in lorry traffic to '*changes in production methods of the manufacturing industry which have led more and more towards stock-reducing, flexible, diverse, rapid and tailored transport with reductions in shipment size and increases in shipment frequency.*' One test of whether JiT is indeed increasing average vehicle-kilometres is therefore the question of whether average payload weights (see *glossary*) are indeed diminishing.

In fact, opinion on this point is somewhat ambivalent. European research into the impact of JiT across a number of sectors concludes that there is no evidence that at an aggregate level JiT is reducing vehicle loading. On the contrary, there appears to have been a net consolidation of loads across national vehicle fleets.[185]

Moreover, and more specifically, a look at UK data on the payload weights of food, drink and agricultural products reveals that in the last 10 years there has been an overall increase in average payload weight.[186] How the picture is affected by changes in the types of foods we are now eating is not clear; it may be that the increase in average payload weights is related to the growth in easy-to-stack convenience foods (meaning vehicle are more fully loaded), but this is speculation.

Other (non food-related) research into JiT and its environmental impact[187] concludes more generally that while an efficient JiT system will generate more vehicle-kilometres than an efficient non-JiT system (and an inefficient JiT is very bad indeed), most non JiT systems are highly inefficient and hence their replacement by an efficient JiT system can lead to overall environmental savings. To quote: '*JiT distribution involving consolidation may well generate considerably fewer vehicle kilometres than an inefficient non-JiT system. And the reality is that many existing transport operations probably fall in to the inefficient conventional category*.'[187]

Finally, a note of caution: there is some doubt that food distribution systems can, strictly speaking, be classed as JiT. Although little-and-often principles of JiT apply, many deliveries are in fact scheduled ones, and as a result there are opportunities to consolidate loads and ensure that vehicles are filled to their maximum capacity.

182 *Retail Logistics 2003,* Institute of Grocery Distribution, Letchmore Heath, November 2002

183 Whitelegg J, *Freight transport, Logistics and Sustainable Development,* World Wildlife Fund, Godalming, 1995

184 *European Transport Policy for 2010: time to decide,* Commission of the European Communities, Brussels, 2001

185 *Redefine: relationship between demand for freight transport and industrial effects,* final report, Contract No. RO-97-SC.1091, European Commission, Brussels, February 1999

186 *Continuing Survey of Road Goods Transport* – comparison of payloads in 1991, 1996 and 2001 for agricultural products, food and drink. Although there was a slight fall in payload weights for agricultural products in 2001, this is likely to have been a temporary consequence of the outbreak of foot and mouth disease.

187 Allen J, *Just-in-Time Transport,* Comment, Issue Number Three, Exel Logistics/BRS, Bedford, 1994; more recent research into the environmental impact of JIT is not available

Factory gate pricing

Factory gate pricing (FGP) is one of the more significant logistical developments of recent years (see glossary) and forms part of the ongoing effort to reduce costs in the supply chain. Factory gate pricing builds upon the growing trend towards the backhauling of goods, mainly packaging. Sainsbury's and Tesco have taken the lead in developing and trialling such systems and now almost 30% of the cases delivered to Tesco's distribution centres arrive on Tesco trucks.[188]

FGP is still in the early stages of development and has not yet been widely adopted, and so its effect upon mileage is uncertain. Advocates argue that FGP will reduce overall transport requirements because return journeys can be used to pick up from suppliers or return packaging, so eliminating the need for a second vehicle to perform the task. Some, however, have challenged the suggestion that FGP will lead to environmental benefits, arguing that many suppliers own and operate their own lorries which, after dropping off a delivery at the depot, go on to deliver to other customers.[189] Under a factory gate pricing system manufacturers will have to make dedicated journeys, possibly leading to an overall increase in transport once both these and the retailers' journeys are added together.

An alternative possibility is that, with the extra cost of making these deliveries, manufacturers may feel that it is no longer cost-effective to deliver to their smaller customers. This in turn undermines the smaller retail sector, and forces them to make separate arrangements for receiving deliveries of these goods. These will generate additional travel and could outweigh the efficiencies achieved by FGP.

Whatever the merits or demerits of FGP it is also important to bear in mind that in 2001 only around 12.5% of the food industry volume of cases was backhauled:[190] for every 100 tonnes of goods a retailer receives, only 12.5 tonnes on average will arrive on a vehicle which has previously dropped off a delivery somewhere else, and which is therefore making use of the return journey. This does not mean that for 87.5% of the time the returning lorry is empty because on many occasions it will be used to return pallets and packaging, but it does suggest that there is considerable scope for improving the efficiency of the delivery process.

Information and Communication Technologies

The Internet and developments in ICT have also made a vital contribution to the globalisation process, with implications for the logistics industry and for freight mileage. The dot-com bubble may, as the cliché goes, have burst, but the influence of the Internet on all aspects of business life has continued to grow steadily. Home deliveries and online auctioning sites such as e-bay are just the more visible aspects of e-commerce. The vast majority of Internet-based dealings are between businesses (B2B) rather than between businesses and customers (B2C). The Internet provides a huge opportunity for business to sell more, faster, to more people, further afield. The same applies to its dealings with other businesses. The Internet also opens up the market to smaller players. This of course will not necessarily mean shorter supply chains as these smaller players could be located several thousand miles away.

For business, ICT has made logistical life much easier. For instance ordering, invoicing and paying for goods can be carried out accurately at the click of a mouse rather than with erratic and irascible photocopiers and fax machines. Vehicle tracking, routeing and scheduling systems can also optimise efficiency as section three highlighted. Other developments include e-based freight exchanges which provide a virtual platform from which carriers can sell or auction space in their vehicles, either on the outward or return journey, to businesses who want loads carried. This reduces empty running and thus maximises vehicle efficiency.

Home shopping is, however, that part of the e-chain that attracts the most publicity and attention is now being paid to its environmental implications.[191] At the moment, opinion is divided

188 *The Grocer,* William Reed Publishing, West Sussex, 18 January 2003

189 *Supermarket Sweep?, Logistics Manager,* May 2002

190 Finegan N, *Backhauling and Factory Gate Pricing: evolution or revolution?* Institute of Grocery Distribution, Letchmore Heath, February 2002

as to whether the system will lead to more or less freight mileage. One Swedish research project[192] examined existing deliveries to 15 shops, restaurants, schools and day nurseries and then modelled an 'ideal' pattern based on vehicle optimisation and shared vehicles. The study found that this improved model could reduce the distance travelled by 39%, the number of vehicles used by 42% and the number of journeys by 58%.

A report prepared for the RAC Foundation estimates that home shopping will reduce car-based shopping by 5% by 2005 and 10% by 2010. This outweighs a forecast increase in delivery traffic of 0.25% and 0.5% respectively. It also estimates that greater use of ICT will reduce goods mileage by 17% by 2005 and 19% by 2010.[193]

Research that focuses specifically on grocery home shopping is also cautiously optimistic. The conclusion here is that supermarket home deliveries are unlikely to increase overall traffic levels and, with the right policies in place, could lead to important reductions.[194] Another study into grocery shopping, commissioned by the Department for Transport, also concurred with this judgement, concluding that *'the corresponding increase in van miles used for delivering orders to householders is more than offset by the major reduction in car miles.'*[195]

For others however, e-commerce is likely to generate more traffic, not less. A report from the Dutch Association of Transport Operators, Transport en Logistiek Nederland,[196] claims that e-commerce will lead to a 17% increase in road journeys in the Netherlands by 2005. The figure – comprising an 8% increase through consumer purchases and 9% through business-to-business transactions – is on top of a 21% increase in road journeys resulting from the 'old economy'.

Closer to home, a report commissioned by English Partnerships concludes that 'it is more than likely' that expanded home delivery will cause an increase in household trips, and that the type of trip generated will have a 'disproportionate effect' on congestion, by increasing traffic largely in residential areas.[197] It should also be remembered that 40% of deliveries fail[198] because people are not at home. This means that an additional journey needs to be made, creating more emissions.

With regard to e-commerce as a whole (as opposed to home deliveries) one US research organisation is entirely upbeat, concluding that e-commerce will help reduce inefficiencies in the distribution system, underplaying the second order impacts that could emerge.[199] However a major study by Forum for the Future into the implications of the digital revolution for sustainable development was more cautious.[200] The logistics chapter of the study suggests that the first order effects of e-commerce may indeed be positive, by reducing wastage and inefficiencies in the supply chain. However the second order impacts are uncertain and could well be deleterious.[201] The two most significant possibilities are first, that the easy and cheap availability of goods online will stimulate overall consumption (meaning more goods travelling) and, second, that the impetus to supply chain globalisation that e-commerce provides will lead to a significant increase in air freight. As far as

191 Wilsden J (ed), *Digital Futures: living in a dot-com world,* Earthscan, 2001

192 Cited in Hopkinson P and James P (2001) *Virtual Traffic: the impact of e-commerce on logistics and the implications for sustainable development,* in Wilsden J (ed), *Digital Futures: living in a dot-com world,* Earthscan, 2001

193 *Motors and Modems Revisited: the role of technology in reducing travel demands and traffic congestion,* National Economic Research Associates (NERA), London, May 2000

194 Cairns S (forthcoming), *Delivering Supermarket Shopping: more or less traffic?* Transport Reviews, Taylor & Francis, London, ISSN 0144-1647

195 Palmer A (unpublished), *Environmental and Congestion Implications for Grocery Home Shopping* (draft report), Retail Logistics Task Force, DTI and DFT

196 *New Wine in Old Flasks,* Transport en Logistiek Nederland, Netherlands, 2000

197 *A Research Study Into Potential Collection Points for English Partnerships,* DTZ Research, April 2000

198 *Home Delivery: the hype and reality, Focus Magazine,* Institute of Logistics and Transport, Corby, June 2003

199 Romm J, *The Internet Economy and Global Warming: a scenario of the impact of e-commerce on energy and the environment,* The Centre for Energy and Climate Solutions, Virginia, United States, December 1999, http://cool-companies.org/ecom/pr.cfm

200 Wilsden J (ed), *Digital Futures: living in a dot.com world,* Earthscan, London, 2001

201 Hopkinson P and James P, *Virtual traffic – the impact of e-commerce on logistics and the implications for sustainable development* in *Digital Futures*, in *The Impact of e-commerce on Society and the Environment,* Wilsden J (Ed), Earthscan, London, 2001

the first is concerned, it is too early to say whether this is actually happening, but the authors do point out that the Amazon website has expanded the market for books. They comment: '*Whilst this expansion is not due solely to price – online retailers may tap some latent demand by offering easier access than existing stores – it seems to have been an important element.*' This tendency has in fact been true of traditional retailing – 50 years ago only the privileged few had a television and now even the very poorest households have one. Many homes today have two or three.

Whatever the potential future benefits of home deliveries, the system as it currently stands is fairly chaotic and inefficient. To quote one industry insider:[202] '*There are a number of systems problems … complex paperwork, lots of rekeying, going into orders more than once, no information flow between activities and systems such as picking and transport – how do you relate the two back to each other? If there is no volume information for each assignment, how do you know how full that van is going to be? The loading of the van, the optimised utilisation of the van, is just not possible …*'

Whether or not it has been fuelled by home shopping, we are certainly seeing an increase in van and light vehicle deliveries. LGVs are less efficient than HGVs in terms of fuel use per weight carried. Given the likely growth in e-commerce, more research into light van goods movements is needed.

Transport costs

All the above underlines the point that sophisticated ICT notwithstanding, the rapidly escalating globalisation process would be impossible without the trucks, the ships, and the aeroplanes that physically deliver the goods and, crucially, the cheap fuel that powers these vehicles. At the end of 2002, grocery distribution costs in the UK were at their lowest level in three years, accounting for an average of 3.44% of sales. Of this 3.44%, warehousing costs constituted 56.1% and transport, 34.8%. In other words, the cost of transport comes in at just over 1% of the end price of the product.[203] The more processed the good, and hence the higher the final sale price, the less important, relatively speaking, the cost of transport is, even though the product itself may well have travelled further than a less processed one.

Of course 1% of £103.8 billion (the total food market in the UK) is a great deal of money, hence the food industry's desire to shave off inefficiencies (and so gain competitive advantage) through FGP and by deploying some of the technological and managerial options discussed in section three. The general conclusion of the Delphi survey was that over the next six years freight transport costs would be fairly influential in deciding the location of warehouses. On a scale of one (no importance) to five (critical factor), freight transport costs were given an average rating of 4.3 for warehousing and 3.4 for manufacturing locations. Nevertheless commercial gains for large companies from global sourcing and retailing are so great that unless economic structures change very dramatically indeed, transport costs are unlikely to impede the trend towards globalisation.

By way of a final qualifying point, there are industry warnings that although global sourcing will continue to grow, '*Consumer resistance will be the key barrier to the growth of global sourcing*.'[204] The likelihood of this consumer turnaround is explored further in section five.

4.3 International and national institutions

The food industry does not operate in a political vacuum. Trade between countries and continents has been occurring for thousands of years, with the rate and pace of it increasing in line with our capacity to move and communicate across long distances.

In the decades after the Second World War, a number of institutions were set up, including the General Agreement on Tariffs and Trade (GATT, superseded in 1995 by the WTO), the CAP and the EU, their aims being to promote trade and

202 Sears-Black C, Isotrack, quoted in *Home Delivery: the hype and reality, Focus Magazine,* Institute of Logistics and Transport, Corby, June 2003

203 *UK Retail Logistics Overview,* Institute of Grocery Distribution, Letchmore Heath, 2003

204 *Future Focus: the future of global sourcing,* Institute of Grocery Distribution, Letchmore Heath, 2002

economic prosperity for the countries involved. All these institutions have given the globalisation process a very powerful impetus.

Many non-governmental organisations (NGOs) have been forceful in their criticism of these institutions, arguing that they have promoted the agendas of the rich while damaging the world's poor and the environment. The purpose of this section is not to offer yet another critique but rather to explore the influence that these complex interrelated institutions have had upon the growth in food transport.

Food in the free market

The World Trade Organisation (WTO) aims to reduce barriers to international trade in order to achieve free and fair terms of trade for all participating members. A succession of agreements both before and since the WTO ministerial talks at the Doha Summit in 2001 has ostensibly sought to achieve this. However the WTO is also dominated by its most powerful members, the US and EU Member States, and it has notably failed to prevent these countries from continuing to subsidise their own farmers heavily while placing tariffs on imports. In the case of the EU these subsidy support systems amount, directly and indirectly to over $300 billion a year.[205]

At the same time the World Bank and the WTO have required developing world countries to eliminate import tariffs and other barriers, to stop subsidising farmers and to use their comparative advantage in agricultural production to grow cash crops for export, in keeping with free market principles.

This combination of subsidies on the one hand, and free market based structural adjustment on the other, has created a distorted international market which has exacerbated the growth in food transport.

There are several reasons for this. Subsidised overproduction of commodities such as milk products and sugar in the developed world, are often transported to and dumped on developing countries, even though the latter can produce these foods themselves. Dumping creates freight movements. It also undercuts developing world producers who cannot compete with the low prices[206] and in so doing creates a dependence on transport-intensive imports, which in turn leads to further freight transport.

In addition, developing world producers of products such as tea, coffee and cocoa face stiff competition amongst themselves, and overproduce in order to compensate for the very low world prices created both by such competition and by international commodity traders. Surplus goods mean more goods moving, and therefore more transport-generated emissions.

Agricultural specialisation has also created a situation whereby countries that were traditionally self-sufficient in staple foods now import them, with additional food transport being one consequence. Indonesia is one example; from a position of self-sufficiency in rice in the 1980s, it now accounts for around 13.5% of world rice imports.[207]

The transport story does not end with commodity crops. In the developing world, very low labour costs, together with the open-house policies of governments desperate for inward investment, combine to create a favourable environment for multinational food manufacturers to set up food processing and packing operations. These companies are able to add value to cheap raw commodities profitably, enabling them to expand and globalise their operations further. Examples of such multinational activities include chicken processing in Thailand and Brazil, and trimmed vegetable preparation in Kenya.[208] The consequence is ever longer supply chains, with the environmental impact of that transport not fully internalised in the final cost of the product.

These market distortions have together led to the generation of unnecessary freight movements. However, market liberalisation, while generally acknowledged to be necessary in order to

205 BBC News, *Doha Trade Deal Unravelling,* November 2002 http://news.bbc.co.uk/2/hi/business/2436803.stm

206 *EU CAP Reforms a Disaster for the Poor,* news release, Oxfam, Oxford, 26 June 2003

207 See: http://r0.unctad.org/infocomm/anglais/rice/sitemap.htm

208 Processing at the point of production also reduces the transport of what eventually ends up as waste but the point is that these foods are sourced from far afield because of the low cost of labour and other costs relative to those in the developed world

improve the terms of trade for the developing world,[209] will not necessary lead to a reduction in food transport. While the removal of a subsidy structure may lessen the incidence of dumping and hence reduce these kinds of food movements, it is also likely to lead to an increase in the production of other (particularly processed) foods for export, with all the transport that this creates. The 2001 *Everything but Arms* initiative agreed between the EU and a number of low-income developing countries, aims to foster more open trading arrangements for the developing world. While welcome from an international development perspective,[210] it will also allow increased imports of certain commodities over the next decade and probably lead to a growth in food transport.

Liberalisation in China and Eastern Europe will give added impetus to the growth in transport mileage, as will the enlargement of Europe. Indeed, with ten new countries joining the Union, we could see the pattern of food production in Europe shifting in new directions, with regions previously enjoying little access to EU markets able to exploit their competitive advantage – in fruit and vegetable production for example.[211]

This may further damage the competitiveness of British farmers still trying to recover after the onslaught first of BSE and then foot and mouth disease. Despite the hugely expensive CAP subsidy system, 60% of British farmers receive individually less than £5000 in annual subsidies;[212] the average UK farmer earns a mere £11,000 a year[213] (less than half the national average of £24,600)[214] for working over 60 hours a week, and many farmers are unable to recoup even the cost of production.[214] The consequence of this is that there are few new entrants to the profession.[215] Indeed, in the six years up to 2002, nearly 65,000 jobs were lost in the UK's agricultural and horticultural industry.[213] While some farms have consolidated and expanded, many others have suffered, and are in decline. As a result, manufacturers are looking overseas for supplies, so exacerbating the shift towards longer supply chains.

At the 2003 EU Agriculture Council, attempts were made to untangle the situation and free up the trading system while furthering environmental and social objectives. These attempts have met with limited success, as discussed in section seven.

In addition to its subsidies structure, other aspects of the CAP have also contributed to the growth in food mileage. For example the emphasis on specialised intensive agriculture has led to a decline in mixed farming systems, and the segregation of different types of farming (arable, livestock, horticulture) into different regions. This in turn has reduced the ability of regions to be self-sufficient in agricultural products.

At the national level, government has begun to develop farming policies which aim to build a stronger and more environmentally sustainable British farming base. We discuss these in the next section.

There are of course many other policies which, while not specifically focused on the food industry, nevertheless have an impact on the way it works and on the freight movements it generates. State aid rules, for instance, more or less prohibit governments from favouring indigenous production over imports on the grounds of environmental or any other considerations.[216]

4.4 Conclusion

A number of very strong influences have helped to lengthen our food supply chains. These include the rules governing international trade, together

209 *The dangers to Doha: the risk of failure in the trade round,* speech by Clare Short at Chatham House, 25 March 2003, Department for International Development, www.dfid.gov.uk

210 *Everything but Arms and Sugar?* Oxfam Parliamentary Briefing 13, Oxfam, Oxford, 2000

211 Baldock D, *Local Food Sourcing: a changing policy context,* Institute for European Environmental Policy, *Wise Moves* seminar, Transport 2000, London, 31 October 2002

212 *Farmgate: the developmental impact of agricultural subsidies,* ActionAid, London, 2001

213 *UK Agricultural Review,* National Farmers' Union, 2003, www.nfuonline.org.uk

214 *Patterns of Pay: results of the 2002 New Earnings Survey,* ONS, www.statistics.gov.uk cci/article.asp?id=364 cross-industry figures for PAYE registered employees working full-time

215 *UK Agricultural Review: farming in crisis,* National Farmers' Union, June 2002

216 Although there are some ways around this, see section seven

with other economic policies, notably the low cost of transport relative to other production costs (especially labour), increasing specialisation in the British and global agricultural industries, competition regulations, and state aid rules that have made it difficult for governments to internalise external (including transport-related) environmental costs. These factors have helped nurture the rise of powerful global manufacturing industries and retailers that depend upon an elaborate international supply network to provide for a public that is not necessarily aware of, or interested in how food is produced, and which demands, and gets, around-the-clock availability of just about everything. Unless these things change, the indications are that supply chains will only get longer. However there are also some (albeit small) indications of counter-trends. Whether these amount to an important shift in direction for the food supply chain or not depends upon the context in which they develop over the next few years. This is discussed next.

Section five

The business approach: Anticipating and preparing for the future

A number of factors are likely to influence the food industry's direction over the next five to ten years. A viable business will be one that negotiates a financially successful path through an often unpredictable obstacle course of threats and opportunities. It will also be one that anticipates and prepares for the future by considering whether small or latent existing trends are likely to grow in importance.

Figure 3 illustrates some of the questions that a business might consider before embarking upon any new course of action.

This section considers whether some of the slight counter-currents to the globalisation process highlighted in the previous section might, in combination, place curbs on the current trend towards ever longer supply chains. It begins by examining the broader geo-political issues affecting existing sourcing patterns, including climate change and other challenges to the resilience of the supply chain. The discussion then moves on to consider more specific recent and evolving policy developments. Lastly, this section looks at consumer attitudes, asking whether there are signs of a growing demand for food which is sourced from closer to home.

It should be emphasised that the purpose here is not to ask whether measures to shorten supply chains or source more locally are desirable from a CO_2 perspective. That is the remit of the next section. It is simply to consider the extent to which there are trends moving in this direction,

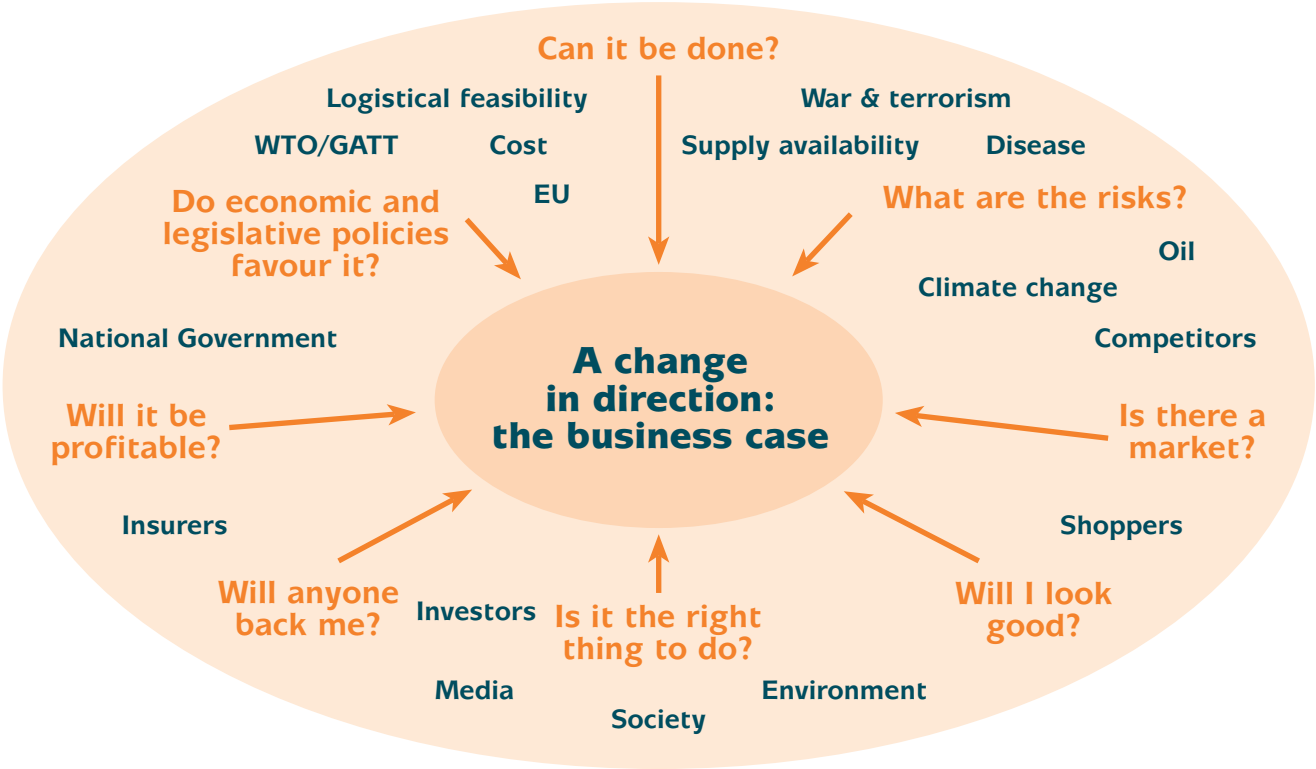

Figure 3

how powerful they are and therefore whether, commercially speaking, it makes sense to pay attention to them.

Whether or not these trends have merit in terms of carbon reduction, any measures to reduce CO_2 impacts from transport and from other life-cycle areas will need to take the commercial perspective into account; anticipating where trends may lead will be part of this process.

5.1 The big picture: Food supply in a risky world

In an ever more globalised world, events taking place thousands of miles away can have profound effects on a business.

Increasingly, policy makers and business leaders are realising that they need to consider and plan for the potential risks (internal and external) to which their supply chains are exposed.[217] Events such as foot and mouth disease, BSE, consumer antagonism to GM foods, the UK hauliers' fuel protest, the (only retrospectively unscary) Millennium bug and the September 11 terrorist attack have all underlined the importance of planning for contingencies – but also the difficulties of so doing. The war against Iraq and the rapid spread of the SARS virus in the spring of 2003 (and the likelihood of viruses such as these taking hold again) add to the uncertainty.

Might nearer be safer?

Given that there is a clear business case for fortifying against potential vulnerabilities, is there a specific risk-avoidance argument for shortening the supply chain?

This is a difficult question to answer. All supply chains are exposed to risk of one kind or another[218] and although a shorter supply chain will be not be vulnerable to some of the risks threatening a global one, the reverse is also true. The risks may be different but not necessarily of less magnitude. Some have argued that a well-prepared business will be one that develops as broad a supply and market base as possible in order to spread its risks and respond to events with agility. Recent agricultural and global crises have in fact impressed upon retailers the need to widen the food network; during the 2001 fuel protest, businesses were actually more able to source goods from the Continent than from within the UK, because the fuel was easily available across the Channel. Those with the most local supply and distribution bases were worst affected.[219] Hence, committing to sourcing everything from one region might be considered a rather risky eggs-in-one-basket approach.[220]

Nevertheless, a globalised sourcing structure is particularly vulnerable to some very specific risks. These include, most prominently, the threat posed by international terrorism, the volatile situation in the Middle East following the war in Iraq and our rapidly dwindling stocks of oil. All have implications for the security of our supply chains. There are signs that the freight industry is becoming highly conscious of these risks. A Freight Transport Association survey for January 2003 revealed that 76% and 35% of respondents have formal contingency plans to deal with possible fuel supply disruptions and transport infrastructure failure respectively.[221]

Oil is the transport fuel of choice. In the year 2000 oil fuelled the vast majority of vehicles and this accounted for around a third of total oil consumption in the UK.[222] Oil is also the fossil fuel with the lowest global reserves to production ratio and (although it is possible that new reserves will be found in Central America and Canada) could potentially be in short supply before 2050.[223]

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217 Cranfield School of Management, *Supply Chain Vulnerability*: *final report on behalf of DTLR, DTI and the Home Office,* Cranfield School of Management, Cranfield, 2002

218 Peck H, *Supply Chain Vulnerability,* presentation prepared by Helen Peck of Cranfield School of Management for *Exploring the business case for more local food sourcing and distribution,* seminar organised by Transport 2000, London, 31 October 2002

219 Maxwell S, WorldWide Fruit, personal communication, 2002

220 *Key Findings: exploring the business case for more local food sourcing and distribution,* Transport 2000, October 2002

221 *Quarterly Transport Activity Survey,* Freight Transport Association, Tunbridge Wells, January 2003, www.fta.co.uk/information/otherissues/trends/qtas/030226QTAS.htm

222 *UK Energy in Brief,* Department for Trade and Industry, London, December 2002

223 Eyre N, Fergusson M and Mills R, *Fuelling Road Transport: implications for energy policy,* Institute for European Environmental Policy and Energy Saving Trust, London, 2002

Traceability is another issue to consider. The more complex and elaborate our supply chains and the greater the range of food on offer, the more difficult it is to know exactly where food comes from and how it has been produced. The recent devastating outbreak of foot and mouth disease, for instance, is likely to have originated from outside the UK, although the exact source is unlikely ever to be identified.[224]

It has been argued that bigger companies have more transparent and traceable supply chains than smaller companies, because they have the resources to put in place the appropriate infrastructure and procedures, whatever the length of the supply chain.[225] In early 2003, Sainsbury's announced measures that will eventually allow customers to use the Internet to track all own-label British organic fruit and vegetables back to the farm, as well as other products from around the world. The company also announced plans to extend the concept to other fresh organic areas including meat and dairy produce.[226]

These measures reflect the importance companies place on consumer concerns but they also highlight the fact that major companies are able to develop such technology. It is unlikely that smaller retailers would be able to afford such an investment. Similarly, consumers' aversion to genetically modified foods has caused the major food businesses to go to great lengths to ensure that their own-brand products are GM free. Smaller local enterprises are very unlikely to have been able to make this stand against the GM industry.

On the other hand, although Due Diligence requirements will apply whatever the size and type of business, the smaller the enterprise, the shorter the distances involved, and the more direct the link between the supplier and the consumer, the less need there may be for elaborate traceability systems. The success of farmers' markets is due both to the shortness of the supply chain and to personalised trading relationships. As such initiatives grow and become more prevalent, it will be interesting to see whether they manage to continue without abuse of trust on either side.

While bigger companies are sometimes better able to absorb shocks than smaller ones, thanks to their ability to switch sources of supply very rapidly, when major businesses do fall, they fall spectacularly, with recent high-profile cases illustrating this point. Of course the picture is more complicated than this since most small businesses – small grocery stores and newsagents for instance – also source globally via their wholesalers. What is evident is that more work needs to be done to develop risk-management strategies which differentiate on the basis of near and far.

The effects of climate change

Climate change, and its impacts, is an area of potential vulnerability. For business, its significance falls into two categories; the effects upon the physical environment, and the political and legislative responses these effects provoke.

In physical terms, climate change will affect agricultural systems, making existing types of food production in some regions no longer viable, while opening up potential in other areas. For UK agriculture, climate change will mean a longer growing season, fewer frost days, more peak temperature days, more rain in winter and less in summer, and increased atmospheric CO_2 levels.[227] There are also implications for livestock production – animals may well suffer from more heat stress and disease. People's food tastes will change too – hotter days will mean more demand for salads and ice-cream and less for warming stews and mashed potato – and business will need to respond to these changes. Hotter average temperatures may also cause an increase in industrial (and domestic) use of refrigerated storage; a requirement which will lead to the generation of additional greenhouse gas emissions.

224 *Origin of the 2001 Foot and Mouth Disease epidemic,* news release, Department for the Environment and Rural Affairs, London, 20 June 2002

225 Comment offered at *Wise Moves* workshop, *Exploring the business case for more local food sourcing and distribution,* Transport 2000, 31 October 2002

226 *JS net tracks British organic own label, The Grocer,* William Reed Publishing, West Sussex, 22 February 2003

227 Hossell J, Clemence B and Roberts A, *Food Sourcing under a Changed Climate,* ADAS Consulting Ltd, paper prepared for *Exploring the business case for more local food sourcing and distribution,* seminar organised by Transport 2000, London, 31 October 2002

Although climate change may favour more indigenous production of some crops such as soya, sunflowers and wine grapes that have hitherto been imported, it is not automatically the case that climate change will shift sourcing patterns in a more local direction. What is more likely is that we will simply make a different set of sourcing decisions. The heat-wave and absence of rainfall in July–August 2003 cut maize and sugar-beet yields in Italy by a quarter, and wheat yields have fallen by a third in Portugal.[228] Other major European crops, including peaches, pears and olives have been severely damaged.[229] One prediction puts the cost of the heat-wave to Italy at more than €6 billion, with one million hectares of crops damaged.

We are unlikely to grow all these crops ourselves instead. What is more likely to happen is that we will simply source from elsewhere – perhaps from Northern and Eastern Europe, or, further still, from China. These changes will not necessarily lead to reductions in transport; for some crops, food miles will grow.

However, in addition to the agricultural impacts, the food supply chain will also have to contend with disruptions to the logistics infrastructure caused by extreme weather events such as floods and violent storms. These are serious threats. It is possible that big business will cope with some of these by developing technological and other solutions, in the form of sturdier air freight carriers, better flood prevention measures, different siting of warehouses and so forth. The extent to which these will counter the disruption will depend upon the severity of the events we experience.

To what extent, then, do climate change and other vulnerabilities in the supply chain threaten the current pattern of sourcing from ever further afield? By its very nature, an answer about risk will not be definite. Threats to the security of the supply chain could come from unpredictable sources both at home and abroad. However, in the short term it may be that the policy actions to tackle climate change and other environmental concerns (some of which are discussed below) will have a greater effect on food sourcing and distribution patterns than the physical consequences of climate change itself.

5.2 Do economic and legislative policies favour shorter supply chains?

To what extent does the international political and economic context favour a shift towards more local patterns[230] of food sourcing and distribution? Section four has argued that historically these policies have often had the opposite effect, fostering (or at least not hindering) the development of longer supply chains. Many of these policies continue, and as such the impetus for lengthening supply chains remains.

However, there are also qualifying counter-trends, which suggest that in small but possibly significant ways some practical restraints are being placed on the globalisation process. In addition, policies are being implemented that increase the relative appeal of more local sourcing options.

UK farming and food initiatives

In December 2002 Government formally responded to the Curry Commission's report with the publication of *Facing the Future*.[231] This report outlines Government's strategy for improving the competitiveness and environmental sustainability of UK food and farming. While critics felt the report was weak in some respects,[232] it is likely that in future years we will see more support for sustainable UK production, and more of an emphasis on local and regional foods.

Some of the policies that may encourage this regional approach include various agri-environment schemes, and the Organic Action Plan. The latter aims that British farmers should supply at least 70% of the UK organic market, compared with the existing 30%, although it does

228 *Heatwave's Warning for Future of Farming, New Scientist,* 20 August 2003, www.newscientist.com/news/news.jsp?id=ns99994072

229 *Heat Damage, The Grocer,* William Reed Publishing, West Sussex, 9 August 2003

230 The term is meant in its relative sense here; nearer rather than further sourcing

231 *Facing the Future: the strategy for sustainable farming and food,* Department for the Environment, Food and Rural Affairs, London, December 2002

232 *More Action Needed for Sustainable Farming Future,* news release, Friends of the Earth, London, 12 December 2002

not specify a date by which this should be achieved. It also puts in place a number of measures to enable and encourage both public procurement bodies and retailers to source organic food from within the UK.[233] As well as plans to increase organic production within the UK as a whole, the Organic Action Plan also commits DEFRA to work with the organic sector to develop healthy and growing sales of local and regionally grown organic food. On the other hand, *Facing the Future* includes strategies to increase exports of organically grown food, which will have the effect of increasing food transport.

As part of its vision for sustainable farming and food, government has also charged the Regional Development Agencies (RDAs) with developing regional food strategies. Most of the RDAs are still in the very early stages of the process and the outcome remains to be seen, not least because the funds available are fairly modest. In principle, however, this devolution of responsibility to the regions could provide opportunities and incentives for the food industry to source more from within the UK as a whole, and even from within the region. The emphasis is, however, on stimulating the production and marketing of 'value-added' foods, rather than on everyday staples. As such these policies may not provide real incentives for business to shift away from their existing sources. It is more likely that they will simply supplement their existing product ranges with regionally sourced value-added foods.

Food from Britain (FFB) has also received a major boost in funding, and has taken on what was previously the Countryside Agency's responsibility for promoting regional foods. Again, FFB's focus is on value-added, niche 'locality' products, and its remit is to promote these foods overseas as much as within the UK. Thus while the activities of FFB will probably increase availability of certain value-added products within the UK, they will do little to halt the trend towards longer supply chains.

There is also the Food Chain Centre (FCC). Housed at the IGD, its activities include work to promote benchmarking among farmers (to improve efficiency and reduce costs), and to explore ways of improving efficiency in the red meat chain through, among other things, more collaboration across the supply chain. It is also supporting some minor work on horticulture, aided by a small grant from DEFRA. As with the other initiatives, the emphasis is on adding value to the supply chain through, for instance, food processing. The transport implications of value-adding and food processing are discussed in section six.

If successful, the work of the FCC may help improve the competitiveness of UK food production, and as such may encourage some product substitution by retailers. On the other hand, it may simply enable them to add UK products to their existing globally sourced range – a matter of supplementing, rather than replacing. Once again, the initiative is still in its early stages and there is as yet no evidence to report.

The re-launched Little Red Tractor Scheme[234] covers more basic agricultural commodities, such as cucumbers and chickens. State Aid regulations prohibit any government-funded scheme from directly promoting the Britishness of foods, and Tractor foods do not have to be British. However, in most cases they are just that. The intention is that in time the Tractor mark will subsume all the other quality assurance marks that are currently on offer around the UK, but this is likely to be a long and difficult process. As it stands, the Tractor scheme has been severely criticised by animal welfare and environmental organisations, who argue that products bearing the mark only have to meet the very minimum (and in their view, inadequate) legal standards.[235] Nevertheless, from a supply chain perspective, it may be that the scheme raises the profile of UK produced foods among consumers. As such it may provide an incentive for businesses to source more from within the UK instead of from further afield. This is, however, speculation; we are not aware of any research which has analysed the impact of the scheme on retailer sourcing patterns or on consumers' interest in buying British food.

The English Collaborative Board is yet another initiative. The board has set up the English Farming & Food Partnership (EFFP) to promote

233 *Action Plan to Develop Organic Food and Farming in the UK,* Annex 2, DEFRA, London, July 2002, www.defra.gov.uk/farm/organic/actionplan/actionplan.htm

234 See: www.littleredtractor.org.uk

235 *Little Red Tractor Under Fire,* BBC Wales, 21 March 2003, www.bbc.co.uk/wales/southwest/farming/digest/stories/2003-03-21logo.shtml

collaboration within the supply chain – between farmers, and between farmers and other food industry players. Again, it is too early to see what effect the EFFP will have on the British farming sector but if successful, it may strengthen the commercial case for sourcing more from within the UK.

The signs seem to be that, at the national level at least, a policy framework is being established that in some measure favours the commercial case for sourcing more from within the UK, and even for more local and regional supply chains. However, the focus is on niche, value-added products rather than on everyday staples. From a commercial perspective, this is understandable; these products have the clearest chance of success as they are obviously different from the many others available to shoppers. People pick them up, say 'this is different' and buy them, even if they are more expensive. There is evidently a clear commercial case for selling more of these products and many supermarkets are already doing just that.

We have suggested, however, that these goods will serve as add-ons to the existing repertoire of goods on offer, rather than providing incentives for product substitution. As such while we may see the development of more UK-based and regional supply chains it is doubtful whether they will replace the existing longer ones.

In addition to measures that seek to promote UK, regional and local sourcing, businesses will also be mindful that other government policies provide incentives that tend in the opposite direction. The low cost of transport relative to other costs, both for national and international freight transport, is a clear example here. In addition, it is an explicit Government policy to foster and encourage globalised trading systems.

Aviation policies

Aviation is one transport policy area with a strong bearing on business food sourcing decisions. An *Aviation White Paper* is likely to be published in early 2004. It remains to be seen what this contains but at the moment, from an environmental perspective, the signals Government is sending appear to be somewhat contradictory.

On the one hand, Government is looking at the options for developing a form of aviation emissions charge, or fuel tax, for domestic freight and passenger flights. As a member of the International Civil Aviation Organisation (ICAO) and the EU, it is also urging the development of an international and/or Europe-wide emissions charging scheme at the earliest opportunity. This issue is discussed in more detail in section seven, where we offer our own suggestions.

On the other hand, the Government is eager to press ahead with a major programme of airport expansion in the UK, some of which (in the East Midlands region particularly) provides for an increase in airborne freight. The effect of this will be to make air freighting goods both cheaper and more convenient, so providing incentives for business to place more reliance on short-order globalised purchasing structures. When the EU-wide aviation emissions charge comes into effect (see section seven) this may have a further bearing on business sourcing decisions. Much, however, will depend on the level of charges set and the precise nature of the scheme.

European policies

At a European level too, we have already highlighted the fact that the enlargement of Europe may well foster longer supply chains and that businesses are in particular looking at setting up manufacturing locations in Eastern and Southern Europe.

To this point should be added the obvious fact that EU (and at an international level, WTO) legislation also places restrictions on attempts to promote indigenous production at the expense of overseas imports. As such, international policies will continue to support the long supply chains of the food industry.

European transport policies do not seem to be doing much to mitigate the effects of such expansion. The *European Transport White Paper* published in September 2001[236] will, commentators suggest[237] provide little disincentive to the growth in transport-intensive distribution systems.

236 *European Transport Policy for 2010: time to decide,* European Commission, Brussels, September 2001

237 *Opaque Commission Adopts Toothless Tiger,* press briefing, T&E: European Federation for Transport and the Environment, Brussels, 12 September 2002, www.t-e.nu/press_briefings.htm#17/10/'01

There has been some speculation as to the possible impact of the soon-to-be-implemented Working Time Directive on freight journeys. The directive will place legal limits on drivers' working hours. Some have argued that this may force an increase in transport fleets, to take into account the fact that more drivers will be needed to do the same job; indeed Lex Transfleet warns that the directive will mean a 12% increase in the number of journeys, although what the effect on total tonne-kilometres might be is not clear.[238] On the other hand, the directive may provide incentives for businesses to adjust their supply chains by, among other things, looking for sources closer to home. One industry figure has commented: *'We need to start looking at genuinely integrated networks across Europe arranged around consolidation centres. These will act as command and control with strategically located depots bounded by four-hour drive zones to comply with the new EU Working Time Directive.'*[239]

Others, still, doubt that the impact on freight mileage will be significant either way.[240] Congestion is far more likely to have an effect on business decision-making although it is not always the case that the shorter route will be the less congested one. It may be, however, that the Working Time Directive will have a bearing on lorry mileage in another respect. ASDA has commented that *'As far as the Working Time Directive is concerned, rail has it licked,'*[241] and that extending its use of rail is core to its strategy for dealing with the implications of the directive.

On balance then, do national and international policies favour a shift towards shorter supply chains? In some areas, the answer is a qualified yes. The post-Curry agricultural agenda has spurred on the efforts of the major supermarkets to source and promote UK produce. It may be that in some areas of transport policy there are weak incentives for the development of shorter supply chains. On the other hand, these may well be cancelled by other policy influences that actively support the development of longer supply chains. What we may see in future years is the development of separate, parallel supply chains: one for niche local and regional foods; and another, international one, for the vast majority of the goods we eat.

5.3 Is there a market? Public opinion, ethics and transport

Do we really care how, and how far, our food travels?

On the face of it, no. As section four illustrated, it seems that on the whole what people want is an ever greater variety of often highly processed foods, at ever lower cost, available all the year round. The consequence has been longer supply chains.

However, section four also highlighted a small but growing demand for food that is not mainstream, including Fairtrade, organic, speciality and local foods. Many of these foods come with various ethical credentials attached, although all also possess other qualities that contribute to their consumer appeal. It seems though that there is a growing niche market for foods offering a moral edge. This is enabling businesses that cater for this market to make healthy profits.

The question for a business to consider might therefore be whether the food miles issue is likely to grow in importance for those shoppers who already buy 'alternative' products. And if so, how far will this concern for food miles enter the mainstream?

The following paragraphs discuss the alternative sector in more detail, exploring whether this growth amounts to an important trend, and if so, whether there are any common contributory factors. We look at this sector *not* because we necessarily equate it with a reduction in transport – imported organic food, for instance, travels further than its home-grown conventional equivalent. The purpose rather is to examine how and why non-mainstream foods can grow in

238 *Interesting Facts and Figures from the Lex Transfleet's Report on Freight,* news release, Lex Transfleet, Coventry, 1 April 2003, www.lextransfleet.co.uk/article.cfm/id/170.html

239 Godsell D, marketing and strategic development director, Christian Salvesen, quoted in *Supply Chain: an editorial supplement to The Grocer,* William Reed Publishing, West Sussex, 14 June 2003

240 Dawson J, Exel Logistics, opinion offered at *Exploring the Business Case for More Local Food Sourcing and Distribution,* Transport 2000 seminar, London, 31 October 2002

241 *ASDA Plans Increase in Rail Use to Cut Three Million Lorry Miles, Rail,* issue 468, EMAP, Peterborough, August 2003

appeal, and hence how other issues, including transport, enter the public consciousness.

We then explore whether concern for food miles, in particular, is growing and if so, how this affects shoppers' choice of products. Once again, our focus is on examining trends with a bearing on business behaviour, not on judging whether local food actually generates fewer CO_2 emissions.

The alternative food sector: Organic

Recent years have seen massive growth in UK sales of organic food. They are now the second highest in Europe,[242] reaching £920 million in 2002, a 15% increase on the year before.[243] While most of this growth (60%) is driven by only 8% of consumers, 71% of us bought at least some organic food in the year 2001–2.

The signs are that this growth is slowing but sales nevertheless continue to rise. The interest in organic food is also helping boost the British organic farming sector – imports of organic food fell by 5% to 65% of sales, meaning that there has been a small but appreciable increase in home production.[242]

The alternative food sector: Fairtrade

Fairtrade food is another sector which has seen particularly rapid growth. More of us than ever before now have an idea of what Fairtrade is about; compare the 24% who understood what the mark stands for in 2001/2 with only 12% in 1999.[244] What is more, we are buying as well as recognising Fairtrade products. Sales leapt by an average of 40% during 2001 – with the market for Fairtrade bananas growing by 83%. In total, £46 million was spent by the British public on Fairtrade products in 2001.[245] By value, 14% of coffee purchases come with Fairtrade credentials (by volume 12.9% of ground coffee and a smaller but still significant 3.6% of all coffee).[246] As interest grows, so does the range of goods on offer; over 100 products now carry the Fairtrade mark.

Neither organic nor Fairtrade food could be classed or even viewed in the public's mind as 'less transport intensive'. There are, however, also signs of growth in more overtly *local* food sectors. Here consumers may perceive there to be a connection with less transport.

The alternative food sector: Farmers' markets

The rapidly growing popularity of farmers' markets is a good example. In 1997, there was only one farmers' market in the whole of the UK, but by 2002 there were around 450. Seventy per cent of markets describe themselves as thriving.[247]

Mainstream retailers have already noted the interest in local and regional foods and most of them are, to varying degrees, now offering, or aiming to offer such foods in their stores. Most now have some form of local and regional food policy and many employ regional food buyers. In addition, since British foods are often associated with 'local' in the public mind,[248] many supermarkets are promoting the Britishness of some of their foods. The box below highlights some examples of their activities.

Supermarkets and local food

ASDA says it has identified a £160 million sales opportunity for local products[249] and it aims that every one of its 258 stores should sell products from at least one local supplier by 2004. To this end, in 2001, ASDA formed a central team to co-ordinate local sourcing activity. An early launch was 'the best of Cornwall and the West Country' where products such as ice-cream and biscuits were introduced to the region's stores. In the North West ASDA is stocking 80 products from 19 small suppliers based at the Plumgarths Lakelands Food Park in Kendal. The businesses are primarily family concerns.[250] This

242 *Huge Boost in Organic Land Shows New Report,* news release, Soil Association, Bristol, 14 October 2002

243 *Food and Farming Report 2002: executive summary,* Soil Association, Bristol, 2002

244 *Fairtrade Fortnight General Action Guide,* Fairtrade Foundation, London, 2003

245 *Faircomment magazine,* Fairtrade Foundation, Summer 2002, www.fairtrade.org.uk

246 *Ethical Approach Finds Favour, The Grocer,* William Reed Publishing, West Sussex, 13 September 2003

247 *Farmers' Markets: a business survey,* National Farmers' Union, London, September 2002, www.nfu.org.uk/ stellentdev/groups/public/ documents/policypositions/farmers'markets-a_ia3e5b8154-3.hcsp

248 *Consumer Watch 2003,* Institute of Grocery Distribution, Letchmore Heath, April 2003

249 See: www.asda.co.uk

250 *The Grocer,* William Reed publishing, West Sussex, 13 July 2002

initiative involved sourcing at quite a low level, with the products in one store sourced from the same town. Clearly though, if enough volume is available from the suppliers, opportunities may be available for extending their reach to other ASDA stores in the north of England. ASDA added 400 new local lines to its stores in 2002 and now has 130 local suppliers on its books.[251]

ASDA has launched a Buy British campaign across all 259 of its stores and plans to invest £1.3 million in new labelling, in-store promotions, and other forms of marketing. It is also looking at ways of extending the UK growing season in a bid to combat foreign imports.[252] In 2003 it aims to double its supply of Scottish carrots and remove foreign imports from all stores. The retailer will source 10,000 tonnes of carrots from Scotland compared to last year's 5000 tonnes and is on course to source 100% from the UK by 2004.

Tesco also plans to put more locally sourced produce on sale at its 75 Scottish stores, following customer research which showed that Scottish consumers were keener to buy local than customers in the rest of the UK.[253]

Sainsbury's employs a team of regional and local buyers. The retailer stocks over 3500 products which it classes as local or regional.[254] Some will be available on a national basis while others will be sold in only one or two stores. The company also runs Small Supplier Development Programmes in the South West and in Wales to help smaller enterprises make the transition to supplying a national retailer.

Waitrose has launched its Select range of milk sourced from a pool of 85 dairy farmers, and has made a commitment to sourcing strawberries only from the UK between June and September.[255] Waitrose has also adopted a definition of local (from within a 30-mile radius) and has published a Small Producers' Charter.

All Safeway organic meat is now sourced from within the UK. It has also worked with Welsh hill farmers to supply Welsh stores with lamb. This has proved very successful and the lamb is now on offer in stores across the UK. Safeway also supplies its Orkney and Lerwick stores with local meat, Northumberland lamb to its Northumberland stores and local fish, meat and eggs to its Channel Island stores.

One survey[256] found that Marks & Spencer is currently sourcing 60% of its organic produce from the UK – much greater than the 25% industry average. Marks & Spencer also sources all its milk regionally and all salmon from within the UK. It has funded the development of new UK varieties of fruit, such as the Jubilee strawberry as well as an indigenous Gala apple. Marks & Spencer has 3% of the UK food market, but it sells 16% of all apples grown in the UK.

Booths, the small North-West based supermarket chain, has built a particularly strong reputation as a seller and promoter of regional produce and in so doing has enjoyed very high growth levels indeed. It saw a 9.7% sales increase in the seven weeks around Christmas 2002, compared with 5% for Waitrose and 4.8% for Tesco, the two next highest supermarkets. Its annual sales increase was nearly 9%.[257]

251 *The Grocer,* William Reed Publishing, West Sussex, 1 March 2003

252 *The Grocer,* William Reed Publishing, West Sussex, 26 April 2003

253 *The Grocer,* William Reed Publishing, West Sussex, 14 September 2002

254 Sainsbury's, www.j-sainsbury.co.uk/csr/regional_sourcing.htm

255 *The Grocer,* William Reed Publishing, West Sussex, 25 May 2002

256 *Supermarkets failing to buy British organic produce,* Organic Targets Campaign, c/o Sustain, London http://www.sustainweb.org/pdf/20_7_02.pdf

257 *The Grocer,* William Reed Publishing, West Sussex, 18 January 2003; 1 February 2003

258 *Consumer Watch 2003*, Institute of Grocery Distribution, Letchmore Heath, 2003

The alternative food sector: Local food

The local foods market is beginning to look very lucrative indeed. Consumer attitude surveys to local food indicate a growing interest. Asked what changes they would hope to see at their local supermarket over the next year, consumers ranked *"locally-produced foods should be available"* third at 15%, after the more predictable *"prices should not increase"* (33%) and *"more special price promotions"* (18%). Interestingly, more local food ranked higher than *"food that is easier to prepare and cook"* at 6%.[258]

Another survey reinforces the finding that active interest in food production is on the increase. The survey, in 2002, found that 18% of shoppers were actively trying to improve their knowledge of food production compared with 14% in 2001.[259] A third study found[260] that most people (59%) are well disposed towards local foods but those who actually buy it tend to be older, female and in higher socio-economic groups. This reflects not just a greater concern for food issues among this section of the population but also the fact that they may have more access to local food than many other groups and are able to afford the often higher cost.

How important are ethics to consumers?

Taken together, the growth in organic, Fairtrade and local foods is significant. At least two questions follow. First: what, if any, are the common factors underlying this growth? Second: how does the issue of food miles fit into the picture and how might this affect business sourcing decisions?

To take the first question first: as section four showed, aside from the obvious criterion of ease of access, people choose foods on the basis of price, taste, appearance and (increasingly) its health-giving properties. In other words, their decision is based on their particular notion of 'quality for money'. What constitutes this quality for money will vary from person to person. Some, for instance, see the McDonald's arches as a sign of consistency, reliability, tastiness and general reassurance; whereas others[261] regard them as symbol of all that is wrong with post-industrialist consumerist Western society. The shopping decisions people make are based on a complex mental arithmetic which juggles the relative importance of a number of factors for any given product.

Thus while price may be very important it is not, except for a small minority, necessarily the overriding consideration.[262] Hence the popularity of branded products which cost more than their virtually identical unbranded counterparts. And hence too the growing popularity of organic, Fairtrade, speciality and local foods.

Most people who buy organic food cite health and food safety as the overriding reason for so doing (with environmental considerations very low on the list).[263] The success of organic babyfood, now accounting for 50% of babyfood sales, is a sign of the connection people make between purity and organic food. Linked to health, is the trust factor. It has been widely argued that there is a crisis of trust in our attitude to the food industry – we increasingly do not trust major manufacturers and food retailers to provide safe and nutritious food. The government's Food Standards Agency was set up, in part, to restore the public's confidence in the food industry.

Supermarkets are highly sensitive to issues of public trust, evidenced by the number of marketing campaigns stressing the authentic origin of products. Advertisements for Waitrose's 'Select' milk describing an 'elite pool of farmers' is one example; Sainsbury's new fruit and vegetable tracking technology is another. Local food is often promoted as a hand-picked or hand-crafted product: it is marketed as food with a human face. Most long-supply-chain food (with the exception of Fairtrade) is not.

How serious are the implications for supermarkets' existing global supply chains? The picture is somewhat complicated by the fact that apparently it is only sometimes that we don't trust the supermarkets and their big suppliers. Most of the time we continue to buy big-brand and own-label foods from the supermarkets, and with apparent alacrity, if the growth in highly processed convenience foods is anything to go by.

Of course we may continue to shop for big-brand products at supermarkets partly because we have little choice, either literally (other stores or manufactured goods do not exist), or because we

259 *Consumer Attitudes to Eat the View, report prepared for the Countryside Agency by the Institute of Grocery Distribution,* Countryside Agency, Cheltenham, 2002

260 Dawson A, *Consumer Watch,* Institute of Grocery Distribution, Letchmore Heath, 2002

261 Ritzer G, *The McDonaldisation of Society,* Pine Forge Press, United States, 1993

262 Institute of Grocery Distribution Consumer Unit, August 2000

263 *Consumer Attitudes to 'Eat the View' Part One: qualitative research prepared by the Institute of Grocery Distribution for the Countryside Agency*, Cheltenham, 2002 and *Consumer Attitudes to 'Eat the View' Part Two: store exit interviews prepared by the Institute for Grocery Distribution for the Countryside Agency,* Cheltenham, 2002

have almost forgotten that there is an alternative, or simply because we do not have time to spend looking for other foods and retail outlets. However, unless it is really the case that we are entirely at the mercy of big business then perhaps another aspect of the answer is that we do not always mean what we say. We may like to complain, but the supermarket cash tills show that we trust the supermarkets well enough to supply us and our children with safe-enough, good-enough food. It is also notable that most of our increased spending on organics has been inside those very supermarkets that we profess to mistrust.[264]

The reality is that shoppers are notoriously inconsistent, and represent an assortment of shifting incompatibilities. I may *in general* want all food to be healthy and nutritious and preferably good for the environment and society too, but *specifically* right now I want something quick, cheap and very sugary and I don't care how and where it was made. As an illustration, while the meat industry is experiencing a decline in carcass meat sales (partly brought on by food scares such BSE and foot and mouth disease), meat-based ready-meals have been one of the strongest growth areas in the food industry.[265] And although we are seeing a growth in the alternative food sector we are also Europe's largest consumer of that most anonymous of food stuffs, the 'savoury snack'. Indeed, the British account for 51% of total sales of savoury snacks, way ahead of the Germans at 18% and the French at 14%.[266]

264 *Food and Farming Report 2002: executive summary,* Soil Association, Bristol, 2002

265 *The Food Industry,* special report, *The Grocer*, William Reed Publishing, West Sussex, October 2002, www.grocertoday.co.uk/resources/marketreport.asp?r=410

266 *Brits Top the European Snack Polls,* Food & Drink Europe www.foodanddrinkeurope.com/news/news.asp?id=2163 15 May 2003

267 *The Future of Global Sourcing,* conference organised by the Institute of Grocery Distribution, London, October 2002,

268 *The Grocer,* William Reed Publishing, West Sussex, 26 April 2003

269 *Co-op Sales Boosted by Ethical Stance,* Food & Drink Europe, 28 April 2003, http://foodanddrinkeurope.com/news/printnews.asp?id=2134

Business is responding to these binary buying tendencies by adopting a similarly dual approach to their supply chain structures. As well as their regional and local buyers, supermarkets also employ global supply chain managers and are seeking to achieve commercial advantage through the globalisation of their supply chains.[267] According to the industry magazine, *The Grocer*, evidence suggests that supermarkets are increasingly sourcing goods from the 'grey market.' This means they are choosing to buy identical but cheaper branded products from overseas because this is more cost-effective than doing business direct with the British manufacturer.[268]

Such an approach may have little impact on food transport, since British manufacturers may in any case carry out production overseas. It does however indicate that, far from being incompatible, the development of both local and global supply chains are viewed as ways of catering to two different (and both lucrative) sections of the market.

Food miles: Might consumer concern grow?

The food miles issue makes ethical demands on the consumer in ways that organics does not. The concern is intrinsically environmental. There is no obvious health message. As such, the extent to which people will buy 'low food miles' food will depend on the extent to which altruistic ethical considerations influence people's shopping decisions.

The experience of the Fairtrade sector may shed some light on the issue. With Fairtrade foods, an explicit connection is made – in terms of the message the product carries and the higher price it commands – between purchasing and ethics. The success of this sector does suggest that people do want their food purchases to make a positive contribution. The upturn in the Co-operative food group's fortunes, where ethics have become something of a selling point, is another instance.[269] However, ethics alone are not sufficient – people will not buy something nasty just because it is good for the planet. Cafédirect, the leading Fairtrade coffee brand, has recognised and exploited this fact with a very successful marketing strategy focusing as much on the 'quality coffee'

angle as on its ethical credentials. In its own words, *'The quality message [had] long been missing from Fairtrade product campaigns and without it, in a quality-conscious consumer society, only a limited number of consumers [would] be motivated to buy.'*[270] Following new marketing and distribution strategies, brand awareness of Cafédirect increased to 56%[270] while Cafédirect coffee sales grew by 20% in value in 2001/2.[270] The success of Cafédirect has also helped expand the overall Fairtrade market, with retailers such as Sainsbury's and the Co-op now selling own-brand Fairtrade products.

With local food too, ethical considerations have had a role, albeit a secondary one, to play in the sector's growth. IGD research found that for those who bought local food the desire to support the local community ranked third in importance as a reason for so doing, after freshness and quality.[271] Environmental factors featured too, both for local[271] and for organic food[272] although fairly low down on the list.

Social and environmental concerns do, then, play a part, provided they are convenient and consistent with self-gratification. The ethical seeds may have been sown by a small core of committed, principled and vocal consumers (and it is therefore unwise for a business to ignore them) but it is self-interest that provides the medium for the sector's growth.

On balance then, concern by some sections of the community for less transport-intensive food is likely to grow. This will have some implications for the food industry's existing, highly globalised food system. The next section discusses the relationship between transport, CO_2 and food life-cycle emissions, and what a carbon-reducing approach might mean for sourcing decisions.

However, as discussed, transport and carbon-reduction objectives are likely to be just one concern among many for the ethical consumer, and as such will be only one consideration affecting the shopping decisions they make. Equally there will still be a large section of the public who knows little and cares less about the threat of climate change. For them, in the short and medium term at least, it will be dinner as usual, and retailers are very unlikely to ignore their demands. However, the situation can change very rapidly. With obesity a growing concern, businesses are suddenly aware that they face the prospect of potentially catastrophic litigation brought against them. Kraft's recent decision to shrink portion sizes and reduce the fat and calorie content of many of its foods suggests that businesses may wish to jump before they are pushed. It is not inconceivable that as people begin to understand what climate change means to them, something analogous may happen.

5.4 Conclusion

What are the implications for today's globalised sourcing and distribution practices? In the short term, the conclusion is qualified. Developing shorter or locally focused supply chains may make sense to some businesses, in some areas, selling certain types of food to certain customers. Increasing consumer demand for alternatively-sourced foods with an ethical dimension suggests that the food miles issue is likely to grow in importance as part of a package of concerns. There may also be commercial arguments for cultivating domestic sources of supply as a way of improving the resilience of the supply chain. However, the general thrust of international and national policy still points towards ever more globalised supply chains,

It is possible however, that things might change. A snowballing of concern by consumers about the climate-changing impact of major food companies might be one trigger. A more rapid onset of very damaging climate change effects is another. A terrorist or other threat to the global supply chain structure is a third. Far-sighted businesses will be keeping these possibilities in mind.

In the meantime however, we need to understand more clearly the relationship between sourcing decisions, transport and CO_2. We discuss these issues next.

270 See: www.cafedirect.co.uk/case_study/product.php

271 Dawson A, *Consumer Watch*, Institute of Grocery Distribution, Letchmore Heath, 2002

272 *Organic and the Political Agenda*, MORI, February 2001

Section six

Food, transport distance and life-cycle carbon emissions: Exploring the relationship

This section is the heart of the report. It examines three questions:

- First, what contribution do the transport stages of the food chain make to the UK's overall greenhouse gas emissions?
- Second, how do measures to shorten the supply chain affect the generation of greenhouse gas emissions elsewhere within the life-cycle of the product? If you cut mileage, might you, for instance, increase emissions from agricultural production?
- Third, what difference does the type of retail outlet make to overall greenhouse gas emissions?

Cooking and eating are also considered, but in rather less detail; we ask whether the highly processed foods we are increasingly eating are more or less carbon-intensive than the home-cooked foods that fewer of us now prepare.

Our discussion draws upon two separate research studies (see box opposite) which were commissioned as part of the *Wise Moves* project. The first study examined various sourcing and distribution options for Braeburn apples, cherries and iceberg lettuce. The second looked at cheddar cheese, white sliced bread and chicken (in whole carcass form).

We also base our analysis upon the findings of other relevant studies where these shed further light on the questions we raise. Except where stated, however, the conclusions we draw in this report are those of Transport 2000. Interested readers should refer to the original research reports for the original conclusions.

It is important to bear in mind that our commissioned research examined in total only six products and the additional studies cited add little more to this number. A large superstore can stock around 40,000 product lines, many of which, as processed foods, contain a complex mix of ingredients. Given these limitations, categorical conclusions about all foods in the supply chain cannot be drawn. However, we chose the products for study with some care, considering them to be representative of the types of food that people eat and of the different supply chains necessary to provide them. The box on the next page provides a more detailed rationale for our choices.

The *Wise Moves* commissioned studies

The first commissioned study was carried out by Francis, Simons and Partners Ltd, in association with East Anglia Food Links. Focusing on apples, cherries and lettuce, it mapped the route by which two supermarkets currently source and distribute these products to their stores in Norfolk. It then modelled ways in which the supermarkets could reduce transport emissions, not by altering the source of these products but by improving distributional efficiency – by sharing distribution facilities and by increasing the loading factor of vehicles. Next, it compared existing supermarket systems and consequent emissions with the supply chains of the Norfolk-based co-operative, East Anglia Food Links (EAFL). EAFL has a deliberate policy of sourcing from as close to home possible although it sources from overseas when nearer supplies are not available. Finally, the consultants modelled a hypothetical 'improved locally focused system,' building upon the EAFL model but with an emphasis on greater efficiency.

The research parameters were as follows:

- The study only quantified *transport*-related CO_2 emissions, although it discussed, in qualitative

terms, how changes in the journey distance might affect energy use elsewhere in the supply chain, such as from production, or refrigeration.

- The researchers focused on CO_2 emissions as these are the main gases responsible for the greenhouse effect and there is a fairly simple correlation between fuel use and CO_2 emissions.
- A 12-month perspective was adopted; this meant that even for the locally focused system there were periods when the produce had to be imported.
- The researchers were asked to compare equivalent varieties of product – Braeburns for apples and icebergs for lettuces. However, they encountered difficulties here as EAFL did not offer these products to customers. Following discussion with our project partners, a broader range of varieties was accepted.
- Backhauling was not considered.
- Customer shopping was not considered.
- We chose Norfolk as a location for this study because both the supermarkets and East Anglia Food Links have a presence there.

The brief for the second research study was slightly different. Here the consultants, EcoLogica Ltd, considered the supply chains of white bread, cheddar cheese and a chicken carcass. This time, the location of the study was the north-west of England, because the consultants were familiar with the region, and because our supermarket partners and the regional supermarket studied had stores there.

The consultants calculated emissions from distributing these foods from the manufacturer to a variety of retail outlets: two national chains, one regional supermarket, and seven local stores. The latter were either independent outlets or members of a symbol group, and were spread between Manchester, Lancaster and a rural area to the north of Lancaster (Silverdale). Next, the consultants calculated emissions generated from customers travelling to and from the shops by various different modes. Third, they compared emissions resulting from the distribution leg and the customer leg respectively with total 'embodied energy' emissions (the total energy used in the product's manufacture and in any associated transport). Since they were not able to secure case-specific information on these embodied emissions (as originally planned) they used generic data. Finally they explored the CO_2 differences which could result were the stores surveyed to source more locally. They based their calculations upon the hypothetical use of existing sources of supply within the region.

Our choice of products

All the products we chose can be grown or produced within the UK, some more easily than others. Some are very often produced indigenously (cheese, chicken), some are imported for part of the year (lettuce, apples) and others are almost always imported (cherries). Bread is always made within the UK but its constituent ingredient is sometimes imported.[273] As such, comparisons can be made between short and long supply chain variants. Those goods that are imported arrive by different modes (sea, air, road) and this provides another basis for comparison. All the foods we chose are common and regularly eaten, although cherries tend to be seen as a luxury. We tried to choose products from each of the main constituents of the average British diet – animal protein, dairy, fruit, vegetable, cereal. We decided to exclude processed foods and ready-meals, despite their growing presence in the British diet because, with the funds at our disposal, we did not feel able to do justice to what would undoubtedly be an extremely complex undertaking.

6.1 Life-cycle analysis: The context

As section one showed, all aspects of the supply chain generate environmental (and other) impacts. The significant elements include the agricultural process itself; the production of packaging; the manufacturing process; heating and/or refrigeration for storage; the construction of the infrastructure (plant equipment, buildings and so forth) which enable the product to be processed and stored (whether in a distribution centre or a shop); storage and cooking in the home; and waste disposal.

273 We did not however examine wheat transport in our analysis

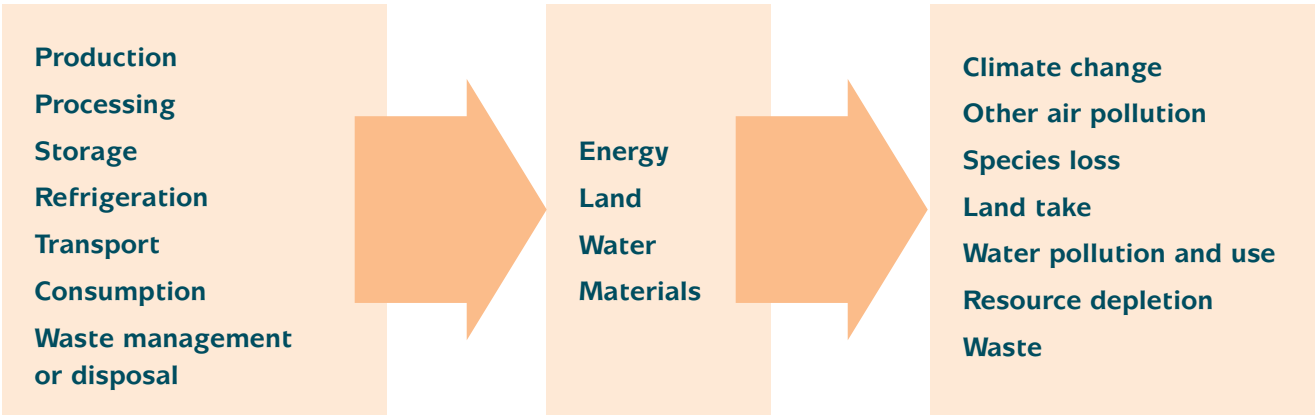


Figure 4

Defining the study boundaries

Almost all stages of the supply chain entail some form of transport. Sometimes the transport involved is obvious and considerable – trucking potatoes to a processing plant, for instance, or driving shopping home by car. Sometimes it is not. Consider, for instance, the mileage clocked up by the van of the plumber without whose services the processing plant would not be able to function. Should this be counted? Should each tiny pebble-induced wiggle in the UK's coastline be taken into account when determining its perimeter? Strictly speaking, yes, but the final calculation is not only likely to be infinite (do we get down to the atomic level?) but also not fantastically helpful for the purposes of, say, going for a walk. Most LCAs understandably draw a line before this point is reached.

There can be occasions when the accumulation of seemingly insignificant detail yields unexpected and potentially important results – a kind of chaos-inducing butterfly effect.[274] One non food-related life-cycle study[275] of an existing modern housing-estate home came to the striking conclusion that the minor building components – kitchen cabinets, roof trusses, glazing, finishes and so forth – accounted for around 25% of total transport energy and 43% of total embodied energy[276] of the house, even though they collectively made up only 2% of the total mass of the construction materials. Moreover, once refurbishments over the life-time of the house were included in the calculations these minor components (now constituting 7% of the total mass of the house) ended up accounting for just over half of total transport energy use. These surprising findings reflect the fact that these minor elements were shipped in from very far away and required many transport movements in their manufacture. A possible parallel might be drawn here between the mainstream commodities we eat and the relatively small but highly carbon-intensive number of foods we fly in by air.

The situation can become more complicated still depending upon what the analysis chooses to focus on. Many studies confine themselves to assessing climate change impacts alone, itself a complicated undertaking. Others look at other impacts instead, or as well, such as emissions to water or other forms of air pollution.

Evidently, then, life-cycle analysis is highly complex. The outcome will depend not only on the quality of the data but upon the boundaries that are set. Hence apparently similar studies can sometimes produce very different conclusions. In June 2003 the EC issued a *Communication on Integrated Product Policy* outlining its strategy for reducing the environmental impact of products, based on the life-cycle analysis approach. This may prove helpful in developing and systematising life-cycle methodologies.[277]

The studies commissioned by Transport 2000 are not full life-cycle analyses. These require large

274 Gleick J, *Chaos: making a new science,* Viking Penguin, 1987

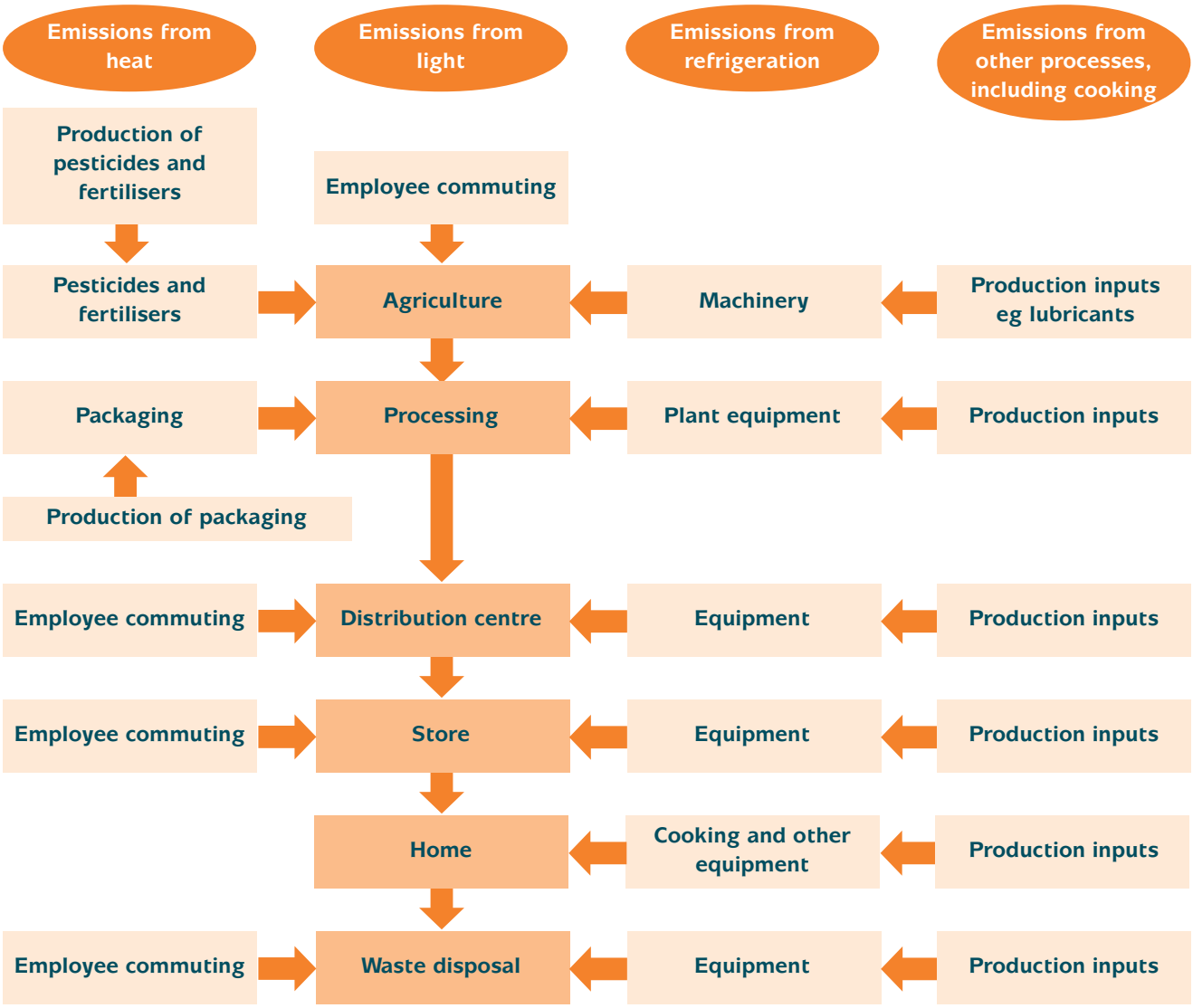
275 Critchley B, *Local Sourcing: a reappraisal of the environmental impact of building material transport,* thesis for MSc in Architecture: Advanced Energy and Environmental Studies, 1997/8 Session, University of East London, 1998

276 This includes transport energy

277 Communication from the Commission to the Council and the European Parliament – *Integrated Product Policy: building on environmental life-cycle thinking,* Commission of the European Communities, Brussels COM (2003) Final, June 2003

Figure 5 Principle sources of greenhouse gases in the food supply chain

Orange arrow indicates transport



amounts of time and money, neither of which were available. Instead, the studies focus mainly on calculating transport-generated supply chain CO_2 emissions. For non-transport impacts such as refrigeration they either (in the case of the second study) use generic, publicly available data, or else limit themselves (as in the case of the first study) to a qualitative discussion of the likely magnitude of different impacts. Even these apparently 'simple' analyses were in fact very difficult to perform, partly because of problems accessing data, and partly because the transport stages alone are full of variabilities and uncertainties.

With all these provisos in mind, then, we turn to the first question: how much of a contribution does transport make to total food-related greenhouse gas emissions?

6.2 Transport and its contribution to total life emissions

Many studies highlight the very great and growing distances that food now travels.[278,279] Fewer, however, examine the *relative* contribution that transport makes to total life-cycle emissions. Those that exist vary greatly in their conclusions,

278 Jones A, *Eating Oil: food supply in a changing climate*, Sustain and Elm Farm Research Centre, London, 2001; and *Food, Fuel and Freeways* (see below)

279 Pirog R, Van Pelt T, Enshayan K and Cook E, *Food, Fuel and Freeways: an Iowa perspective on how far food travels, fuel usage and greenhouse gas emissions*, Leopold Center for Sustainable Agriculture, Iowa State University, Iowa, United States, www.ag.iastate.edu/centers/leopold/pubinfo/papersspeeches/food_mil.pdf

with some suggesting transport's share to be very high whilst others arguing the opposite. Evidently the conclusions reached depend not just upon the life-cycle methodology adopted (see above) but on the nature of the product itself. Here we look at some of this research, before highlighting the findings of our own commissioned studies.

One US estimate puts transport's overall contribution to total food chain energy costs at around 11%.[279] The UK's Food and Drink Federation cites data collected by one manufacturer who estimates that the CO_2 impacts of sourcing raw materials and distributing products make up around 5% of his food chain CO_2 emissions.[280] It is, however, unclear whether this estimate included non-UK sources.

Using Department for Transport data, we calculate that food distribution accounts for around 2.5% of the *totality of the UK's CO_2 emissions*.[281]

Our calculations were as follows:

- Road transport of all kinds accounts for 24% of the UK's CO_2 emissions.[282]
- Of this freight accounts for 35% of road vehicle CO_2 emissions.[283]
- It therefore accounts for 35% of 24% = approx. 8.4% of total CO_2 emissions.
- Food makes up 28% of total freight tonne-kilometres.[284]
- Therefore food transport is responsible for 28% of 8.4% = approx. **2.5%** of total UK CO_2 emissions.

This figure is, of course, an approximation. On the one hand it excludes emissions generated by vehicle refrigeration units; including these would produce a higher figure. On the other hand the calculation assumes that the food sector employs the same mix of vehicle classes and achieves similar vehicle load factors to the road freight sector as a whole. As we have discussed, the food industry appears to perform rather better than the average for the freight sector as a whole, and this greater efficiency is likely to bring the figure down again.

To the logistics leg we might add the passenger travel to and from shops:

- Transport of all kinds accounts for 24% of the UK's CO_2 emissions.[285]
- Of this car, van and taxi movements account for 60% of transport-related CO_2 emissions.[286]
- They therefore account for 60% of 24 = 14.4% of total CO_2 emissions.
- Car-based food shopping accounts for 5% of total car, van and taxi mileage.[287]
- Car-based food shopping therefore accounts for 5% of 14.4 = **0.72%** of total CO_2 emissions.[288]

We need also to include the transport involved in disposing of consumer food waste and associated packaging. The calculations given here do not include waste produced during the manufacturing process since such data is not available. This, if included would probably increase the final figure fairly considerably.

- Food waste and packaging accounts for 0.16% of total freight tonne-kilometres.[289]

280 *World Summit on Sustainable Development 2002*, contribution by the UK food and drink manufacturing industry, Food and Drink Federation, London, 2002

281 This does not include the customer leg

282 *Transport Statistics Great Britain (2002 Edition)*, Department for Transport, London, 2002

283 *Focus on Freight*, Department for Transport, London, 2003

284 *Transport of Goods by Road in Great Britain 2001*, Department for Transport, Local Government and the Regions, London, 2001

285 *Transport Statistics Great Britain 2002 Edition*, Department for Transport, London, 2002

286 This is an estimate based on the figure for freight transport given earlier. The assumption is made that if freight accounts for 35% of all road transport emissions and an estimated 5% is deducted for buses from the remaining 65%, then the remainder, 60%, is emitted by cars, vans and taxis

287 *National Travel Survey 1999/2001*, Department for Transport

288 The actual figure may be greater as much of the driving will take place on congested roads; this is more fuel-intensive than driving on open roads

289 In 2001, 31 million tonnes of household waste were removed for disposal, accounting for 720 million tonne-kilometres. Nearly 17% of this was made up of kitchen waste – in other words, food. Packaging of one kind or another makes up around a quarter of household waste. Nearly 70% of this is food packaging related – in other words 17.5% of household waste. In all, then, 34.5% of household waste is associated with the food supply chain. See calculations in discussion of waste in section two for more information

- Freight accounts for a fifth of transport-related tonne-kilometres;
- Therefore domestic food waste transport is responsible for **0.03%** of the UK's greenhouse gas emissions.

In all then, transport associated with the food supply chain accounts for nearly **3.5%** of the UK's greenhouse gas emissions. This, as we have highlighted elsewhere, is an underestimate, partly because it does not include manufacturing-stage food waste disposal but largely because it does not take into account the emissions generated while bringing foods into the UK. From our commissioned research into the supply chain of apples, it appears that the overseas leg of the journey creates almost three times as much CO_2 as the domestic journey.[290]

To confuse the matter further, in order to gauge transport's *relative* contribution to total UK-caused emissions it would be necessary not only to include transport emissions from overseas-sourced food, but also to compare these with other supply chain emissions (from agriculture or food processing) generated overseas. We would also need to compare the food sector as a whole with the relative impact of other industrial and domestic sectors, such as steel imports for the construction industry or indeed passenger air travel.

The study we commissioned into bread, lettuce and chicken found that, at roughly 1%, the distribution stage made only a small contribution to these foods' overall emissions. The 'embodied energy' of the product, calculated using generic data, was several orders of magnitude greater. However, this study defined distribution as movements from the manufacturer through to the retail outlet. It did *not* include in its definition the transport movements that took place during the manufacturing process, for instance in sourcing and assembling the raw ingredients. These were included instead in the category 'embodied energy.' If the embodied energy figure were disaggregated into its component parts, various additional transport emissions would emerge and hence transport's contribution would reveal itself to be higher.

One Swedish researcher looked at the separate elements contributing to energy use in the life-cycles of tomatoes and carrots, originating from various countries and consumed by Swedish customers. The study focused on four key areas: the production of fertilisers, the agricultural process itself, storage and transport. For indigenously grown (Swedish) carrots and tomatoes as well as those imported to Sweden from other countries including Italy, Germany, the Netherlands, Denmark and the UK, she calculated the energy consumed and the emissions produced.[291]

The researcher, Carlsson, found that the relative importance of transport compared with other life-cycle stages varied both by product and by its country of origin. With carrots, transport accounted for 21 to 43% of total emissions. Storage was more significant at 37–53%, while farm production contributed 14–28% and the production and transport of fertilisers, 4–10%.

For tomatoes, the figures were quite different. Carlsson looked at two cropping systems – high-input (intensive protected cropping prevalent in Denmark, Sweden and the Netherlands) and low-input systems (practised in Spain and 'other countries').

She found that the farm production process accounted for 94–96% of total emissions generated during the life-cycle of tomatoes in intensive cropping systems but only 28% for low-intensive cropping ones (a figure comparable to carrots, which are also not intensively produced). Transport's contribution to total life-cycle impacts was around 1–4% for highly intensive systems, compared with 39% for low-intensive ones (Spain and 'other countries'). These figures reflect the fact that the total quantity of emissions produced by the highly intensive system was, in absolute terms, very much greater than that of the low-intensive systems. Since most of these emissions were generated during the production process, transport's contribution was, in relative (although not necessarily in absolute terms, as we discuss below) not so significant. Similarly, storage

290 As we have discussed, some of these emissions will be included in other nation's greenhouse gas inventories but the point here is to calculate the transport's relative contribution to the life-cycle emissions of UK-destined products.

291 Carlsson A, *Greenhouse Gas Emissions in the Life-Cycle of Carrots and Tomatoes: methods, data and results from a study of the types and amounts of carrots and tomatoes consumed in Sweden,* IMES/EESS Report No. 24, Department of Environmental and Energy Systems Studies, Lund University, Sweden, March 1997

accounted for only 2% of emissions for highly intensive systems but 8% for low-intensive ones. Fertiliser emissions, by contrast, contributed greatly (24%) in highly intensive systems but only slightly 1% in low-intensive ones.

Tomatoes and carrots are fresh products. For processed foods life-cycle analysis yields a different set of results. Another analysis (also Swedish), found that in the case of tomato ketchup, transport accounted for only 2.4% of total energy use. While 2.4% is low, it is nevertheless 2.4% of rather a lot; the packaging and processing involved makes tomato ketchup a highly energy-intensive product. Hence total energy requirements per kilogram of ketchup amount to around 39 megajoules. By contrast the total energy used in the life-cycle of a kilogram of the fresh Spanish tomatoes[292] in the previous study (for which transport-kilometres represented a *relatively* more significant energy impact) consumed only five megajoules of energy.

Of course, tomato ketchup and fresh tomatoes are used in very different ways; one does not eat a kilogram of ketchup in one sitting, whereas a family of four could easily eat a kilogram of fresh tomatoes. A really thorough life-cycle analysis might have to look at the relative contribution each food made to meeting our dietary needs expressed in terms of carbon emissions per nutritionally recommended portion.

It is worth noting that the study also assumed that once opened, the ketchup would be stored in the refrigerator, in line with the manufacturer's recommendations, and concluded that this constituted a major energy impact. Given that many people, the writer included, do not store their ketchup in the fridge (with no subsequent ill effects, one might add), and that this energy impact can therefore more or less be discounted, this revises the overall energy figure downwards and as a result, increases transport's relative share. There may indeed be a case for manufacturers to consider changing their storage instructions for some foods, a simple measure which can yield results and which has a precedent. One study by Marks & Spencer into the life-cycle of men's underpants (!) found that the most effective way of reducing CO_2 emissions was to switch from recommending a 50°C to a 40°C wash temperature.

One Australian life-cycle analysis of wheat starch concluded that transport accounted for about 18% of the total CO_2 equivalent emissions.[293] Of course, Australia is more than 30 times larger than our tiny islands and it is quite possible that transport's share reflects these longer journey distances – but it shows, yet again, the variability of findings. It is also important to bear in mind the example given above of the contribution that minor building components make to the total energy use of a house. It is quite conceivable that for food too, seemingly minor ingredients such as wheat starch (which can often be ignored) would, if included, end up increasing not just the product's *total* life-cycle energy costs quite considerably, but also transport's *share* of these total energy costs. This is because, as in the case of wheat starch, transport is a relatively substantial contributor to its life-cycle energy use.

These, and in particular the 2.5% logistics figure quoted earlier, do not sound like a great deal when compared with the 22% that one study estimates the food system[294] contributes to the UK's greenhouse gas emissions as a whole. Surely there are other more significant life-cycle areas to worry about than transport? One could argue that attention might more usefully be paid to other impacts.

Not necessarily. It is of course essential to look at other areas too but this does not mean that transport is insignificant. For a start, that estimated 22% can itself be broken down into smaller percentages. The energy attributed to food processing, for instance, can itself be broken up into lots of little two per cents (say 2% for washing, 2% for chopping, 1% for frying the onions, and so forth), all of which could be deemed essential if the product is to reach our tables in the way we expect it to. In other words, if we are not careful, figures tend to disaggregate into atomic essentials.

292 As the ketchup tomatoes were from 'Mediterranean' countries, the comparison stands

293 Narayanaswamy V, Altham J, Van Berkel R and McGregor M, *A Primer on Environmental Life-Cycle Assessment (LCA) for Australian Grains,* Grains Research & Development Corporation and Curtin University of Technology, Northam, Western Australia, September 2002

294 *Achieving the UK's Climate Change Commitments: the efficiency of the food cycle,* e3 Consulting, Holly Farm, Dyke, Bourne, Lincolnshire, 2002

Second, the distance travelled by food is growing as cost-saving efficiencies within the system (such as cheap labour in Thailand or Brazil) drive costs down, enabling the extra transport cost to be absorbed within the system as a whole. This extends to air-freighting which, while expensive, makes sense for the retailer as more and more people are willing and able to pay for premium food. Consequently we may see transport's share of total emissions growing. Our food supply chain involves more transport than any other country in Europe and the signs are that where we 'lead', the rest of Europe is likely to follow. Even those twin shrines to gastronomy, Italy and France, are now starting to embrace the convenience food culture.[295]

Third, transport mileage is itself a good indicator, or benchmark, of high energy use elsewhere. Food miles (as section two showed) have increased in line with growth in consumption of processed food. Processed food contains a very high embodied energy, not just because of the transport required in the assembly of the component ingredients but also because of packaging, heating and refrigeration. And there appears to be a correlation between growth in one area and growth in another. Food needs to be packaged more because it travels more. Food needs to be refrigerated more because it travels more. And so forth. Action to reduce food miles can be seen as compatible with other attempts to reduce the CO_2 intensiveness of our food.

This discussion leads on to the second question: what happens to overall supply chain emissions if you take steps to reduce transport? What are the trade-offs?

6.3 Is shorter better? What are the trade-offs?

The studies we commissioned into lettuce, apples, cherries, cheese, chicken and bread concluded that on the whole, and with qualifications, a reduction in transport distance could yield substantial transport-related CO_2 savings. In particular, sourcing from within the UK instead of overseas can considerably reduce CO_2 emissions from transport. For equivalent products, such as British and Spanish lettuces, the UK-sourced versions always generated fewer transport-related emissions than the overseas-sourced ones.

The estimated transport-related CO_2 emission reductions for the products studied were as follows:

- Cherries: Around 25% if Southern European cherries substituted for some of the US imports (which are in season at the same time as their European counterparts)[296] and 35% if the UK also expanded its production.
- Chicken (from point of manufacture): Up to 90% but typically between 40–70%.[297]
- Cheese (from point of manufacture): Over 60% savings and up to 92%.
- Apples: Up to 45% (averaged over a year and including summer imports).
- Lettuce and bread: No reduction was identified, for reasons we discuss below.

These assessments take into account the need to a provide a year-round supply of these foods (with the exception of cherries which are in any case not available even in supermarkets all year) and they seek as far as possible to compare like varieties with like. This was not always possible; Braeburns, one of the UK's best-selling apples are not grown to any great extent in the UK and hence alternative, less popular varieties would have to be offered instead. They also allow for the fact that more local systems are likely to use smaller vehicles which, in terms of tonnes carried per kilometre travelled, use more fuel and hence pollute more than large goods vehicles.

However these studies were not able to calculate what effect the reduction in journey distance would have on other supply chain emissions. The downside of cutting transport distance includes the possibility that the nearer manufacturing plant – the dairy, bakery or abattoir, for example – could be less energy efficient, consuming larger quantities of electricity and gas to produce the same amount of product as compared with the

295 *The European Ready Meals Market,* Leatherhead Food International, Surrey, June 2001

296 Mason R, Simons D, Peckham C and Wakeman T, *Wise Moves Modelling Report,* commissioned by the *Wise Moves* project, Transport 2000, June 2002

297 These take the manufactured product as their starting point

more distant, larger scale plant (unless of course the nearby manufacturer happens to be large and efficient). Alternatively, the local agricultural process may be highly energy-intensive; compare UK protected lettuce production versus field-based continental systems. It may also be the case that the opposite is true; many studies suggest that small-scale agriculture is more productive (in terms of outputs per land area and other inputs) than larger scale farming, both in developed and developing world contexts.[298] On the whole, however, there is a general presumption that economies of scale lead to greater efficiencies than their smaller counterparts. What is clear is that a comparative analysis needs to be undertaken.

While this lack of full life-cycle analysis is undoubtedly a limitation, we nevertheless feel that the commissioned studies have helped move the discussion forward.

Cherries

For cherries, the consultants highlighted possible trade-offs between transport and refrigeration. Cherries have a short shelf life and need to be temperature controlled. Air-freighted cherries are not refrigerated during the flight, although they are in the lorry journeys at each end. Road-hauled cherries from Turkey are refrigerated for five days. Either way, refrigeration is a relatively less important factor for cherries than for apples, because of their short life span.

Whatever the environmental balance between trucked Turkish and air-freighted American cherries, the CO_2 impact of both of these supply chains is very high. The consultants concluded that moves to source cherries more from Southern Europe[299] would help reduce emissions. However, industry opinion has it[300] that European cherries tend to be of lower quality than Turkish or US ones. However Italian growers contacted by the consultants felt that quality was less influential a factor than the lower cost of Turkish labour. It would be possible for European countries to improve the quality of their offerings and become more competitive, but growers have invested in other fruit, such as peaches and nectarines, and are unwilling to change.[301] European growers would need to invest significantly in improving harvesting and in infrastructure such as packhouses. A simple switch by European growers to cherries, from peaches and nectarines, might also mean that UK buyers would need to go elsewhere – possibly further afield – to meet demand for these fruit.

Chicken and cheese

With chicken, the comparisons were between mainstream chicken producers, all British (except for one Irish producer), and so the trade-offs were likely to be less pronounced. This was also true for cheese, as the local creamery studied was fairly large in scale. The study did not trace the constituent ingredients (such as milk for the cheese or chicken feed for the chickens) back to their sources but offered the opinion that the different suppliers probably used similar types of supply for these constituent ingredients – in other words, supplies that were nationally sourced and distributed. As such the average distances travelled for the constituent ingredients would be similar for all producers.

Lettuce

For lettuce, the consultants[302] felt that attempts to extend the UK growing season would, because of its dependence on heated glasshouses, be counterproductive, leading to greater overall supply chain emissions. They did however raise the possibility that hardier alternatives to iceberg lettuces could be grown – lambs lettuce or sorrel, for instance – although again there could be trade-offs associated with the need to pick and wash such fiddly little leaves. They also highlighted examples of growers in the UK and Ireland who are using wind and/or solar power to heat, ventilate and irrigate their greenhouses and polytunnels.

298 Rosset P M, *The Multiple Functions and Benefits of Small Farm Agriculture,* Policy Brief 4, Food First, Oakland, California, September 1999, www.foodfirst.org/pubs/policybs/pb4.html

299 Or even building up UK production – although this is a very temperamental crop

300 Maxwell S, WorldWide Fruit, personal communication, 2002

301 Mason R, Peckham C, Simons D and Wakeman T, *Wise Moves Modelling Report,* commissioned by the *Wise Moves* project, Transport 2000, June 2002

302 Mason R, Peckham C, Simons D and Wakeman T, *Wise Moves Modelling Report,* commissioned by the *Wise Moves* project, Transport 2000, June 2002

Bread

Bread is sourced fairly locally by all retailers and the consultants felt that there was little room for localising further.[303] A full life-cycle analysis which took into account attempts to localise the source of the main ingredient, flour, would be an important exercise but since the necessary time and money was not available, we confine ourselves here to a general discussion. Currently, 83% of the wheat flour used in the UK is indigenously produced – a significant increase over the situation 15 years ago when the proportion was only 62%.[304] Since most of this flour (over 60%) is used for bread-making, the chances are that a standard loaf will use a high percentage of British flour. This said, the proportion is likely to be less than 83% since bread-making requires the use of flour with a high gluten content and North American wheat is particularly suitable for this. The exact proportion will vary from company to company but one of the bread brands which the consultants looked at (Warburtons) mainly uses Canadian flour.[305] Hovis bread, however, is made mostly from UK flour.[306] With bread the customer's potential contribution to total CO_2 costs is also very significant, as we discuss later in this section.

Apples

With apples the picture is somewhat complex. Apples are indigenous to the UK and a year round (or most of the year round) supply would be possible if a broader mix of varieties were used, and stored. As we discussed in section four, this may not sit readily with what consumers apparently want to eat – ideally the big, round, sweet apples which tend to be grown elsewhere. As regards the environmental impacts, the expansion of UK apple production raises the possibility of several trade-offs. The UK's climate is harsher than that of, say, France and so more UK apples are spoiled through frost and disease.[307,308] This, however, may be offset by the possibility that some overseas apples are spoiled during transit and will be wasted.

When it comes to imported apples, the mode of transport makes a big difference to the carbon count. The environmental impact of transport from New Zealand by sea is not dissimilar to that of transport from southern Europe by road, even though the distance involved is far greater.

Storage considerations add to the complexity. Once picked, apples are stored in a controlled atmosphere at 2°C throughout the supply chain. New Zealand apples can only be stored in the UK for three months (because of a UK government levy which is imposed on New Zealand apples) while British and European apples can be stored for longer. As a result New Zealand fruit appears to generate lower refrigeration emissions. But this is not a complete answer, for several reasons. For a start, refrigeration emissions during the sea crossing from New Zealand will be relatively greater than those emitted from land-based cold storage systems. Second, for the time when New Zealand apples are not available, apples from somewhere else will be eaten instead, and these too will have been refrigerated. As a result, the overall refrigeration requirements do not go down just because for some months of the year New Zealand apples will be eaten.

The storage issue also raises the possibility that the benefits (in terms of reduced transport) of stepping up UK apple production and storing them to extend the UK apple season, need to be balanced against any increases in emissions that may result. But in fact indigenous and imported varieties are stored for similar lengths of time – up to six months – and will produce similar quantities of emissions. Indeed emissions may be marginally greater for imports since they will have spent some time in less efficient mobile refrigeration units.

303 Ecologica, *Wise Moves Modelling Report: sourcing and distribution options for bread, and chicken,* report commissioned by the *Wise Moves* project, Transport 2000, June 2003

304 *The UK Flour Milling Industry,* National Association of British & Irish Millers, London, 2003 www.nabim.org.uk/images/pdf/facts.pdf This increase is thanks largely to the breeding of higher gluten varieties, together with innovations in bread baking techniques and technologies

305 Warburtons website: www.warburtons.co.uk/about_warburtons/faqs/index.html

306 Rank Hovis, personal communication, September 2003

307 Maxwell S, WorldWide Fruit, personal communication, 2002

308 This is not true of all crops – some do very well indeed in the UK climate

There have been other studies of apples and their supply chains. Jones[309] takes a life-cycle approach, examining the supply chains of apples originating from four sources: imported (from New Zealand), sourced nationally, sourced locally (within 40km) and home-grown (at the bottom of the garden), and distributed variously to a supermarket, an independent grocer, a street market and through a home box scheme in two areas of the UK: Denbigh[310] and Brixton in south London. At both locations Jones considered all possible sourcing / retailing combinations and for all of these calculated the carbon emissions that were generated during the apples' life, including agricultural production, storage and transport.

Jones also uses a range of representative values (taking into account possible variations in type of vehicle, distance and load), and presents minimum, average and maximum energy values for each transport leg. He assumes that a local or regional supply of apples could be provided for most but not all of the year and that traditional, rather than modern, storage techniques would be used. He does not discuss how much waste might result from these storage techniques, nor does he examine issues relating to consumer taste and demand.

Jones found that locally sourced apples are responsible for 87% fewer CO_2 emissions than imported apples purchased at a supermarket in Brixton (285g CO_2/kg apples). And buying apples through a home delivery box scheme instead of from a supermarket in Denbigh results in a 96% reduction in CO_2 emissions.

He also found there to be a direct relationship between the distance apples travel and other life-cycle impacts, such as emissions from refrigeration. The further the apples travel, the longer they spend in refrigerated storage. He does however point out that this is not necessarily the case for UK production systems which require irrigation or protection. In these instances, the energy consumption of cultivation increases and the production stage becomes more significant.

309 Jones J A, *The Environmental Impacts of Distributing Consumer Goods: a case study on dessert apples.* PhD Thesis (unpublished), Centre for Environmental Strategy, University of Surrey, Guildford, Surrey, 1999

310 A small town in a rural area of North Wales

311 *Heatwave's Warning for Future of Farming*, *New Scientist,* 20 August 2003, www.newscientist.com/news/news.jsp?id=ns99994072

Lessons from other research: Carrots and tomatoes

The Swedish study into carrots and tomatoes discussed above addresses just this issue. For carrots, it appears that the closer to home (Sweden) they are sourced, the fewer overall emissions they produce, as Table 4 shows.

There is considerable variation according to the country of origin. For Italian imports to Sweden, transport emissions are greater than storage emissions. The opposite is true for indigenous carrots. At some distance between the Netherlands and Italy lies a critical point beyond which emissions from transport outweigh in significance emissions from other sources, suggesting there may be an optimal radius within which suppliers could source. Importantly, there also appears to be a correlation between transport mileage and storage impacts. The further the carrots travel the more energy is also spent storing them. There is less variability for other areas of the life-cycle.

Meanwhile, an increase in indigenous tomato production would create CO_2 emissions – revealing how difficult it is to make generalisations across food categories. A domestically grown Swedish tomato emits nearly twice the quantity of CO_2 of its Spanish counterpart. This suggests that the Swedes may be better off importing tomatoes. With our milder climate the conclusion for the UK may not be so clear cut.

However, even when a current strategy of importing horticultural produce may make immediate sense, in the long term it might not, both commercially and environmentally speaking. Southern European horticulture is increasingly facing the prospect of serious water shortages, partly because of the changes in global climate.[311] This in time could lead to a decline in Southern Europe's horticulture industry and will require British retailers to seek other sources of supply, which may be more distant still, thus entailing additional transport. Alternatively the Southern European industry may put in place remedies, such as artificial irrigation systems, which are themselves either energy intensive or which exacerbate in other ways the effects of climate change.

Moreover, just because Spanish tomatoes are less carbon-intensive than (for Sweden) indigenously grown ones it does not follow that the amount of

Emissions in CO_2 equivalents for carrots and tomatoes

Table 4 Carrots

Country of origin	Source of emissions	Emissions expressed in g CO_2 equivalents – 20 year perspective A*	B*
Denmark	***Transport***	***22***	***85***
	Storage	46	180
	Farm production	30	110
	Production of fertilisers	8.1	31
Denmark total		**110**	**400**
Netherlands	***Transport***	***42***	***150***
	Storage	67	240
	Farm production	23	80
	Production of fertilisers	4.8	17
Netherlands total		**136**	**482**
Germany	***Transport***	***3.5***	***120***
	Storage	7	240
	Farm production	2.6	90
	Production of fertilisers	0.77	26
Germany total		**14**	**475**
Great Britain	***Transport***	***2.1***	***100***
	Storage	4.9	250
	Farm production	1.7	89
	Production of fertilisers	0.52	27
Great Britain total		**9**	**477**
Italy	***Transport***	***39***	***270***
	Storage	36	240
	Farm production	13	87
	Production of fertilisers	3.9	27
Italy total		**92**	**626**
Sweden	***Transport***	***420***	***70***
	Storage	630	100
	Farm production	480	79
	Production of fertilisers	170	28
Sweden total		**1700**	**280**
'Other countries'	***Transport***	***11***	***270***
	Storage	12	300
	Farm production	6.5	150
	Production of fertilisers	1.4	35
'Other countries' Total		**31**	**760**
Total per capita/average per kg		**2100**	**310**

Table 5 Tomatoes

Country of origin	Source of emissions	Emissions expressed in g CO_2 equivalents – 20 year perspective A*	B*
Denmark	***Transport***	***35***	***78***
	Storage	38	84
	Farm production	2400	5100
	Production of fertilisers	21	48
Denmark total		**2500**	**5600**
Netherlands	***Transport***	***410***	***150***
	Storage	160	71
	Farm production	10,000	3600
	Production of fertilisers	59	22
Netherlands total		**11,000**	**4100**
Spain	***Transport***	***660***	***300***
	Storage	140	67
	Farm production	470	230
	Production of fertilisers	410	200
Spain total		**1700**	**810**
Sweden	***Transport***	***120***	***68***
	Storage	66	38
	Farm production	7000	3800
	Production of fertilisers	82	47
Sweden total		**7200**	**4200**
'Other countries'	***Transport***	***66***	***240***
	Storage	170	640
	Farm production	68	260
	Production of fertilisers	55	210
'Other countries' total		**360**	**1400**
Total per capita/average per kg		**23,000**	**3100**

* Column A shows the g CO_2 equivalent for the total quantity of each product the average person eats a year from each country source.

* Column B shows the g CO_2 equivalent emitted per kilogram of product from each country source.

carbon they emit is acceptable. Instead of importing tomatoes it might, for Swedish consumers, be better still to eat something else with a lower carbon footprint but which approximates in terms of taste (sour-sweet), function (sandwich filler or salad ingredient, for instance) and nutrition. Beetroot might be one possibility here or indigenously produced Swedish carrots, which emit a third less carbon equivalent per kilogram than Spanish tomatoes.

We note, furthermore, that just because the *share* of an impact is low it does not mean that in absolute terms those impacts are slight. For instance, although the production of Dutch tomatoes (in heated glasshouses) accounts for the largest share of the CO_2 they emit, transport emissions are still a fairly hefty 150g of CO_2 per kilogram. Even indigenously grown Swedish tomatoes produce 68g CO_2 per kilogram during the transport stage – equivalent to a quarter of the 300g emitted in transporting Spanish tomatoes. From a policy-making perspective, therefore, one might conclude that although the main focus of any energy reduction work should be on the agricultural stage, impacts elsewhere should not be ignored.

Other variables to consider

From a policy perspective it is also important to consider the total quantities eaten of each food from each source. Going back to the carrots, it is clear that while Italian carrots are far more energy-intensive than indigenously grown Swedish ones, the overall impact of the Swedish carrot industry is, in absolute terms, greater since Swedish people eat more Swedish carrots than they do Italian ones. While a small number of foods may produce disproportionate quantities of CO_2, our 'bread and butter' foods, which are more likely to be grown indigenously, contribute to a large part of the emissions. We might thus need to consider not just how to persuade people to eat fewer energy-intensive imports but also what measures would help reduce emissions from mainstream foods.

It is also important to consider the 'solvability' of a certain impact. At present the UK's specialist glasshouse horticulture sector is the highest agricultural energy user, with energy accounting for around 55% of its variable costs.[312] However, while this translates into a great deal of CO_2, there is also significant scope within the sector for the application of cleaner and renewable energy technologies. Indeed, we are already seeing small-scale adoption of renewable and combined heat and power (CHP) systems in the horticulture industry. British Sugar, for example, makes use of waste heat, electricity and CO_2 from the sugar production process to grow tomatoes. Waste water (used for washing the sugar beet) irrigates the tomato plants.[313]

It is at present easier to apply renewable technologies to stationary infrastructure such as greenhouses than it is to vehicles. And where these technologies are applied, production related emissions will decline. This may alter the carbon balance between indigenous and imported produce. Field-grown Mediterranean systems may still remain less energy-intensive than the renewables or CHP-based British systems. However, the combination of reduced production emissions and the shorter transport journeys which indigenous production systems entail may lead to lower overall CO_2 emissions from indigenous produce than their imported counterparts. Instead of a trade-off between transport and horticultural production, a carbon-reducing synergy is thus achieved. Of course, all will depend on the effectiveness of these cleaner technologies and the extent to which they are applied within the horticultural sector.

Finally, there is the question of organic production to consider when balancing life-cycle impacts. The foods sourced by East Anglia Food Links are for the most part organic. Studies suggest that organic systems use between 30–50% less energy[314] than their conventional counterparts per unit of output.[315,316] This can

312 *Climate Change UK Programme,* Department for the Environment, Transport and Rural Affairs, 2000

313 Personal communication, British Sugar, 2002, and *British Sugar and the Environment* www.britishsugar.co.uk/bsweb/bsgroup/environ.htm#Horticulture

314 This results from a lower use of direct inputs, such as farm machinery and of indirect ones, such as fertilisers and pesticides

315 *Energy Use in Organic Farming Systems,* ADAS Consulting for MAFF, Project OFO182, Department for the Environment, Food and Rural Affairs, London, 2001

316 *Harmonisation of Life-Cycle Assessment for Agriculture,* Final Report, *Concerted Action* AIR3-CT94-2028, European Commission, DGVI Agriculture, Brussels, 1997

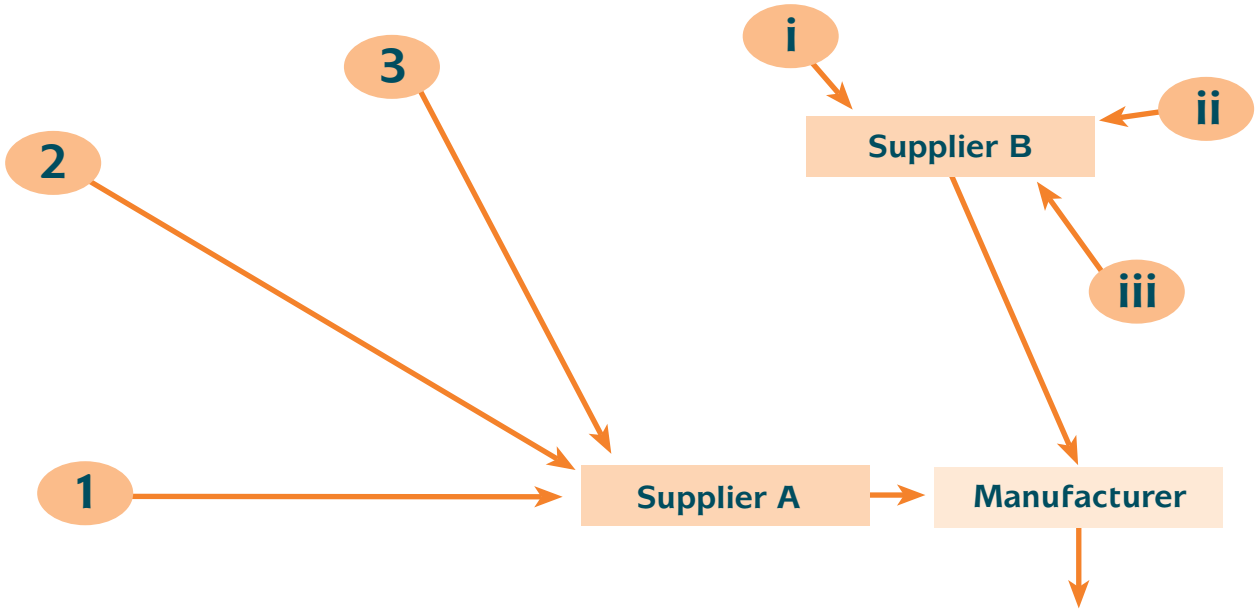


Figure 6

affect the balance between imports and indigenously produced food, depending on which is the organic system. The significance of this reduction will of course depend on the relative contribution that the actual growing process makes to total life-cycle carbon costs. The greenhouse gases produced by air-freighting organic produce will far outweigh the savings achieved, but when it comes to trucked produce the figures are likely to be more finely balanced.

So far we have explored whether efforts to shorten the supply chain might lead to increases in *non-transport*-related CO_2 emissions. However there is also the possibility that a shorter supply chain could in fact lead to an overall increase in *transport*-related emissions. This could come about if the 'local' supplier sources the primary raw ingredients from far away, while the ostensibly non-local supplier sources the primary raw ingredients from close to the place of manufacturing. Figure 6 illustrates this confusing possibility, with supplier B, the more distant supplier, being the most energy-efficient choice.

This is absolutely possible and it undoubtedly does occur, highlighting the importance of taking into account the source of the inputs to the end food product, something we were not able to do with our research.

This said, a three-year survey by the Foundation for Local Food Initiatives found that significantly more local food enterprises use local suppliers[317] than non-local enterprises – 75% compared with 50%.[318] They are also more likely to use local breeds and varieties, (18% compared with 10%), be involved in waste reduction (29% compared with less than half this figure) and either farm organically or be involved in some form of land management scheme. Again, this is a case of synergies rather than trade-offs between shorter supply chains and a reduction in environmental impacts elsewhere.

Of course these are small enterprises who are in a sense deliberately pioneering new ways of doing things for reasons which sometimes go beyond commercial incentives. There is nothing which dictates that a small or local business will be more environmentally aware. Nevertheless it may be that for small retailers, who are more interconnected with the local business community, it is in their commercial interest to source from nearer to home.

In addition to the possibility just described, it may also be that more locally focused systems still generate more transport emissions than more mainstream counterparts because they make use of smaller, less efficient vehicles. Heavy goods

317 In this case they do not define what they mean by local

318 *Flair Report 2003, Food and Agriculture Information Resource,* Foundation for Local Food Initiatives, Bristol, March 2003

vehicles are between five and eight times more efficient than vans per tonne carried.[319] We discuss this next, in the light of the third question: are local stores more or less transport intensive?

6.4 Local shops: How transport intensive are they?

The study into apples, cherries, and lettuces found that, for apples and cherries, the supply chain of the co-operative EAFL produced fewer transport emissions than those of the supermarkets. This was because for apples EAFL sourced from within the UK far more, and for more of the year, than the supermarkets. For cherries, EAFL sourced from Europe rather than, in the case of the multiples, from the US or Turkey. In addition, EAFL offered cherries to its customers only for a short season.

For lettuces however, the supermarket supply chains produced fewer transport emissions than EAFL's. This remained the case even when hypothetical improvements to the latter were modelled. There were various reasons for this, some logistical and others to do with trading relationships. For a start, EAFL's Italian supplier is further away than the supermarket's Spanish suppliers. EAFL sources from this supplier because it shares EAFL's commitment to the principles of co-operation and organic production. It is, however, looking to make links with a French co-operative which, if successful could reduce the distance greatly.[320]

Another reason for EAFL's higher emissions was because the route within the UK, both for imported and indigenous lettuce, was more circuitous and less efficient.

A third reason was because EAFL's local (as opposed to imported) lettuce supplies are carried in relatively small and therefore less efficient (per tonne-kilometre) vehicles. This said, the far shorter local distances entailed will have compensated for this to some degree, so it is really the first two factors which are the most significant.

The second study that the *Wise Moves* commissioned, into cheese, chicken and bread, looked at the differences between local shops and supermarkets, examining both their distribution systems and the way customers travel to buy their food. For this second study it should be emphasised that by 'distribution systems' the consultants mean the distribution of the retailer's best-selling product line from the manufacturer to each of the shops. Some of those goods were locally produced, while others were not. While some of the local shops studied source certain products directly from the manufacturer, often they do not, buying in from an intermediary wholesaler instead. This wholesaler may operate depots around the country.

Furthermore, the consultants do not assess the transport emissions from the inputs to the manufacturing process – the transport of milk for the cheese or of feed for the cows. Nor, when modelling more local sourcing options, do they model what CO_2 differences might result from localising the inputs (milk, feed for cows). What they examined was different sources of the finished cheese and the CO_2 emissions associated with transporting those finished cheeses to different types of store and then on to the customer's home. Finally, the consultants looked at only one of each of the multiples' stores. As such they did not consider what effect an alteration in the store's distribution strategy might have on the logistical arrangements of the other stores in the region that are served by the same RDC or RDCs. This is an important point and one which a future study should address.

Notwithstanding these limitations, their research revealed very interesting results, which varied widely both by product and by type of retailer. Generally speaking the smaller shops perform less well on greenhouse gas emissions when compared to the larger supermarkets, measured in terms of mass of CO_2 per mass of product. This is largely because smaller shops use smaller, less efficient delivery vehicles than the supermarkets and have less well integrated supply chains. Hence, when the consultants ranked each of the shops by CO_2 (for the logistics leg from manufacturer to store) a local shop ranked worst on each list. There was however considerable variability among the seven local stores, since the rankings also placed a local

319 Mason R, Peckham C, Simons D and Wakeman T, *Wise Moves Modelling Report*, commissioned by the *Wise Moves* project, Transport 2000, June 2002

320 Peckham C, East Anglia Food Links, personal communication, July 2002

Table 6 Shops ranked by CO_2 emissions from logistics for the three products

CO_2 emissions	Ranking	Cheese	Chicken	Bread
Best performing	1	Shop D	Marks & Spencer	Shop G
	2	Booths	Booths	Shop A
	3	Shop C	Safeway	Marks & Spencer
	4	Safeway	Shop C	Shop E
	5	Marks & Spencer	Shop F	Safeway
	6	Shop B	Shop B	Shop D
	7	Shop A		Shop C
	8			Booths
	9			Shop F
Worst performing	10			Shop B

Table adapted from Ecologica modelling work study

shop at the best performing level both for bread and for cheese. Marks & Spencer's transport system produced the fewest CO_2 emissions per unit of product for chicken.

These rankings reveal that supermarkets have, on the whole, more efficient supply chains than local shops.[321] This conclusion reflects the time, money and expertise they have invested in efficiently servicing a nationwide distribution of stores. Just as significantly, however, the rankings also suggest that there is some relationship between lower CO_2 emissions and shorter journey distance.

To illustrate, one local shop achieved the lowest CO_2 emissions of all stores for bread because it sources locally. It is also the case that, of the CO_2 generated while transporting cheese from the manufacturer to one of the local shops, 63% of this CO_2 was emitted during the journey from the manufacturer to a wholesaler's RDC in Preston. This suggests that omitting this leg and sourcing more directly might change these results markedly. This will however depend on whether the load was consolidated, and with what.

Balancing distribution efficiency with journey distance

How important is distributional efficiency compared with overall journey distance? Of course, cutting kilometres from an efficient logistics system will be a good thing, provided it remains efficient, just as will cutting it from an inefficient one. But does a fairly inefficient supply chain have to be very much shorter indeed for it to generate fewer emissions than a longer but more efficient co-ordinated system, or does even a little reduction in overall kilometres tip the balance in favour of the shorter trip?

Unfortunately, once again the answer is not simple. The graphs[322] overleaf plot CO_2 emissions per unit of product on a total journey basis for cheese and for chicken.

As shown in Table 7 (cheese), the general trend seems to be that the further cheese travels, the more CO_2 it produces. There are, however, anomalies. One supermarket transports its cheese for 470km but produces fewer emissions than a local shop where the distance travelled is only 300km (and this is without taking the complex variations in embodied energy into account). Table 8 (chicken), even more confusingly, shows no clear pattern whatsoever.

From this one might conclude that while in some cases the advantages of an efficient distribution system offset the disadvantages of greater distance, in all cases a short, efficient supply

321 Although see discussion of empty running in section three

322 Additionally supplied by Alastair Kirkbride of Ecologica and based on raw data gathered for the commissioned modelling work research, June 2003

Table 7 Cheese

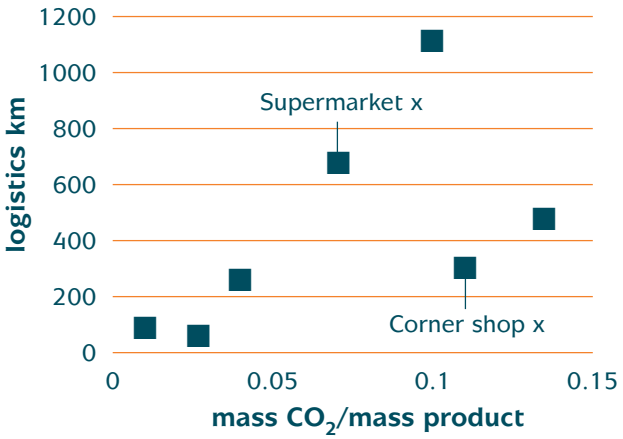
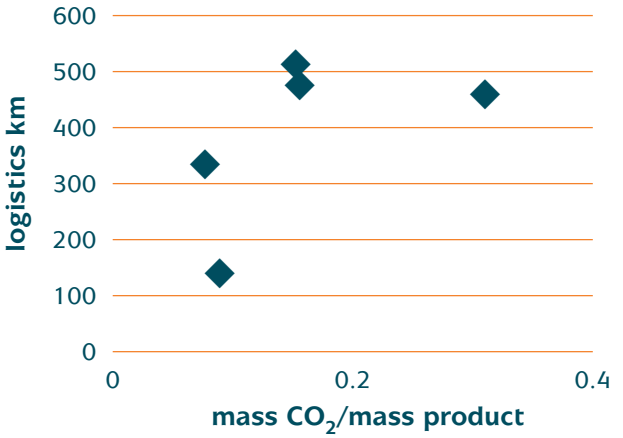


Table 8 Chicken



chain will be the best option. This however will not always be possible; local, relatively small-scale production can make it difficult to achieve full loads although 'milk-round' systems of the kind used in the automotive industry can improve efficiency. In addition the retailer will find it very difficult to accommodate the individual delivery systems of all its suppliers during a given 24-hour period, particularly given the loading and unloading restrictions that often operate.

For long distances, the efficiency factor has a different weight. The research into lettuce, cherries and apples compared what could be achieved simply by improving distributional efficiency (leaving the source unchanged) with what would happen following a change to a more local supply. One efficiency option they considered was improving two-way loading factors to 95%. This would mean ensuring that vehicles are more or less fully loaded both on the outbound and on the incoming journey. While this goal is probably unattainable, it serves as a way of gauging how significant such a measure could be relative to other measures. The consultants found that this improvement in the two-way load could cut transport CO_2 emissions by 6–12% for lettuces and 13% for apples[323] but that for cherries the impact was negligible. If the two retailers were to share their distribution facilities, they could achieve additional savings of about 4% for lettuces and apples, but again, the effect on emissions from cherries would be minimal. Section seven discusses the scope and merits of shared systems in more detail.

This variation among products reflects the fact that for cherries the vast majority of transport emissions are produced overseas, or more accurately in the air. For lettuces and apples this is not the case. These are grown and sourced from the UK for some of the year, during which time all their associated transport emissions take place here. As a result the relative importance of making UK road haulage movements more efficient are greater. In addition, when lettuces and apples are imported, they tend to come in by ship or road. This, while polluting, is less so than flying them in. Hence the greater relative significance of UK-based freight movements and the greater the scope for cutting emissions through the distributional efficiency approach.

Moving away from distribution, another area of difference between local shops and supermarkets lies in the way customers travel to reach them. More people drive to supermarkets than to local stores. The growth in the multiples' local store formats may in future years affect this distinction but at present most people in the UK do a weekly planned supermarket shop, for which they use a car. The consultants studying the bread, cheese and chicken supply chains assume that 60–90% of people drive to the supermarket, depending on its location, while only 10% drive to local shops. The data sources upon which they base these assumptions are detailed in their report.[324] They also state their assumptions as to how often the product is bought and what proportion it makes up of the total shopping basket, in order to calculate its share of the shopper journey, and thus its share of CO_2 emissions.

323 This figure is based on the fact that the vehicle will be loaded on the return journey, although obviously it will not be loaded with apples or cherries.

Figures 7, 8, 9 Mass of CO_2/mass of food product for the logistics and shopper trip components for each product and shop

Source: Ecologica modelling study

The significance of this modal difference among store types varies according to the product. For cheese (where supermarket logistics performance is roughly equal to the worst of the local shops and much worse than the best of them), the mode of shopper travel makes little difference to the overall ranking.

In the case of chicken, the supermarkets on the whole produce fewer emissions than local shops, even once the car-based shopping leg is taken into account.

For bread, the situation is different again. Without the shopper leg the supermarkets perform about average. However, once a car trip is taken into account, supermarkets do between five and eight times worse than local shops. This is because bread is a daily, perishable food and must be bought little and often.[325] For the bread studied, the logistics element contributes relatively few emissions. The importance of shoppers' mode of travel relative to total transport emissions is therefore much greater.

Qualifying this statement, it is important to add that shoppers are unlikely to make dedicated trips to the supermarket just to buy bread. Most people will buy it once a week at the supermarket as part of their major shop and buy additional loaves from local stores for the remaining part of the week. Since bread bought at a supermarket is being purchased together with other products as a part of the planned weekly shop, supermarket bread's overall transport CO_2 emissions will be proportionately less than the figures just quoted, but still greater than if purchased from a local store.

For high embodied energy foods, or those which can be stored for a long time, there appears to be less advantage in shopping locally although this conclusion needs to sit clearly within the context of the ongoing wider discussions about local shops.

For three sets of products alone the results are confusing and obviously it would be impossible to subject all foods to an analysis of this kind. However if a representative sample were looked at, some general principles might emerge. For instance it could be that for everyday perishables such as bread, milk or vegetables, walking to the local shop to buy them is a better approach than driving to the supermarkets,[326] particularly if local shops' logistics operations were improved, and provided that shoppers do indeed walk, and not drive. There is however a large element of uncertainty as to how the distribution system might be affected if people were to buy more products from local shops; more research is needed here.

For staples or high embodied energy foods, such as meat, processed foods or rice (which is durable and bought in bulk) the local advantage is less evident. For other products still the shopper's mode of travel will tip the balance one way or the other.

6.5 Cooking

The kinds of foods we consume and how we prepare them also affect life-cycle CO_2 emissions. As highlighted in section four, fewer of us are now cooking from scratch, preferring ready-meals or partially-prepared foods such as pasta sauces.

The drive towards improving efficiency (in all areas) has had the effect of reducing the cost of food relative to total average household income. This has stimulated demand for now-affordable processed foods, leading to more consumption, more production of such foods and hence more overall use of resources, infrastructure and related mileage, up to the point where the food reaches the store. Of course there is only so much food one can eat but if pre-packaged, pre-processed foods are just as cheap as (or cheaper than) buying the unprocessed kind, then people will continue to consume more of them, relative to their consumption of less-processed foods, as well as yet more elaborately processed versions of the same foods.

These trends will affect the overall balance of emissions in the food supply chain. Some have argued that more processed food will lead to fewer overall CO_2 emissions within the food

324 Ecologica, *Wise Moves Modelling Report: sourcing and distribution options for bread, cheese and chicken,* commissioned by the *Wise Moves* project, Transport 2000, June 2003

325 One can buy bread once a fortnight and freeze it but this adds to the emissions

326 This of course will require changes in people's behaviour – changes they may not be willing to make (see section seven for a fuller discussion)

supply chain, while others argue quite the reverse. The discussion here offers no conclusions but we feel it is important to articulate the debate, thereby, we hope, stimulating further research in this area.

The food industry points out that processed food – a lasagne, for instance – will have been baked in large batches in efficient commercial ovens, in contrast with inefficient domestic ones. Waste peelings and off-cuts will have been kept to a minimum and may even be used in the production of other foods or for animal feed (although discussion with industry suggests that this is not always the case). Packaging – which may appear very visible to the untrained eye – will in fact be no more than what is required to prevent the food from being spoiled in transit and may in fact represent less waste than the packaging surrounding the component ingredients of a home-cooked lasagne – the pasta box, the tray for transporting tomatoes, the plastic wrapper surrounding the cheese, the milk carton and so forth. Moreover those little rectangles of ready-made product will be easily stackable and hence enable vehicles to be filled to their maximum capacity. Only food that is eaten will be transported – energy will not be expended in carrying bits of vegetable that end up as peelings, and which are thrown away, themselves needing to be transported to landfill. Finally, heating up a microwaveable ready-meal uses very little domestic energy.

On the other hand, critics might argue that 'home' cooks often make enough lasagne to feed a whole family and still leave enough for dinner the next day, with leftovers reheated in the microwave. This domestic 'efficiency of scale' is in contrast with the portion-controlled sizes of ready-made meals: since people's appetites vary, for some a portion of ready-made lasagne will be too much (and the remainder may be thrown away) while others will still be hungry and will need to eat something else as well, something embodying additional packaging, processing and so forth. With home-cooked food it is easier to have second helpings of what is already cooked and available.

It may also be that a direct comparison between a particular processed product and its home-made equivalent will not always be valid. Ready-meals and processed foods are often more elaborate and complex than those we would normally cook, hence their appeal. We eat ready-made pesto sauce because it is convenient; if it disappeared from our shelves, most of us would not pound away with pestles and mortars instead. While a regular consumer of ready-meals may eat lasagne one night and Thai curry the next, it does not follow that we should necessarily compare emissions arising from these foods with those cooked domestically. A person who cooks from scratch may eat more simply, making meals that require fewer ingredients and which do not always require an oven or 20 different ingredients.

Hence the growth in demand for processed foods creates new expectations of what constitutes everyday eating, and stimulates the development of products whose very existence depends on being trucked and flown about for various stages of assembly, processing and packaging. In addition, while a processed meal may ultimately generate less food waste, it may not follow that a reduction in waste automatically leads to environmental improvements. Arguably less waste means that more food gets through more efficiently, using less transport; this means that the price to consumers will be lowered, which in turn leads to more demand for yet more complex (and hence transport-intensive) products. And so on and so forth.

Finally, there are also the second-order impacts to consider. By no means all (or even many) cooks know or care much about climate change. However some have argued that knowledge and enjoyment of food and cooking may play an important part in educating consumers about environmental issues, and about their personal contribution to the problem of climate change. Food is, after all, the part of the planet that we eat. Those who cannot cook and know little about food production are psychologically remote from the environment that sustains their existence, just as climate change is forcing us to acknowledge our dependence upon it.

As with all life-cycle analyses, the conclusions will depend on the data used and the assumptions made, as we have already discussed. Moreover, the fact remains that whether people choose to buy ready-made food or to cook from scratch, they will waste both energy and other resources if they are interested in saving neither.

Given the uncertainty, we suggest that one helpful approach might be to compare the eating patterns of a spectrum of people who eat processed foods regularly with those who do not, averaged over a period of time. This way we would gain a clearer understanding of the variation between cooking and non-cooking households in the foods eaten, in preparation methods and in the treatment of leftovers; and on that basis develop a clearer understanding of the energy impacts of both approaches.

6.6 Conclusions

This section explored three questions: the importance of transport relative to other life-cycle stages, the effect on overall CO_2 emissions following a reduction in transport distance and the performance of supermarkets compared with local stores. It also discussed the uncertainties regarding the relative impacts of home-cooked versus ready-made food and highlighted the need for further research in this area.

Food transport's contribution to food-related CO_2 emissions is small but significant, especially for some foods and particularly as food transport emissions continue to grow. A small percentage of a lot is still a lot and 3.5% of total UK generated CO_2 emissions[327] is a very great deal. This figure does not include unquantified emissions generated while transporting foods from overseas. These do not appear in any UK government data and are likely to be highly significant and on the increase.

This said, CO_2 emissions from other life-cycle stages will, at least when it comes to UK-produced foods, often be greater than those from transport. Agricultural production, food processing and refrigeration can all generate very significant impacts. The focus should very clearly be on achieving a lower carbon food chain, not on prioritising emission reductions in one area at the expense of others. We need to take action to reduce greenhouse gas emissions at all stages in the supply chain.

There is a complex relationship between transport distance and other life-cycle emissions. One cannot simply balance transport, on the one hand, against other life-cycle impacts on the other. Many hands will be needed: alter one life-cycle area and complex interactions will occur among all the others, some positive and others not.

Sometimes, action to shorten the supply chain can lead to increased CO_2 emissions elsewhere in the supply chain. For processed foods the efficiency of the manufacturing plant may carry more weight than its location. For fresh produce it may be less carbon-intensive to source unseasonal produce (or produce which cannot readily be grown in our climate) from abroad. In all cases however, the point beyond which other life-cycle advantages outweigh the transport disadvantages will depend on the specifics of the production process, the transport mode and other factors.

We also suggest that at times the growth in food transport can be a good benchmark of unsustainability in other areas. Longer supply chains can mean more time spent in refrigerated storage and more loss through spoilage, both of which increase CO_2 emissions. Shortening the supply chain can help reduce emissions in these areas.

Our analysis highlights the need to consider the solvability of various life-cycle problems. There may be more technological scope for 'greening' UK glasshouse horticulture or refrigerated storage through the use of renewable energy than for doing so with transport; there will thus be synergies between reductions in production stage and in transport emissions. We also touch upon the future downsides of overseas sourcing strategies which at present appear to make environmental sense.

It is also important to bear in mind that where it appears to be 'better' to source from far away, it may be preferable still not to source that product at all. The consumer issues this raises are discussed more fully in section seven.

From our analysis, then, we conclude that there appears to be some relationship between shorter supply chains and less transport CO_2, although the relationship is by no means simple and will depend on the product, what sort of distances are involved and the mode and logistical efficiency of transport. We suggest that the goal of an efficient sourcing and distribution system is to balance the following elements:

327 This includes the customer leg

- *Local clustering:* The inputs to the product must be situated near to the site of production. For processed foods, it is important that the constituent ingredients can be and are grown or produced near by.[328] For livestock production a nearby source of (among other things) feed and fodder will be important. There are also downstream connections to consider – in the case of livestock this will be the location of the abattoir, the cutting rooms and so forth. Conflicts will arise between the goal of locating near upstream sources and downstream customers.
- *Journey distance:* The distance from point of production to point of retail to point of consumption should be minimised.
- *Logistical efficiency:* The fuel efficiency of a vehicle and the way it is managed and operated are very important. In addition loads must be consolidated and vehicles as full as possible while they are in use.

For brevity we will from now on use the term *shorter-plus supply chains*, to characterise supply chains which combine a focus on journey distance with these other essential factors. We also suggest that there is some correlation between *shorter-plus* supply chains and lower life-cycle CO_2 emissions. The relationship is, however, even more complex. To hold true, some or all of the following elements will also need to be in place:

- *Seasonal and indigenous:* Fresh produce grown during its natural growing season and well adapted to UK growing conditions will be less transport intensive and produce fewer overall CO_2 emissions than non-indigenous foods or those imported out of season.
- *Efficient manufacturing:* The processing plant needs to be efficiently operated and managed.
- *Minimal use of temperature controlled storage:* This should not, in the process, compromise safety standards or generate waste through spoilage.

Of course it will not be possible for all of these factors to be present all of the time. However, these three factors, in combination with the three elements which characterise a *shorter-plus* supply chain could provide useful goals to aim for.

In addition to the food miles question, this section examined the relative efficiency of local shops compared with supermarkets. From the supply chains of the products we examined, the evidence suggests that for a given set of equivalent foods, supermarket transport systems tend to be less carbon-intensive than local shops. The qualifications we have included in this statement are, however, critical.

For a start, it is very difficult to separate logistical efficiency (vehicle size, use, management and so forth) from journey distance. Where, in the case of the co-operative EAFL, an attempt was made to source on a more local basis – cherries from Southern Europe rather than California, apples mainly from the UK – the transport CO_2 emissions generated were *lower* than those of the supermarkets. These reductions reflect the fact that for these imported foods, the majority of transport CO_2 was emitted before the products even reached the UK. As a result, the question of UK-based efficiency was comparatively far less important than that of the total journey distance. With lettuce, however, where both EAFL and the supermarkets used a combination of indigenous and imported sources, the supermarkets' logistical advantage tipped the transport CO_2 balance in their favour.

In the case of the Ecologica study (bread, chicken and cheese), none of the stores examined made any special attempts to source the products locally. However all sourced from within the British Isles and hence for these shops the emissions produced were lower than for those examined in the first study. The supermarkets performed consistently above average (in terms of low CO_2 per unit of product) but there was much more variation in the performance of local stores, with some performing very well and some very badly. The reasons for this variation are complex. The local stores that ranked best in the list did so because they sourced from nearer to hand than the supermarkets.[329] However, the performance of others who also sourced from relatively near by was undermined by their smaller vehicles, and other logistical

328 Although the producer of raw ingredients may also supply to other manufacturers, complicating the matter further

329 The focus here is on relative distances, not on deliberate local sourcing strategies

inefficiencies. With the smaller distances entailed in UK supply chains, the importance of efficient distribution is very clear, hence the supermarkets' good performance in this respect. From this one might conclude two things: first, that we should place greater emphasis on improving efficiency across all store formats; and second, that importing from overseas changes the scale of emission production significantly. In other words, for imported goods the major concern (in terms of transport CO_2 emissions) is the overseas leg of the journey rather than the efficiency of distribution within the UK.

The supermarkets' logistical advantage lessens somewhat once the shopper trip is taken into account, although only in the case of bread does the advantage swing in favour of local stores. We suggest that for perishable foods, including fresh produce, the advantages of shopping on foot at local stores (this can include multiple-owned local formats) may outweigh the disadvantages of greater logistical inefficiency.

Is there anything to suppose that local, independently owned shops are inherently predisposed to being less logistically efficient than supermarkets? Section three described how better fleet management can improve efficiency and achieve CO_2 reductions; these will apply whatever the size of distribution operation and regardless of the distance the goods travel. However, it is fair to say that it will be much harder to achieve co-ordinated, co-operative systems for the many small and disparate enterprises in the independent retail sector. This underlines the importance of improving efficiency within the independent sector, perhaps based on greater collaboration between them and the multiples. Section seven discusses some options.

As regards the supermarkets, while centralisation has its advantages, it also poses considerable challenges when it comes to shortening the supply chain and adopting more seasonal approaches to retailing food. As we have already highlighted, brand consistency and the ability to offer a huge range of foods from across the world have been critical to the supermarkets' success and popularity. Sausages on sale in Glasgow may not, in a decentralised system, be the same as those sold in Slough. Strawberries may not be available in December. Applying this approach will require a fairly fundamental reappraisal of the supermarket's brand identity, together with substantial efforts to communicate its values in ways which win the public's approval.

Finally: however complex the solution, it is undeniable that there is a problem. We continue to internationalise our supply chains, and CO_2 emissions from transport continue to increase. Emissions from other parts of the food supply chain are also growing. A lower carbon food system is urgently needed. *Shorter-plus* supply chains, incorporating the other factors discussed, can play a part in achieving the required reductions across the whole of the food chain. In the next section we describe what policies might foster a lower carbon food system and, as part of that, shorter, seasonally-focused, efficient and integrated sourcing and distribution systems.

Section seven

A lower carbon food system: Exploring the alternatives and the policies for achieving them

The status quo is not sustainable. It is important to be very clear about this. The IPCC states that we need to achieve a 60–80% cut in human-generated greenhouse gas emissions.[330] All sectors, including the food industry, will have to make a proportionate contribution to achieving this goal.

However, while deciding upon the least carbon-intensive ways of producing and distributing food may be difficult, we need to keep in sight the truth that the way we do things at the moment is not compatible with the lower carbon future that we urgently need to create. Despite the gains in efficiencies that have been achieved, the magnitude of the problem we face dwarfs them.

We need to consider alternative approaches. In our conclusions to the last section we suggested that the features of a lower carbon food system would include the following six elements:

- *Seasonal and indigenous:* Fresh produce grown during its natural growing season and well adapted to UK growing conditions will be less transport intensive and produce fewer overall CO_2 emissions than non-indigenous foods or those imported out of season.
- *Efficient manufacturing:* The processing plant needs to be efficiently operated and managed.
- *Minimal use of temperature controlled storage:* This should not, in the process, compromise safety standards or generate waste through spoilage.
- *Local clustering:* The inputs to the product in question must be situated near to the site of production. For processed foods, it is important that the constituent ingredients can be and are grown or produced nearby.[331] For livestock production a nearby source of (among other things) feed and fodder will be important. There are also downstream connections to consider – in the case of livestock this will be the location of the abattoir, the cutting rooms and so forth.
- *Journey distance:* The distance from point of production to point of retail to point of consumption should be minimised.
- *Logistical efficiency:* The fuel efficiency of a vehicle and the way it is managed and operated are very important. In addition loads must be consolidated and vehicles as full as possible while they are in use.

These goals are challenging, particularly given the existing, not especially favourable socio-economic context described in sections four and five. This section sketches out what a lower carbon alternative might (in theory) look like and how it might differ from the system we have today. It then moves on to discuss what policies we might need in order to move in this direction.

Before doing so it is important to state that although the starting point for this report was transport, we have ended up concluding that transport, while very important, is certainly not the whole story. If the following paragraphs place more emphasis on the reduction of emissions from transport than on other life-cycle areas, this is because in order to arrive at our conclusion, we spent most of our time looking at this area. And as a transport organisation this is evidently the subject upon which we focus our attention. Further research needs to be undertaken into other life-cycle areas.

330 *First Assessment Report,* Intergovernmental Panel on Climate Change, Geneva, 1990

331 Although the producer of raw ingredients may also supply to other manufacturers, complicating the matter further

A lower carbon food system

This report suggests that a more regionally focused approach to sourcing and distribution can help foster a lower carbon food system. Such an approach would rely upon the development of an invigorated farming sector working with its regional manufacturing base to supply a regional population with much of the food it needs. Where supplies are not available from within the region, producers from elsewhere within the UK would largely be able to satisfy demand.

We would of course continue to import some foods, because they have come to be seen as essential and a part of our food culture or because there are benefits, in terms of carbon reduction, from so doing. A sustainable (as opposed to simply low carbon) food system will also have to balance carbon-reduction objectives against other wider social and environmental issues, such as support for developing countries through fair terms of trade. This, however, is beyond the remit of the report.

In our view, a regional approach offers more CO_2-reducing potential[332] than either globalised systems or very local ones. Section two has already highlighted some of the problems of globalised systems. As regards local ones, we feel that it will not always be possible to grow and produce a sufficient variety of foods locally in sufficient quantities to meet local needs. As a result, transport journeys from a number of different sources will be needed to meet demand, possibly leading to more transport mileage overall. It is also the case that for some manufacturing processes there are energy-efficiency gains to be had from scaling up operations. In addition, we would argue that from a transport perspective at least, a reduction in overseas imports is perhaps the most significant challenge we have to address and as such we should concentrate on this rather than on the final 30 miles or so. This said, there are some particularly fertile and agriculturally varied parts of the UK where a fairly local approach may well be both achievable and environmentally preferable.

Supporting the agricultural supply base would be an efficient and co-ordinated distribution system, involving co-operation among suppliers and retailers throughout the supply chain. Supporting it too would be a technological infrastructure specifically geared towards reducing carbon emissions and based on renewable or cleaner energy sources. This would enable goods to be grown, manufactured and produced in ways that do not create the potential trade-offs highlighted elsewhere in the report. Information and Communication Technologies as well as intelligent transport systems (for brevity, all called ICT) would also provide decision-makers with information and other tools they need both to maximise distributional efficiencies and to make sourcing decisions based on carbon life-cycle analyses.

What about the developing world?

Action to foster regionally oriented supply chains need not, as some have argued, destroy trade opportunities for the developing world. We are certainly not advocating no trade at all. On the contrary, we advocate trade which combines positive socio-economic objectives with environmental ones, including the goal of minimising CO_2 emissions. We would recommend that the scope for investing in value-added, non-air freighted products with UK market appeal be researched, and investment be made in enabling developing world growers to make the switch from energy-intensive crops, such as horticultural products, to value-added, lower carbon alternatives. We would also recommend support for developing countries to produce and market foods for consumers within their own regions.

We also envisage a more diverse retail structure fostering different patterns of shopping and more seasonal approaches to eating.

This is a somewhat simplistic account of what would undoubtedly be a far more complex picture. It does however highlight the fact that a lower carbon food system is likely to look significantly different from the way things are right now.

To achieve a full 60–80% cut in food-related greenhouse gas emissions, we will need to make very substantial changes in our way of life. However some reductions are better than none at all – we can work towards this goal by making many small shifts in the right direction. Hence the measures we suggest below are not intended to

332 Both as regards total life-cycle CO_2 reductions and those arising from transport

be absolutist. Some indeed build upon measures that are already in place. None of them will work in isolation; a combination of policies is needed. All should of course be placed in the wider context of a sustainable food agenda.

Getting there: The policy options

Achieving a lower carbon food system requires movement in the following direction:

1. A recognition that the food system needs to reduce the quantities of CO_2 it emits very considerably.
2. Policies and measures to reduce carbon emissions throughout the life-cycle of food so that trade-offs become synergies.
3. A stronger national and regional food base.
4. Measures to shift businesses away from long distance food transport and towards more nationally and regionally based sourcing.
5. Co-ordinated and co-operative methods of distributing goods both for the multiples and for local independent stores.
6. Information and Communication Technologies which assist the development of less carbon-intensive systems.
7. Different retail structures.
8. Changes in the way we consume.
9. Ongoing research.

7.1 The status quo is not sustainable

We have access to sources of the highest quality foods from across the world and, in relative terms, spend less on food than at any point in history. On the other hand:

- The food system generates over a fifth of the UK's CO_2 emissions.
- Food transport alone is responsible for 2.5% of the UK's total CO_2 emissions, or 3.5% if shopper travel is included.
- Supply chains are, on average, getting longer. In terms of greenhouse gases, much of the overseas leg of the journey is an uncounted cost; and can be far greater than the emissions generated within the UK.
- Aviation is the fastest growing source of climate change. Growth in air freight is faster than growth in passenger air travel. Food is the largest air freight sector.
- In addition to climate change there are many other social and environmental problems associated with the ways in which we produce and distribute foods, some transport-related and some not.

7.2 An integrated low carbon food chain

Transport, while important, is just one consideration in the development of a low carbon food chain. As we have seen, the supply chain also generates often greater quantities of emissions during other stages in the food's life-cycle, such as in agricultural production, processing, storage and refrigeration, cooking, and waste disposal. Whatever the balance of emissions, however, action to reduce them needs to consider the supply chain as a whole.

Climate change policies, both international and national, aim to tackle emissions from the food and other sectors. This section discusses the effectiveness of policies first before examining more specifically what else government could be doing to reduce emissions from all areas of the food chain.

International agreements

For climate change, the most important international development in recent years has been the ratification by 180 countries of the Kyoto Protocol, the notable exceptions being the United States and Australia. The knock-on effects of the Treaty for the UK have been the development of various schemes to reduce carbon emissions from fossil fuels and to promote the use of renewables. At the end of 2001 the UK government set up the world's first economy-wide greenhouse gas emissions trading scheme. Nearly 900 organisations have now signed up to it and in so doing have agreed to reduce their emissions against 1998–2000 levels. An EU-wide emissions trading scheme is also likely to be launched in

2005 although transport is not included. When this scheme is introduced, it does have the potential to affect business energy use across Europe. However, the rate of change will depend on the number of pollution permits available.

In the UK, the Climate Change Levy (CCL) which came into effect in 2001 has a potentially important role to play in encouraging carbon reduction across the supply chain. All food businesses are subject to the levy. In addition the major food retailers, manufacturers and many smaller ones have now signed up to making targeted energy reductions in certain areas of their business in return for which they receive an 80% rebate on the CCL. For supermarkets, the eligible areas are their bakery and rotisserie operations; Safeway, for instance, has reduced emissions from these sources by 2% in the last year. Added to this, 1.48% of its energy now comes from renewable sources. Both measures, while small in themselves, may not have been achieved if it were not for the levy.[333]

However, the levy at present has a very limited effect on business operations, since most of the large businesses, at least, are able to swallow the cost without undue discomfort and carry on more or less as before. Government needs to consider ways of increasing the cost to business of producing CO_2 emissions while not, at the same time, penalising them out of the country. The reduction by 0.3 percentage points[334] in employees' National Insurance Contributions introduced in conjunction with the levy is an attempt at offering carrots as well as sticks. However, the relationship between the charge and the NIC reduction is for many businesses unclear.[335] The thinking behind this relationship needs to be made more explicit. Increases in the cost of the levy as well as in the NIC reduction should also be considered.

It is unfortunate too that other aspects of energy policy, notably the New Electricity Trading Arrangement (NETA) which has brought down the cost of electricity, have run counter to measures to reduce energy consumption.[336] A great many horticultural enterprises in the UK have access to a CHP facility.[337] For most of these enterprises, however, the CHP option is simply not cost-effective. If we are to see a reduction in climate changing emissions from all sectors of the food industry, Government needs to take further action to ensure that its policies harmonise with, rather than work against, one another.

A number of other levies, taxes and incentives aimed at encouraging business to be more energy efficient have been set up. However, industry has found this assortment of initiatives somewhat confusing, and with reason.[336] A clearer, simplified system of accessing information, grants and assistance will help.

Government also needs to develop many more measures that help small businesses reduce their carbon emissions. At present few of them have the resources or incentive to think strategically about their energy use.[338] It is encouraging to see that the Environment Agency has recently produced an online guide to enable smaller food and drink businesses to navigate their way through environmental legislation.[339] The Carbon Trust also provides information for small businesses. Ongoing measures to promote their use, however, will be essential.

February 2003 saw the publication of the Government's Energy White Paper.[340] This White Paper signals government's intention to *'work towards'* cutting emissions of CO_2 by 60% by 2050 in line with IPCC recommendations, and the Prime Minister is urging other EU nation states to do the same.[341]

333 *CSR Report,* Safeway 2003, www.safeway.co.uk

334 Which is greater than a 0.3% reduction

335 *The Climate Change Levy: first year assessment,* Confederation of British Industries and Engineering Employers' Federation, London, November 2002 www.cbi.org.uk/ndbs/PositionDoc.nsf/81e68789766d775d8025672a005601aa/e8fd76fd3a0f8eef80256c6800396f9b/$FILE/CCLbrief.pdf

336 *Next Steps for Energy Taxation: a survey of business views,* Green Alliance, London, 2002

337 Horticultural Development Council, personal communication, August 2003

338 *Next Steps for Energy Taxation: a survey of business views,* Green Alliance, London, 2002

339 See: www.environment-agency.gov.uk/netregs/sectors/457023/?version=1&lang=_e

340 *Our Energy Future: creating a low carbon economy,* Department for Trade and Industry, London, February 2003

341 Letter from UK Prime Minister Tony Blair to Costas Simitis, Greek Prime Minister and President of the European Council, February 2003, www.number-10.gov.uk/output/Page3093.asp

A Sustainable Energy Policy Network (SEPN) has also been set up in the wake of the White Paper to ensure that the key elements of the energy strategy actually materialise. With workstreams focusing on, among other things, renewable energy, CHP and energy efficiency, there is much here that could aid the development of a lower carbon food chain. However, the relevance to the food industry is only implicit. There is in fact scarcely a mention of food in the White Paper despite the significant contribution the sector makes to climate change.

The SEPN, the food industry, government departments and public interest organisations need to sit down together to identify which of the 130 objectives articulated in the White Paper could apply to the food industry. They then need to develop a lower carbon action plan for the food industry as a whole, complete with easily accessible and well-disseminated information to encourage the uptake of grants and other opportunities by its members. In addition, Government needs to encourage greater clarity and transparency in company reporting on greenhouse gas emissions. At present it is difficult to make comparisons between different businesses. Such transparency will also enable progress to be assessed over time.

Government also needs to be bolder in its ambitions for the food industry. It could, for instance, issue a challenge or competition to all elements of the food industry, inviting players to achieve a 20% cut in the emissions they produce over ten years. Whether they achieve this by focusing on improving emissions from agriculture, from manufacturing or from logistics, would be up to them.

Achieving such a cut would require co-operation along the supply chain. It would also have the effect of substantially reducing emissions for the foods that the vast majority of people actually eat – *Mars Lites* as it were, for the masses. The educational and marketing potential of approaches such as these is discussed more fully below.

In addition there is private sector catering to consider, which is worth around £23 billion a year.[342,343] By 2025, spending on food eaten out of the home, on take-aways, in pubs, restaurants, cafés and work canteens, could equal and begin to overtake food retail sales.[344] This sector is tremendously fragmented, spanning multinational chains, family-run sandwich bars and Michelin starred restaurants. Government could equally direct its low carbon challenge to the major catering chains.

7.3 A regional supply base

Greater regional availability of a more diverse range of raw and manufactured foods will require regional, national and European policies to support and strengthen regional farming and food manufacturing enterprises.

To an extent Government is starting to move in the right direction. Nevertheless there are still areas of serious weakness. However positive many of these developments have been, the support on offer is too little to counter the force of the trends heading in the opposite direction; towards globalisation, specialisation and sourcing from overseas. The danger is that a two-tiered agricultural system may emerge, with intensive food production overlaid by a greener, more environmentally benign but essentially Marie-Antoinette type of recreational farming; imported everyday foods supplemented with locally produced smoked salmon, as it were. Government needs to extend its policies beyond support for value-added niche products (which are also produced for export) to embrace the mainstream foods that we all need.

As a first step, Government needs to state far more explicitly than it currently does not only that carbon reduction is core to its agricultural vision but also *how* its policies will achieve the reductions that we all want to see. There appears to be little policy overlap between agricultural and energy policies.

342 *UK Foodservice Market Overview,* Fact Sheet, Institute of Grocery distribution, Letchmore Heath, 21 August 2002, www.igd.com

343 Its contribution to greenhouse gas emissions may be less than this figure suggests simply because the £23 billion will include a significant mark-up; the constituent ingredients are likely to be far smaller in quantity than the figure suggests

344 *Foodservice Sales to Equal Retail Food Sales by 2025,* news release, Institute of Grocery Distribution, Letchmore Heath, 4 January 2001, www.igd.com

There is, moreover, too little emphasis on the promotion of diverse and mixed farming systems – as opposed to farm 'diversification' into bed-and-breakfast accommodation. We need to see a greater emphasis on agricultural diversity (and not just at the smallholding level) if we are to regionalise our supply base, build up energy-efficient regional production and manufacturing, and reduce the transport of food across regional and national boundaries.

The Food Chain Centre (FCC) is, at present, a missed opportunity. Its focus is very much on efficiency and its remit lacks an explicit environmental dimension. Of course if it is successful in its goals of improving the competitiveness of British farming (hence enabling the substitution of some imports with British produce) and cutting down on waste, this focus could lead to transport emission reductions. However, the relationship between efficiency and overall reductions in CO_2 emissions is, as we have argued, not inevitable. Consequently we suggest that the FCC's purpose needs redefining, with the meaning of 'efficiency' enlarged to include carbon efficiency.

One important area of concern is the severely under-supported horticultural sector. Government needs to provide more assistance for horticultural enterprises and to combine this support with investment in lower carbon technologies. This will minimise any potential trade-offs between transport and other life-cycle emissions.

Government also needs to tackle the scarcity of local and regional abattoirs, a shortfall which requires animals to travel over long distances before they are slaughtered. More than half of all abattoirs have closed over the last five years, principally because of a charging system which favours larger over smaller ones.

In addition, Government has recently introduced new requirements which will further increase costs for small slaughterhouses. Clearly, food safety must be paramount but it has been argued that Government could offset the costs to small enterprises with rebates or other cost recovery mechanisms.[345]

The Animal By-Products Regulation, introduced in April 2003, requires all abattoirs to collect and store blood for later disposal. As well as the expense, disposal by this means would mean substantially increased long distance lorry journeys. The Country Land and Business Association, National Federation of Women's Institutes, Soil Association and other partner organisations are urging DEFRA to request a permanent derogation for smaller abattoirs.[345]

In addition to this derogation, government could require supermarkets to use a broader selection of suitable abattoirs instead of, as they do, contracting to only one or two abattoirs each for the whole of the UK.[345] Such measures are justifiable not just from a transport reduction perspective but also to reduce the suffering that live animals undergo on their way to slaughter.[346] We also need to see more support for the development of infrastructure such as cutting rooms, processing plants and packhouses, situated near to the point of slaughter. In many cases such developments will not require the construction of new facilities but rather changes in the use of existing slaughterhouses. At present not all slaughterhouses have such facilities and as a result, whole carcasses need to be transported for cutting and further processing.

At the regional level, while many of the RDAs have undertaken a high-level analysis of the food chain in their region, there is a need for much more specific research into food needs and food availability. This should be based not only on what is eaten now but on what might be eaten in a few years time, and should also take into account other government and regional policies, including those aimed at increasing fruit and vegetable consumption. Below, we explore how such analysis could help the development of Internet-based technologies that enable suppliers and purchasers to make lower carbon decisions.

Much of the work we need to see places emphasis on the importance of communicating to all elements of the food industry what is going on, what grants and other forms of support are available, encouraging the uptake of new schemes

345 Soil Association, personal communication, July 2003

346 While it is arguable that it may be easier to supervise the animal welfare standards of just a few, large and efficiently run operations, equally an inspector may be able to check up on, and gain an impression of a smaller set-up relatively quickly. The point is to ensure that the standards and monitoring procedures in place are rigorous, otherwise they will be open to abuse whatever the size of the operation

and providing support, such as IT training, to deal with the inevitable paperwork that is involved. This will not be an easy task and it remains to be seen how the English Food & Farming Partnership (EFFP), set up to do just this, approaches the problem. We would also hope to see the EFFP promoting collaboration to achieve CO_2 reduction as well as economic objectives.

The point is frequently raised that action by government to promote British or regional farming contravenes State Aid regulations. These regulations certainly do present obstacles. For instance EU Public Procurement regulations prevent discrimination against a supplier on the grounds of location or nationality. While allowing external economic costs incurred by the purchasing authority to be taken into account in the award of contracts, they do not allow the external economic costs incurred by the purchasing authority's *community or society at large* to be considered.[347]

Many have, however pointed out there are ways of promoting regional foods within the context of these regulations, France and Italy have been particularly successful in this respect. As Sir Donald Curry points out[348] it is possible, although not easy, to develop procurement contracts which in effect require food to be sourced on a national or regional, rather than an international basis. Approaches include specifying that the food must be of a certain quality or degree of freshness, or meet certain environmental requirements. Government has taken welcome steps to promote sustainable procurement within current EU restrictions, as we discuss below.

Evidently however, the situation is far from ideal and government has a role to play in campaigning for the inclusion of environmental and social criteria in purchasing regulations both at an EU and an international level. There are also opportunities for using other structural funds, rural development programmes and so forth more carefully.

As an additional approach, there is also the Appellation Controllée or Protected Status foods designation to consider; the kind that only allows ham produced in Parma to be called Parma ham. At the September 2003 WTO talks in Cancun, the EU presented a list of 41 products that in its view require protected status.[349] While no agreement was reached, the EU Commissioner Franz Fischler has stated that these proposals will remain on the table for future talks. The impact of such a designation is uncertain. On the one hand, Protected Status may promote regionally specific food, and by increasing awareness of (and liking for) such foods within the home region, help protect against imported variants[350] On the other, it could lead to increased food transport as consumers seek authentic speciality foods from overseas. A decision to grant protected status to feta cheese[351] means that a Yorkshire producer of a feta-like cheese is now no longer able to call it by that name. While this may not put off regular customers, it may mean that new customers go for the imported feta as a first choice, leading to more food transport. The impacts of Protected Status accreditation need to be considered in more detail.

Moving on from UK and European policies, we also need to see profound changes at the international level. The recent landmark CAP agreement reached at the Luxembourg Agriculture Council meeting in June 2003 is a welcome step in the right direction as it 'decouples' or breaks the link between subsidies and production, enabling funds to be diverted towards less environmentally damaging forms of production. However, a £30 billion a year subsidy structure still remains and many development organisations are still concerned that export dumping will continue to damage developing world farmers.[352,353] This dumping represents unnecessary transport and unnecessary transport emissions.

The WTO talks in Cancun in September 2003 presented an opportunity for the UK government

347 *Sustainable Food Chains, Briefing 2 Public Sector Catering: opportunities and issues relating to sustainable food procurement,* Sustain, London, 2002

348 Quoted in *The Grocer,* William Reed Publishing, West Sussex, 11 January 2003

349 *EU Set to Fight over GIs,* Food & Drink Europe, 29 August 2003, www.foodanddrinkeurope.com/news/news.asp?id=2723

350 *Strategy for Support for Regional Food,* Department for the Environment and Rural Affairs, 17 July 2003, www.defra.gov.uk/foodrin/foodname/news2000.htm

351 *Europe Rules on Yorkshire Feta,* BBC North Yorkshire News, 13 September 2002, www.bbc.co.uk/northyorkshire/news/2002/09/13/cheese.shtml

352 *CAFOD Slams CAP Reform for Failing the Third World,* news release, CAFOD, London, 26 June 2003

353 *EU CAP Reforms a Disaster for the Poor,* news release, Oxfam, Oxford, 26 June 2003

to press for an end to dumping on developing world countries and to work towards achieving a more environmentally focused global agriculture. The process largely failed and there was minimal discussion of environmental issues. A strengthened developing country lobby did, however, emerge from the ashes and it remains to be seen what happens next.

7.4 Measures to curb long distance food transport

If Government is serious about meeting its climate change obligations it will need to adopt a far more robust approach to transport than is the case right now.

It needs to put in place a policy structure which optimises freight movements, encourages shorter supply chains and which abandons its current plans to build its way out of our transport crisis.[354,355]

This discussion start with the most polluting form of transport, aviation. Most policy makers, including the UK Government,[356] the EU[357] and the International Civil Aviation Organisation (ICAO)[358] now recognise that an increase in the cost of aviation is necessary and are considering – some more vigorously than others – the options. In addition, a number of bodies, including the Aviation Environment Federation,[359] Transport 2000,[360] the Institute for Public Policy Research[361] and the Royal Commission on Environmental Pollution[362] have put forward proposals for change. We summarise some of the options in the box opposite.

354 *Massive Roads Expansion for the UK,* BBC News, 9 July 2003 http://news.bbc.co.uk/1/hi/uk/3056636.stm

355 *£7 billion Blitz on Britain's Most Congested Roads,* news release, DfT, 9 July 2003

356 *Aviation and the Environment: using economic instruments,* DfT, 2003

357 *Air Transport and the Environment,* European Commission, Brussels, http://europa.eu.int/comm/transport/air/environment/index_en.htm

358 International Civil Aviation Organisation www.icao.int/cgi/goto_atb.pl?icao/en/env/aee.htm;env

359 Sewill B, *The Hidden Cost of Flying,* Aviation Environment Federation, London 2003

360 Whitelegg J and Williams N, *The Plane Truth: aviation and the environment,* Transport 2000 Trust and Ashden Trust, London, 2001

Aviation: The policy options

The first, most immediately obvious approach would be to tax aviation fuel. Such a tax has been seen to be long overdue.[359] Imposing it, however, raises a number of difficulties. The international aviation industry is against such a move and has strong backing from the US and many developing world countries (particularly the Far East) who see such a tax as a threat to their tourism and export industries. Some have argued that its imposition unilaterally could undermine the competitiveness of British airlines, and while an EU tax would create a level playing field within Europe the disadvantage would manifest itself in competition at the global level. Moreover, were global agreement to be reached world wide, imposing the tax would require the dismantling of over 2000 bilateral air-service agreements.

The UK Treasury has moreover argued that a tax would not have a very strong effect. According to its calculations, a 100% increase in the cost of kerosene would only reduce demand by about 10%.[363] Others have pointed out that this does not necessarily constitute an argument for not taxing aviation fuel but rather for taxing it more highly or taxing in other ways as well. A 300% increase in fuel costs (amounting to about 54p a litre) would put the cost of aviation fuel more on a par with (but still lower than) truck diesel which costs around 62–65p a litre before VAT.[359]

One option proposed[359] is a 'fair tax package' for the UK. This, combining a tax on aviation fuel with the imposition of VAT and the abandonment of duty free, could help contain growth to within the capacity of UK airports. It would allow for a slight increase in demand, with this offset by those efficiency gains which the RCEP feels to be realistic, meaning that the aviation industry keeps to today's level of emissions.

A second approach[359] might be to auction slots. Airlines would bid for the right to land and take off at airports, the idea being that there would be (preferably declining) limits on the amount of slots available – a winged version of musical chairs. This could have a similar effect to the fair tax package. It would need to be combined with restrictions on airport development to encourage greater competition for, and raise the implicit price of, the available take-off and landing slots.[360]

A third alternative, and the one most favoured by ICAO, is open emissions trading.[364] The total amount of allowable emissions would be capped and permits to emit CO_2 could be then bought and sold to meet emission reduction objectives.[365] As an open system, the aviation industry would be able to buy permits from other industrial sectors. While this could work, the risk is that airlines will simply buy permits from elsewhere and carry on growing, and polluting, more or less as before.

Emissions *charging* is the fourth option, and one which appears to be most likely to go ahead, with the UK Government and most environmental groups also in support provided the charging scheme goes hand in hand with policies to ensure that industry cannot buy its way out of the problem. Charging, rather than a fuel tax, would be more acceptable to industry too and would have the reasonable effect of penalising the generation of emissions, rather than the source of those emissions. Both the EU[366] and the UK Government[367] have commissioned research to establish what a fair price for emissions charging might be. While such research has signalled a step towards action, environmental groups have argued that the reports do not take into account the full climate changing costs of aviation, in so far as a cost can ever be established.[368] If imposed, estimates suggest the charge would reduce demand by about 7% and emissions by around 5%. As freight operates to lower profit margins and is therefore more cost-sensitive than passenger travel, we may see much of the cut in demand coming from the freight industry.

Underpinning any form of aviation charge however, is the need for Government to abandon its proposals for airport expansion. It is very difficult to see how sustainable aviation objectives can be achieved if the infrastructure available to the airline industry is allowed to expand so significantly.

Indeed, the Environmental Audit Committee had this to say about Government policies: '*The Secretary of State for Transport appears to have his own agenda. He has recently dismissed the Royal Commission's report on aviation as superficial. He also dismissed the possibility of fiscal measures to take account of the environmental costs of aviation, and indeed his reported comments suggest that he has set himself against any rise in air fares.*'[369]

Government's aviation and international development policies highlight a major flaw in its approach to greenhouse gas reduction – the fact that it does little to consider the environmental impact of its overseas activities. This is because official methods of measuring national greenhouse gas emissions do not include emissions generated by the UK 'off shore.' Hence there is little or no focus by policy makers on discouraging food and feed imports. Indeed, while the introduction of measures which have the effect of increasing regional sourcing might lead to absolute reductions in greenhouse gas emissions,[370] what might show up on the UK greenhouse gas balance sheet is an apparent increase in emissions. This is because CO_2 emissions generated by overseas food production and transport are not included.

For aviation, there are, however, steps that government can take independently of Europe or the international community which will also have the effect of reducing those UK emissions that do presently 'count.' It can for instance introduce charges for domestic flights. While this will not affect food (which does not travel internally by

361 Bishop S and Grayling T, *The Sky's the Limit: policies for sustainable aviation,* Institute for Public Policy Research, London, 2003

362 *The Environmental Effects of Civil Aircraft in Flight,* Royal Commission on Environmental Pollution, London, November 2002

363 *Air Traffic Forecasts 2000,* Department for the Environment, Transport and the Regions, London, 2000

364 International Civil Aviation Organisation, www.icao.int/cgi/goto_atb.pl?icao/en/env/aee.htm;env

365 *Aircraft Engine Emissions,* International Civil Aviation Organisation, www.icao.int/icao/en/env/aee.htm

366 Dings J, *External Costs of Aviation*, CE, Delft, 2002 www.aef.org.uk/PDFs/CE%20external%20costs%20of%20aviation.pdf

367 *Aviation and the Environment: using economic instruments,* HM Treasury and Department for Transport, London, 2003

368 Johnson T, Aviation Environment Federation, personal communication, 2003

369 *Pre-Budget Report 2002: tax and the environment,* Fourth Report, Environmental Audit Committee, London, 2002, www.parliament.the-stationery-office.co.uk/pa/cm200203/cmselect/cmenvaud/167/16703.htm#a10

370 And other emissions, provided measures are put in place to achieve CO_2 reductions throughout the product's life-cycle.

air) it can help establish the charging principle and, by setting an example, may hasten the development of an international system.

As regards land transport, Government appears set to embark upon a new phase of road building.[371] Many NGOs have argued that the consequences of this will be highly damaging[372] as, among other things, it directly undermines attempts at managing demand, reducing unnecessary transport movements and promoting efficiency. More roads will, at least in the short term, lead to easier and quicker journeys. The consequences will be lower transport costs to business and less of an incentive to minimise unnecessary movements.

The introduction of a lorry charge in 2006 could, in principle, provide a counter-weight to Government's road building policies. This charge will replace other existing ones, such as Vehicle Excise Duty. It will affect different types of journeys in different ways and will lead to some journeys costing more than they do at present. Others will cost less. Overall however, the charge will be revenue neutral. At the time of writing neither the detail of the scheme nor the modelling assumptions underlying the charge were publicly available and as such it is difficult to assess what, if any, effect it will have on transport movements or carbon emissions.

Once the principle of the charge has been established, there may be scope for varying the charges, depending on lorry weight, axle structure and vehicle emissions, or by road type or time of day and this variation could lead to some overall reductions in CO_2 within the freight sector.

For real changes to flow from the new charge, however, we would need to see significant increases in the cost structures. Since the charge will be accompanied by a drop in the price of fuel (possibly down to the EU minimum) this increase would have to be fairly considerable if it is to encourage business either to adopt further fuel efficiency measures or to rethink the distances their fleets travel. Given Government's willingness to abandon the fuel duty escalator a few years ago in the face of industry and public pressure, it is hard to believe that the pricing structure for the charging scheme will be especially hard hitting.

What is clear is that over time the charge needs to be increased quite considerably for it more accurately to reflect the costs that lorries impose. Food freight transport's contribution to UK CO_2 emissions stand at around 2.5%. The cost of transport relative to the end price of food is just over 1%.[373] The market is clearly not ensuring that the cost of food transport is in keeping with the relative contribution it makes to the UK's greenhouse gas balance. To ensure that food transport pays its way even within existing cost structures (which do not reflect the true cost of greenhouse gas emissions to society) we would need to see the cost of transport at least double.

We should emphasise, however, that economic signals (based on assigning CO_2 emissions a cost) will only go so far. Since transport is such a small percentage of overall costs[373] (although it may be greater for air) even a hefty price increase will only have a limited effect on total supply chain costs.

A US study on paper production, which examined the relationship between paper production, paper transport and various taxation options found that a fuel tax which raised the cost of transport by around 5% led to a mere 0.3% reduction in energy use within the paper life-cycle as a whole.[374] This partly reflects the fact that transport only accounts for one element of total supply chain emissions. It also suggests that, with transport accounting for only a small proportion of the total product cost, even relatively large tax increases will have a limited effect on transport demand.

In addition, a report[375] which examined the effect of fuel price changes on motorists' behaviour found that a 10% price increase leads to a 6–8% decrease in fuel consumption over the long term.

371 *£7 Billion Blitz on Britain's Most Congested Roads,* news release, Department for Transport, 9 July 2003

372 *Transport 2000 Reacts Angrily to 'Roads Binge',* news release, Transport 2000, London, 10 December 2002

373 *UK Retail Logistics Overview,* Factsheet, Institute of Grocery Distribution, Letchmore Heath, 2003

374 Vanek F, *The Transportation-Production Trade-Off in Regional Environmental Impact of Industrial Systems: a case study in the paper sector, Environment and Planning A* (2000), 32:5, 817-32, Pion Ltd, London, 2000

375 Glaister S and Graham D, *The Effect of Fuel Prices on Motorists,* AA Motoring Policy Unit and United Kingdom Petroleum Industry Association, Basingstoke, September 2000

For freight, it is probable that demand would be rather less elastic and so the reductions would be correspondingly lower.

This is not an argument for not charging. On the contrary, it is an argument for raising charges quite considerably and we would recommend just such a measure. But there is only so far that fiscal measures can go; a charging structure which reflected the 'true' costs of climate change but which allowed polluters to carry on emitting unsustainable quantities of CO_2 would not suffice. We also need to develop policies that in effect place absolute limits on food transport emissions, as well as on emissions from other sectors. Government and other players need to consider how this objective might best be achieved within the context of a free market economy.

Most important, for food, we need to see transport policies introduced in combination with other non-transport-related policies, including those which raise the cost of energy use in other life-cycle areas. The integration of these measures is critical, both to help industry move in the right direction and to offset the financial burdens that arise, by compensating in other areas.

7.5 Different distribution structures

There is a risk that the regionally focused system we propose may at times mean the transport of smaller quantities of goods and as such, a loss of efficiency. The challenge will be to work out when the benefits of short distance outweigh the disadvantages of inefficient vehicles and when they do not. Efforts will also need to be made to minimise inefficiencies and we discuss a few possible approaches here.

One approach is for retailers to share infrastructure; this will mean the collective use both of distribution facilities and of vehicles. Although the study into lettuces, apples and cherries found shared networks could deliver only modest savings, their model was based upon co-operation between just the two retailers. The more companies involved in the shared network, the greater the potential savings are likely to be, although of course the greater the complexity too. Several retailers could share, or retailers might share with their suppliers. A group of food companies might even share with those from a different industrial sector. A group of businesses could collectively pool their assets. The use of white, unbranded (or multi-branded) vehicles delivering to and from consolidation centres, or making deliveries to several retailers in succession, could significantly reduce the number of journeys needed.

As we have also highlighted, with a regionally focused system the relative savings achievable through the shared use of infrastructure are also likely to be greater than those modelled in the Cardiff study report because all the environmental impacts will be occurring within the UK rather than overseas.

For all these possibilities, concerns will be raised about the risks to commercial confidentiality. Another perceived drawback for retailers is that by using anonymous white vehicles they are missing out on advertising opportunities.

These problems do not appear to be insuperable. Indeed retailers are already taking advantage of the financial savings sharing can offer. Panasonic delivers its products from Cardiff to Northampton and then, on its return journey to Cardiff takes Safeway products from the retailer's Tamworth RDC to its Bristol RDC. The consolidator, Fowler Welch, also delivers seven or eight loads a week to Safeway stores after it has dropped off loads at Safeway RDCs.[376] Somerfield is adopting shared systems to solve the problem of empty lorries coming back from Scotland; Woolworths' stock is trucked to East Kilbride and then delivered to stores from the Somerfield depot. On the way back, drivers collect potatoes from a Somerfield supplier in Airdrie.[377]

In future years we may well see more collaboration between retailers, and between retailers and suppliers (as we are already seeing through factory gate pricing). These are promising developments since they show that collaboration is possible where the will exists. In order to shift more elements of the food industry in this direction, we need a clear policy lead from government. One option could be to provide incentives, such as a lifting of delivery hours

376 Ellen N, Strategy Manager – CSR, Safeway, personal communication, July 2003

377 *Supply Chain: an editorial supplement to The Grocer*, William Reed Publishing, West Sussex, 14 June 2003

restrictions for those who pool vehicles, distribution assets and delivery schedules. What we also need to see however – and what is often missing – is a very strong focus by policy makers and industry alike on collaboration for CO_2 reduction. Sometimes efforts to reduce costs lead to reductions in emissions but this will not always be so.

For urban areas, goods could be consolidated at urban distribution centres before making the final leg of the journey to store. While supermarket deliveries to store are already fairly efficient, this is much less the case for independent local stores, as we have seen. So far the success rates of city logistics trials have been patchy, to say the least.[378,379] While some schemes have undoubtedly achieved enormous savings in vehicle-kilometres, participation in these trials has been limited. Other schemes have failed for various reasons, including poor management, loss or damage of goods because of the extra handling involved, and problems do to with commercial confidentiality. Despite these past failures, the principle of urban distribution is interesting. It is important to examine the options for developing workable schemes further since, if successful, they could help achieve the necessary co-operation and consolidation that the independent retail sector needs in order to improve its logistical efficiency.

There may also be scope, where centres are rail connected, for retailers to share rail deliveries; an option which might reduce costs all around.[380] The smaller wagons now available for rail freight add flexibility to the rail freight option.

Finally, we suggest that we step back and consider what could be learnt by looking at different models, including non-mainstream retail and distribution structures. Supermarket distribution systems provide a vast range of food to a very wide customer base. And they do so more efficiently than many local stores, measured in terms of CO_2 per kilometre travelled. However, many of the easy battles, logistically speaking, have now been won. Barring a low carbon technological breakthrough, it may prove harder and harder to achieve further efficiencies in the coming years.

The first study we commissioned highlighted some overseas examples of co-operative food supply models which work differently from those of the supermarkets.[381] There are also many alternative UK based systems, such as vegetable box schemes, community-supported agriculture and farmers' markets, whose supply chains differ from those of the multiples. It is most likely that such systems would, if studied, reveal themselves to be less efficient, measured in tonne-kilometres, than supermarket movements of comparable products. This is not surprising. Many of these systems are small-scale, inadequately funded, volunteer-based and still evolving.

However, rather than ignoring, or dismissing these systems out of hand, these alternative supply chains should be looked at more closely. Some may contain elements which, once refined, developed and combined with mainstream technologies and logistical principles, could point towards lower carbon ways of doing things. Or they may not, as the case may be – the point is that at the moment we do not know. We suggest that further research be undertaken into the logistical arrangements of the alternative food sector, both with a view to improving efficiency within that sector, and to applying any good practice to mainstream systems.

7.6 Better use of Information and Communication Technology

Technology is critical to the development of a lower carbon food system. Intelligent transport technologies already help retailers optimise routing and scheduling patterns, in order to make the best use of vehicles and plan around road

378 Kohler U and Groke O, *New Ideas for the City-Logistics Project in Kassel,* in Taniguchi, E. and Thompson, R. (eds.) *City Logistics III: proceedings of the third international conference on city logistics*, 25-27 June 2003, Madeira, pp.331-344

379 Whiteing T, Browne M and Allen J, *City Logistics: the continuing search for sustainable solutions,* chapter in Waters, D, (ed) *Global Logistics and Distribution Planning: strategies for management,* Kogan Page: London, pp.308-320, 2003

380 Beecroft M, Lyons G and Chatterjee K, *Freight and Logistics: the seventh of eight reports from the Transport Visions Network,* Transportation Research Group, University of Southampton, Landor Publishing, London 2003

381 Mason R, Peckham C, Simons D and Wakeman T, *Wise Moves Modelling Report,* commissioned by the *Wise Moves* project, Transport 2000, June 2002

blockages and other occurrences. It is likely to grow in importance as factory gate pricing systems become more widely adopted with less standardised journeys.

But smart technologies could achieve more than this. They could help in deciding upon the best sourcing approaches for any given product based on information about energy use during the whole life-cycle of the product. For instance, they could help industry buyers choose between imported apples and indigenous ones (we bear in mind of course that CO_2 emissions reduction will not form the only basis for their decision – other environmental and social concerns, as well as produce quality and safety standards will also be included in their consideration). The development of such modelling and decision-making tools will require considerable investment in life-cycle research across different food sectors but the methodology is already becoming more established. The challenge is to develop ways in which this information could be applied in commercial decision-making situations. Ultimately such information could be bar-coded to enable information to be more immediately accessible, and could provide the basis for providing information to consumers about the CO_2 impacts of the food they buy.

Information and Communication Technologies could also supply up-to-the-minute information on the nature and availability of supplies – highlighting gaps, identifying when regional supplies are not available, pinpointing the nearest source beyond the region, and identifying potential for links between producers, manufacturers and retailers along the supply chain. Embryonic versions of this are already emerging; BigBarn, for instance, provides details of suppliers and retail outlets in any given area while the National Farmers' Union's SourceDirect links wholesale buyers with local producers of primary and processed goods. The websites of the regional food groups such as Northumbrian Larder and First4farming, an online agricultural marketplace, provide further examples. These separate initiatives need to be integrated and expanded to include not just speciality goods but also mainstream foods, together with information on regional processing plants, packhouses, abattoirs and so forth. All this information will need updating to take account of seasonal variation.

The widespread sharing of vehicles and distribution centres, as discussed above, would help create a more finely grained network of distributional opportunities. Such a function could build upon retailers' existing software as well as on existing e-based freight exchanges, where empty space on vehicles can be bought or sold, often through auction. Internet-based technologies can, moreover, pinpoint when the point beyond which the advantages of a short journey are outweighed by the disadvantages of a partial load for a given product.

At present, the technology, while still in the developmental stages, is on its way. But it is being put to many disparate uses. The goals of BigBarn, for instance, are to promote local sourcing and purchasing. E-based freight exchanges are about maximising vehicle loads in order to save money. Retailer software such as Paragon plans optimal routes. Life-cycle analysis software quantifies emissions at various life stages of the product. We need not just to build upon but also to *integrate* the principles and possibilities of existing innovations. And we need a clear force driving this integration; the goal of achieving a low carbon food chain.

The system we have in mind would thus be based on a comprehensive database of suppliers, manufacturers and retailers from plough to plate. A retailer looking for tomatoes would have access not only to a list of suppliers but also to the CO_2 implications of sourcing from those suppliers and the optimal routing strategies. This information would also take into account what other foods the retailer wanted to source – a slightly more distant source of tomatoes might be preferable if the nearest source of cheese, say, was also being picked up in the process. The system could be nationally co-ordinated, with regional information-gathering hubs, enabling detailed information to be gathered and then fed into the nationwide system. In response, industry would have to develop very fluid, responsive systems, which would need to vary according to the often changing characteristics of different products.

All this sounds extremely ambitious. It is. But we already have also sorts of highly sophisticated technologies enabling us to send space craft to Mars (possibly), communicate virtually across continents and – more prosaically – hold vast quantities of information about consumer

shopping preferences. Developing technology to help achieve lower carbon systems should be possible, given the will within industry and impetus and incentive from Government.

Developing such a system would need the involvement of many organisations, including the food industry, the English Food & Farming Partnership, environmental organisations, the IGD's Food Chain Centre, logistics experts, IT companies and of course Government, three key departments being the Department for Transport, DEFRA, and the Department for Trade and Industry.

From a policy-making perspective, an IT system of the sort described would also be invaluable when the EU emissions trading scheme comes into being, since industry would be able to gather more precise information about their emissions and take highly targeted action to reduce them. It may be, for instance, that a relatively few products are responsible for emitting disproportionate quantities of CO_2 (as highlighted in section six) and that fairly painless modifications in their sourcing strategies could achieve considerable reductions. This would help them meet the 20% carbon reduction target proposed earlier.

Once established, maintaining the technology, vehicles and distribution assets would be a considerable task. Hitherto, such control has been shared by the retailers, the wholesalers or the third-party logistics providers (3PLs) such as Exel or Tibbet & Britten. For a lower carbon food chain, we suggest 3PSs instead – third-party sustainability providers.

This new generation of Exels would not only manage the technology and other assets but they would also provide emissions information to the retailers, who could make their buying decisions in the light of that information. 3PSs could also be contracted to take on responsibility for quality control and traceability – in other words for ensuring that the products available on the database meet certain standards. Within a regional food structure this could well be an easier task than it is today. Product uniformity and other cosmetic standards, as we discuss below, may not feature so highly, but safety and other specifications certainly will. The use of a 3PS would also help alleviate some of the concerns about commercial confidentiality, although not all retailers will wish to outsource control. The functions we have sketched out could also be carried out by the retailers themselves.

The issue of home deliveries also needs considering. At the moment retailers are vying in their attempts to offer the most flexible and reliable service. However, this drive towards ever more convenience for the consumer is not necessarily the soundest approach from a transport perspective. A more energy-efficient option might be to vary the price structure so that people living in the same neighbourhoods ask for deliveries at similar times. Alternatively, retailers could charge lower delivery rates to customers who are prepared to wait several days for their deliveries, as this provides retailers with the opportunity to plan their routes more effectively.

The supermarkets are showing signs of heading in this direction anyway, as they begin to get to grips with their home delivery systems. There could, however, be an explicit focus on engaging customers themselves with the issues by pointing out to them that advance ordering means lower emissions. Framed in this way (and with the additional cost incentive) customers may be more prepared to wait.

7.7 Different retail structures

The nature of shops themselves – what kind of store they are and where they are located – also influences the sustainability of the supply chain. The analysis in section six suggests that we may need different shop types to suit the distributional needs of different products, a possibility which, interestingly, was raised in an independent report by the University of Southampton's Transportation Research Group[382] as well as the research which the *Wise Moves* project commissioned. [383]

The Southampton report suggested that we might need two main kinds of store. The first

382 Beecroft M, Lyons G and Chatterjee K, *Freight and Logistics: the seventh of eight reports from the Transport Visions Network,* Transportation Research Group, University of Southampton, Landor Publishing, London, 2003

383 Ecologica, *Wise Moves Modelling Report: sourcing and distribution options for bread, cheese and chicken,* commissioned by the *Wise Moves* project, Transport 2000, June 2003

would be for durables – for those goods which we do not buy especially often and which either cannot be sourced locally or which may benefit, in energy terms, from being produced more centrally (more on this below). Rice, jam, pasta and biscuits are possible examples. People would buy these foods fairly infrequently (once a month, say) and buy large quantities. While the marginal cost, in environmental terms, of driving to buy them is not as great as for other foods (see below), public-transport-out, taxi-back type systems would reduce the environmental impact. Home deliveries may also reduce car travel, although as we have highlighted, this last point is contestable. There are likely to be relatively few of these stores.

The second type of shop would be for perishables – those foods which we need to buy two, three or more times a week. The Southampton report calls these 'freshgrocers.' These shops would sell bread, fresh vegetables, and so forth. Given the need to buy these foods frequently, the marginal environmental cost of driving to do so can be very significant indeed, as our research has shown. There is a real advantage here in shopping at local outlets which people can reach on foot, and as such there should be many of them, accessible to most people wherever they live. We might add that if Government's attempts to get us to eat more fruit and vegetables are successful (see below), these types of food, and the retail outlets providing them, will grow in importance, and the total volume of sales of these foods will increase. This will have both sourcing and distributional implications.

There are also foods which we might class as borderline; these include the chicken and cheese which we studied. As these products have a high embodied energy (see glossary), where they are sourced from and how they are processed are much more important factors than how the shopper travels to get them. From a practical point of view, however, these foods are bought reasonably frequently and as such they would need to be stocked in local shops. There would, of course, be some overlap – someone running out of rice, say, should not need to travel all the way to a durables store – but the principle of two types would stand.

Such a system bears more than a passing resemblance to the old idea of a diverse high street, populated by greengrocers, butchers, bakers and so forth. It might also be argued that the Tesco Metro-style supermarket formats perform the function of a 'freshgrocer.' The essential difference between the model suggested and existing ones is that the functions of the shops, and the type of goods on offer there, are expressly in keeping with objectives to minimise transport-related emissions. This cannot be said of the present situation which, as we saw in section four, has developed the way it has for an entirely different set of reasons.

Does this different retail structure have a bearing on the supermarkets versus independent shops question? It would, in fact, be possible for both models of ownership to co-exist for both store types. We could have independent stores for durables and freshgrocers owned by multiples, or vice versa, or a combination of the two.

However, it is important to note that a varied pattern of retail ownership is intrinsic to our lower carbon objectives. The Competition Commission has found that retailer concentration reduces the negotiating power of British farmers and manufacturers.[384] As such this concentration undermines the development of a strengthened farming and manufacturing sector whose presence, we have suggested, is essential if we are to achieve a lower carbon food system. If, in the absence of other retail outlets, farmers and manufacturers have little choice but to sell to the multiples[385] then they also have to accept the terms which the multiples offer. If they refuse these terms, the multiples can look overseas or further afield within the UK for cheaper supplies. And if this happens (and it is already happening), British farming and British manufacturing will die and there will be no indigenous supply base from which to source. The only alternative then will be to source from overseas. The consequences will be more greenhouse gas emissions.

In effect, then, a strengthened, invigorated and diverse UK farming and manufacturing supply base is inextricably linked with a strengthened, invigorated and diverse retail sector, and both are fundamental to a less carbon-intensive supply

384 *Supermarkets: a report on the supply of groceries from multiple stores in the United Kingdom,* Competition Commission, London, 2000

385 This usually happens via an intermediary such as a product marketing organisation

chain. Action to foster such diversity is important since these very independents which we would wish to see more of operate very inefficient distribution systems.

What policies are needed in order to achieve this objective? For one, we need to see a vastly strengthened supermarket Code of Practice applied to all the main retailers. The present one is ineffectual and the Office of Fair Trading is currently in the process of reviewing it. Government also needs to appoint an independent watchdog to ensure that food industry players are complying with the code.

We also need to see much more support for small retailers so that suppliers are able to go elsewhere if they are not happy with the terms on offer from the supermarkets. Such support could take the form of tax relief for independently owned stores or a statutory limit on the market share of any one company.

Clearly we do not want to see a strengthened independent retail sector which nevertheless continues with highly inefficient distributional systems. Policies to promote independent retailers must go hand in hand with policies to improve the distributional efficiency of all retailers, whatever their size and ownership model.

Finally, although we may need a different balance of ownership within the food retail industry, this does not necessarily mean that in absolute terms we need any more shops. Most of us (and there are still exceptions) – have more or less enough to eat. Most of us, and with the important exception of some rural areas, have access to a vast range of products sold in shops that are usually very close at hand. Government therefore needs to tighten planning legislation considerably in order to prevent supermarket expansion and the environmental impacts that ensue; it is to be hoped that the forthcoming PPG6 will address this issue.

7.8 Different eating habits

A lower carbon food system would mean fairly substantial changes to the way we shop and eat. This jars with the food industry's often predestinarian view of consumption trends. The role of the food industry is to predict and provide for its powerful and increasingly demanding customers. Curbs on the consumers' right to choose are seen to be not just uncommercial, but undesirable and, in a free market economy, extremely difficult to achieve.

Partly in response to this approach, environmentalists at times fall over themselves to deny charges of austerity and to promote their win-win-win vision as being at once green, healthy, hedonistic, convenient, cutting edge, great for the kids and just about everything else as well. The truth is however, that if we are to see major reductions in greenhouse gas emissions from our food system, then something will have to give and that something is likely to be the dazzling array of choice that we currently, and undoubtedly, enjoy.

The approach does not need to be absolutist. We do not suggest a ban on eating cherries. But while a little bit of what we fancy does us good, we might question whether more is better still. Does one ultimately gain more by eating cherries from February through to October rather than for a short month or two? A life-cycle analysis of pleasure is not proposed, but we do suggest that measures to discourage 'season creep' might be helpful, and only a minor infringement of the inalienable right of everyone to eat anything anytime anywhere.

Such changes will not be easy to implement. In order to move in this direction, we propose the following possible approaches, and discuss them in more detail:

(a) *Pricing* foods in ways which reflect the environmental damage they cause.

(b) *Persuading* people to eat differently by informing them of the issues and making it more attractive for them to do so.

(c) *Providing* lower carbon food – people can only choose to eat more sustainably if such food is available.

(d) *Planning* for lower carbon eating in ways that harmonise with other government objectives, such as that of fostering healthier eating.

Some of these are actions which government and local government alone can take. Others will require business commitment.

Pricing food

Some foods are produced, sourced and distributed in such carbon-intensive ways[386] that we need to send clear economic signals to dampen public enthusiasm for them. Many measures to curb long distance transport will only increase the price of those products very slightly. We have argued that we also need fiscal measures in place to reduce energy use in other life-cycle areas, including through an increase in the Climate Change Levy. The consequence of these fiscal measures may be higher end prices to the consumer.

Government will need to tackle this problem in a number of ways. To start with, this rise in energy costs to business could be mitigated by deploying other measures to reduce costs in other, non polluting areas. The lower rate of employee National Insurance Contributions, imperfect as it is, is one approach.

Government also needs to take steps to make higher priced food more politically acceptable. Many organisations[387] argue that the price of food fails to reflect the social and environmental costs of production. Climate change features prominently in their list of concerns. Of course action to raise the cost of food is hardly going to win votes. Nevertheless it is argued that since we already pay for these costs indirectly through taxes (for instance to fund NHS treatment of diet-related illnesses), pricing foods more transparently will enable consumers to demand foods produced in ways which are less damaging. Lower carbon food may ultimately be the cheaper option.

In the short term at least though, the cost of food will rise. Some have argued that increasing the cost of food is a regressive move that will harm the poor most. It is important, however, to distinguish between two types of transport-intensive food. The first is the luxury product, such as Thai baby corn. These foods are mainly eaten by wealthier people and increasing the price of these will not be regressive.

A more serious concern is that the cost of everyday cheap foods, such as processed meals made of imported chicken, may increase. This is potentially a problem but there are ways of approaching it. The first is that many food policies and pricing structures are already regressive. 'Junk' food fills people up more cheaply than fresh fruit and vegetables.[388] More poor people than rich die from diet-related illnesses.[389] Some have already advocated measures to raise the cost of unhealthy foods[390] on the grounds that these would be comparable in their intent to a tax on tobacco.

We do not propose a carbon tax on top of the energy-related fiscal disincentives we outlined earlier, since the latter would in any case raise the cost of food. Our point here is simply that policy makers are already considering the scope for altering the the structure of food pricing in order to fulfil social objectives, and that arguments for pricing food to reflect its climate change impacts sit within the context of this debate.

The second point to make about higher food prices is that branding is key. Research suggests that people from almost all socio-economic groups are prepared to pay for branded food even if in blind tests those foods are sometimes not liked as well as their unbranded rivals.[391] Hence for most consumers there might be said to be some 'slack' in the budget. The challenge would be to brand lower carbon food in appealing ways that convince people that it is worth paying that marginal extra.

The third and perhaps most important point is that policy-making should never occur in isolation. We need to ensure that government policies harmonise with one another. Measures which end up raising the cost of some foods need to be balanced with policies that lower costs in other areas for low-income consumers. This can include making lower carbon, healthier foods more readily and cheaply available to low-income consumers. This is certainly not the case at the moment. The Maternity Alliance, for instance,

386 Jones A, *Eating Oil: food supply in a changing climate,* Sustain and Elm Farm Research Centre, London, 2001

387 *Final Sustain Response to the Consultation Document issued by the Policy Commission on Future of Farming and Food,* Sustain, London, January 2002, www.sustainweb.org/pdf/curry.pdf

388 *Food Poverty: policy options for the New Millennium,* Sustain, London, 2001

389 *Independent Inquiry into Inequalities in Health,* report of the independent Inquiry into Inequalities in Health (Acheson Report), London, the Stationery Office, 1998

390 Marshall T, *British Medical Journal,* 320, 2000

391 Lury G, *Adwatching,* Blackhall Publishing, Dublin, 2001

argues that means-tested welfare benefits are still too low to support optimum maternal and child health.[392]

Persuasion

It is important to make lower carbon food attractive to shoppers. We suggested above that Government might issue a challenge to the food industry to cut carbon emissions by 20%. Such a move could bring with it all sorts of promotional and marketing opportunities. Consumers would be made aware of the link between climate change and their eating patterns but would be very gently introduced to the subject without need for gustatory sacrifice.

We also need to offer consumers a range of options. As an example, take lettuce. Measures which shift us towards a lower carbon food system need not deprive us of shredded iceberg lettuce garnishes. What carbon-reducing policies can do instead is provide us with a range of various options (together with more information about the consequences of the choices we make). If we want something green to go in our sandwiches, we could buy imported icebergs from the nearest possible overseas source. Or we could eat UK-grown lettuces, produced in a more sustainable manner following investment in cleaner greenhouse technologies or in the breeding of more cold-tolerant varieties. Or we could be offered something more seasonal to put between our bread instead – shredded cabbage for example, or rocket, or lambs' lettuce. An acceptable approach might be to develop a balance between all three options, and the balance will be different for different foods.

It will also be important to market and promote regional and national foods more effectively. In some instances and for some foods this will be easy – some regional foods are flying off the shelves. However a more regionally focused system is about more than clotted cream. It is also about everyday foods which, in a regional system are likely to be more variable in, for instance, size and colouring. Such variability will present challenges to marketing departments. We do not suggest that bad products be fobbed off on consumers. This would in any case not work; even good advertising cannot sell bad food. What we highlight is the need to think creatively about how such variability is presented. To take an example from textiles, consumers now accept that the 'imperfections' of raw silk are part of its beauty.

Once we know more about the CO_2 impacts of products (aided by the technology described above), retailers will be able to provide that information to consumers, through labelling and point-of-sale information. This will enable consumers to make informed decisions about the food they are choosing. Although roughly half of all consumers do not read labels, this nevertheless leaves an equal half which does.[393] The Advisory Council for Consumer Products and the Environment could encourage Government to take a lead here. Those supermarkets running loyalty card schemes could also promote lower carbon foods by directly linking purchases to bonus points.

Providing these foods is not in itself enough if people then go on to cook them in ways which waste energy. In section four we highlighted the growing popularity of convenience and processed foods. In section six we looked at the CO_2-related arguments surrounding home-cooked versus commercially-prepared meals, highlighting the absence of research in this area. We also suggested that a narrow life-cycle approach might be too limited to allow for the complexities of people's behaviour and emphasised the need to take account of any second-order consequences that could result from changes in the way we cook and eat. Whatever the balance, for the time being most people will continue to cook at least some of the time. Action to improve the efficiency of domestic cooking appliances and to encourage people to buy electricity from renewable providers will continue to be very important and should form part of a lower carbon food strategy.

Providing lower carbon food

Public procurement accounts for a sizeable proportion of total food eaten. The annual food bill of the National Health Service (NHS), the largest employer in the country, is around £500

392 *Healthy Start Consultation Meeting,* Maternity Alliance, London, November 2002, www.maternityalliance.org.uk/welfare.doc

393 *Consumer Attitudes Survey,* Food Standards Agency, London, 2001

million.[394] Tackling the NHS food sourcing and distribution system represents an enormous opportunity for achieving carbon reductions. There are also local authorities, schools and other public sector establishments to consider. School meals now have to meet minimum nutritional requirements; an essential further step must be for caterers also to have to meet minimum environmental standards, in accordance with sustainable procurement guidelines. Where there is a potential clash between nutritional and environmental objectives (and in most cases there need not be), then nutritional requirements should take precedence.

As we discussed earlier, the regulations governing public procurement are at best confusing and at worst highly limiting. However, in August 2003, Government launched a major review of the way the public sector obtains its food and catering services.[395] The review will, among other things, look at energy issues. This is to be welcomed and supported.

Planning for lower carbon eating

It is especially important that policies to promote less carbon-intensive sourcing and distribution work with, not against, health objectives.

The critical issues, as far as nutritional health is concerned, are the rise in obesity, particularly among children, and the link between our poor diet and nutrition-related illnesses such as coronary heart disease, stroke, some cancers and diabetes. It is now generally accepted that a diet rich in fruit and vegetables can help prevent the onset of such diseases, and health bodies worldwide, including the UK's Department of Health (DoH), urge people to eat more of these foods. Supermarkets and many food manufacturers are also promoting the five-a-day message both in the fresh produce aisles and through their processed ranges.

It is not joined-up thinking to promote Vitamin C rich air-freighted blueberries if in the process we undermine Government's own climate change objectives. Government food policy has until now had nothing to say about the health-environmental relationship even though the DoH's own research[396] indicates that the direct health impacts of climate change in the UK alone are likely to be very considerable. The DoH needs to ensure that the policies it puts in place to promote better nutritional health are compatible with the goals of environmental sustainability, and it should require health development agencies and other health promotion bodies to do likewise.

Government also needs to consider what, logistically, would happen were people to change their eating habits in accordance with Government recommendations. Five portions of fruit and vegetables a day and fewer calorie-dense (and therefore compact) foods might mean different logistical patterns – possibly more frequent journeys from supplier to store but fewer intermediary journeys for production and processing. It may also need different patterns of shopping. Some of these fresh foods will need refrigerating and it is difficult to fit a week's worth of fruit and vegetables for a family of four into an ordinary fridge. A shift towards larger fridges to hold all this food would fall foul of objectives to reduce emissions from refrigeration. Assuming that the DoH is confident that the policies it has put in place will work, it clearly needs to work with the DfT to look at ways of delivering, in the most literal of senses, its five-a-day message to the average British home. As far as the customer leg of the supply chain is concerned, the two types of shop highlighted above would provide a solution, since instead of buying a week's worth of fruit and vegetables, we would buy them three or more times a week, on the way home from work. Many people as it is shop on the way home for top-up foods and ready-meals. If trends continue, with more people living alone, it is quite possible that this pattern of shopping will fit well with their increasingly autonomous life styles.

To encourage this pattern, we need to develop more disincentives to car-based shopping together with positive improvements to the street environment to encourage cycling and walking. The new PPG should make clear the need for strong limits on car parking availability at supermarkets and other large stores.

394 *Claiming the health dividend: unlocking the benefits of NHS spending,* King's Fund, London, 2002

395 *'Sustainable' food and catering services for the public sector – initiative launched,* news release, DEFRA, London, 26 August 2003

396 *The Health Effects of Climate Change,* Department of Health, London, 2001

7.9 We still don't know enough

Evidently there is a need for far more research to understand better some of the issues which this report covers. In particular we need to:

- Refine life-cycle analysis methodology and expand the database on which LCA calculations are made. Importantly, we also need to develop ways of applying life-cycle data to commercial contexts so that food buyers can easily access and use such information when making decisions.
- Develop ways of undertaking life-cycle analyses for whole sectors of the food industry, as opposed to specific products. This will help in the early stages of assessing food's carbon impacts, as individual life-cycle analyses for all products will present a considerable challenge.
- Examine the contribution that UK consumption patterns make to overseas food transport, and to the CO_2 emissions that arise.
- Map the regions. For each region we need to work out what people eat, where it comes from and where and how it is produced. We need to consider not just food but other inputs to the food chain, such as packaging. We also need to take a year-round perspective.
- Examine the logistical effectiveness of alternative distribution systems highlighted in the first commissioned study,[397] as well as UK box or community-supported agriculture schemes. We need to consider whether these models have potential to yield carbon savings and if so whether there is scope for refining, building upon and applying such systems to a more mainstream context.
- Consider the impact of Protected Status (Appellation Controllée) foods on food transport emissions.
- Identify where new infrastructure, such as pack-houses, consolidation centres, processing plants, abattoirs and so forth may be needed in order to help the development of *shorter-plus* supply chains.
- Research the scope for developing successful urban consolidation and distribution models and consider in particular the role they could play in improving the logistical efficiency of the independent retail sector.
- Examine the logistical arrangements of the alternative food sector, both here and where there are established models overseas.
- Look more closely at the impact of the food service sector on freight emissions as well as on other life-cycle areas such as food processing and preparation, refrigeration and storage.
- Assess further the strengths and weaknesses of regional and national sourcing patterns, in keeping with the DfT's recent work on supply chain vulnerabilities. Consider in particular how to ensure that *shorter-plus* supply chains of the kind described are as resilient as possible.
- Develop appropriate methods of conducting energy life-cycle comparisons between processed ready-meals and home-cooked meals.
- Examine ways of increasing people's understanding of the environmental implications of their food choices.
- Examine further the potential for developing a two-store-type model (embracing all retail ownership models), considering both the effect on emissions from distribution and from shopper transport.

7.10 Conclusion

This section has suggested some ways in which we could move towards a lower carbon food system. The measures we have outlined will require changes in some Government policies and a strengthening of others. They will require changes both in the structure and in the behaviour of the food industry. And they will require changes in the way we, as consumers, shop and eat.

397 Mason R, Simons D, Peckham C and Wakeman T, *Wise Moves Modelling Report*, commissioned by the *Wise Moves* project, Transport 2000, June 2002

With the right policy framework and the right degree of political will, we believe many of the measures we propose can be readily implemented. Others, however, will be harder to put in place. A low carbon food system will ultimately look very different from the one we have at present, and will require us all to rethink many of our core assumptions about shopping and consuming.

Eventually however, change we must. The existing system cannot deliver the greenhouse gas reductions that we desperately need to achieve at the rate we need to achieve them. And despite the quality, the diversity, the abundance and the affordability of the vast range of foods on offer it may be that the system as it stands does not, ultimately, fulfil our needs.

We are paying less and less for environmentally damaging food that we have less and less time to eat, because we are too busy achieving an economic prosperity that we do not appear very much to enjoy[398] and which in itself is contributing to the problem of climate change.

We suggest it might be time to sit back and assess whether the looking-glass situation we have built for ourselves is really worth having.

As Jonathan Porritt, Chair of the Government's own advisory body, the Sustainable Development Commission puts it:[399] *'It took the best part of 20 years to demonstrate that economic growth and increased energy consumption were not inextricably wedded, and that it was perfectly possible to secure high levels of economic growth without corresponding increases in energy consumption. But will it really take another 20 years to persuade politicians that one can de-couple improved societal wellbeing and individual happiness from high levels of consumption? If it does, sustainable development is pretty much a dead duck.'*

398 *Redefining Prosperity: resource productivity, economic growth and sustainable development,* Sustainable Development Commission, London, 2003

399 Porritt J, *Odd Couple,* Society section of *The Guardian,* 9 July 2003

Section eight
Recommendations

These recommendations summarise the policy proposals we outlined in section seven, grouped in accordance with the nine key areas identified.

1 Recognise that the status quo is not sustainable (see section 7.1)

Government should:

- Set a target for the food industry to reduce field-to-store CO_2 emissions by 20% over ten years.
- Make lower carbon food a clear cross-departmental policy objective.
- Incorporate food emissions reduction into the aims and work plans of all Government departments and agencies, and in particular DEFRA, the DfT, Department for Education and Skills (DfES), Department of Health (DoH), Department for Trade and Industry (DTI) and the Food Standards Agency.
- In the follow-on work from the Energy White Paper, implement a cross-departmental and organisational work programme to research, promote and help achieve lower carbon food chains.

The main food industry players should:

- Measure their CO_2 emissions from all sources (including those generated overseas) and develop policies and targets for reducing them in line with the government target above. They should report on their progress in corporate social responsibility and annual reports.

2 Aim for a low carbon food chain (see section 7.2)

Government should:

- Focus attention and funding on the research, development and application of greener technologies across the food chain, including in agriculture, horticulture, food processing, refrigeration (both in situ and in transit), storage and waste disposal.
- Encourage greater transparency and consistency of company greenhouse gas reporting to enable comparisons between companies and over time to be made.
- Ensure carbon reduction is a clear criterion of sustainable procurement contracts.
- Provide more support to enable smaller businesses to reduce their carbon emissions.

3 Develop measures to promote regional sourcing patterns (see section 7.3)

Government should:

- Promote and develop, through grants and regulation, the infrastructure and other aids to the development of more regional sourcing patterns. This will, among other things, include support for the development of:
  - More and smaller abattoirs, cutting rooms and so forth.
  - More (and more diverse) horticultural and agricultural enterprises.
  - More consolidation centres and other logistics-related infrastructure.
- Expand Food from Britain's remit to focus on supporting mainstream and not just 'value-added' foods.

- Set reduced maximum journey limits for the transport of live animals.
- Campaign for changes to EU public procurement requirements to enable procurers to purchase goods on the basis of environmental and social as well as economic considerations.

Regional Development Agencies should:

- Carry out detailed food maps. These maps should identify what is eaten, where the food comes from and what the environmental implications are. They should also identify where nearer sources of such foods exist and where there could be scope for developing enterprises to fill gaps in regional availability. Non-food elements, such as packaging, also need to be included.
- Provide support for infrastructure (including that detailed above), for the development of enterprises to fill gaps in availability, and for the marketing of regional foods.

The Food Chain Centre should:

- Broaden its remit to include environmental sustainability, part of which will entail fostering lower carbon food chains.

4 Put in place measures to curb energy-intensive transport (see section 7.4)

Government should:

Recognise that we need absolute, and progressively declining limits on food freight transport emissions both in the UK and from UK-owned traffic overseas. To help achieve this reduction:

- Monitor the impact of the lorry charge on CO_2 emissions and consider ways of altering the charging structure, so as to help achieve an absolute decline in emissions from freight transport.
- Review the criteria and scale of the road-building programme.
- Review those proposals for airport expansion which are based on a projected increase in freight movements.
- Reduce non-UK food transport emissions through the development of economic instruments, including a European or internationally applied aviation emissions charge. Work within the EU and International Civil Aviation Organisation respectively for their implementation at the earliest opportunity.
- The DTI and Department for International Development (DfID) should examine the scope for UK businesses to invest overseas in products which produce lower carbon emissions both at the production and at the transport stages and which provide viable alternatives to air-freighted horticulture.
- Continue and strengthen measures to promote rail and short sea shipping.

5 Develop better distribution and collaborative working (see section 7.5)

National and regional government should:

- Develop frameworks to promote collaboration for CO_2 reduction among retailers of all sizes. This might include incentives such as removing restrictions on deliveries made by lower emission vehicles at certain times of the day.
- Examine ways of promoting collaboration and the use of shared infrastructure among different elements of the food industry.
- Focus attention on improving the distributional efficiency of smaller players and consider measures to encourage improvements.
- Consider the potential role of urban distribution centres and develop trials to test their use and effectiveness.
- Examine the distribution systems of public bodies (such as the NHS) and examine ways of improving their efficiency.

The food industry should:

- Build upon the improvements they are already making and examine ways of collaborating along their supply chains.

Other agencies should:

- The English Food & Farming Partnership should, as part of its work to promote co-operation and collaboration among farmers and food manufacturers, consider the scope for improving the distributional efficiency of these enterprises.

6 Utilise Information and Communication Technology for carbon reduction (see section 7.6)

Government and the food industry should:

- Examine the potential for developing integrated Information and Communication Technologies to help the food industry make lower carbon sourcing and distribution decisions. Such a system would provide information about CO_2 emissions throughout a product's life-cycle, enabling decisions to be made about source (based on embodied energy, distance, mode and conditions of delivery), route and vehicle type.

Government should:

- Provide financial support for the development and application of such technology in a commercial environment.
- Work to ensure that such technology is available to, affordable for and adopted by retailers of all sizes.

7 Establish different retail structures (see section 7.7)

Government should:

- Introduce a strengthened Code of Practice for supermarkets and appoint an independent watchdog to ensure compliance with the code.
- Continue to tighten planning legislation to curb out-of-town food shopping.
- Develop other policies to discourage car use and encourage non-car based food shopping.

8 Encourage different ways of shopping and eating (see section 7.8)

Government should:

Require the DoH to ensure that the policies it puts in place to promote better nutritional health are compatible with the goals of environmental sustainability, and require health development agencies and other health promotion bodies to do likewise. As part of this the DoH should:

- Work with the Department for Transport to consider the logistical implications of the five-a-day fruit and vegetables message.
- Place a clear focus on carbon emission reduction in its work on sustainable procurement.
- Explore ways of raising awareness among consumers of the hidden social and environmental costs in our existing food system, and persuading people of the need for food pricing which better reflects those hidden costs.

9 Further research goals (see section 7.9)

Government should:

Prioritise lower carbon food research. It should provide sufficient funds and support for such research. In the first instance we need to undertake more work to:

- Refine life-cycle analysis methodology and expand the database on which LCA calculations are made. Importantly, we also need to develop ways of applying life-cycle data to commercial contexts so that food buyers can easily access and use such information when making decisions.
- Develop ways of undertaking life-cycle analyses for whole sectors of the food industry, as opposed to specific products. This will help in the early stages of assessing food's carbon impacts, as individual life-cycle analyses for all products will present a considerable challenge.

- Undertake research into the relative energy efficiency of small and large-scale manufacturing enterprises for commonly eaten goods such as cheese, bakery products, fruit juice and so forth.
- Examine and quantify the contribution that UK consumption patterns make to food production and transport emissions generated overseas.
- Develop appropriate methods of conducting energy life-cycle comparisons between processed ready-meals and home-cooked meals.
- Examine the logistical effectiveness of alternative distribution systems highlighted in the Cardiff study,[400] as well as UK box or community-supported agriculture schemes. We need to consider whether these models have carbon reducing potential and if so whether there is scope for refining, building upon and applying such systems to a more mainstream context.
- Identify where new infrastructure, such as pack-houses, consolidation centres, processing plants, abattoirs and so forth may be needed in order to help the development of *shorter-plus* supply chains.
- Examine the merits of developing different, lower carbon retail structures based on maximising opportunities for non-car based shopping.
- Consider the impact of Protected Status (Appellation Controllée) foods on food transport emissions.
- Look more closely at the impact of the food service sector on freight emissions as well as on other life-cycle areas such as food processing and preparation, refrigeration and storage.
- Assess further the strengths and weaknesses of regional and national sourcing patterns, in keeping with the DfT's recent work on supply chain vulnerabilities. Consider in particular how to ensure that *shorter-plus* supply chains of the kind described are as resilient as possible.
- Examine ways of increasing people's understanding of the environmental implications of their food choices.
- Undertake more research into ways of sustainably extending the growing season of UK produce.
- Carry out further work into the potential impact of the growth in light goods vehicles and the contribution that food movements make to this growth. Examine the scope for improving both their technological and logistical efficiency.

400 Mason R, Simons D, Peckham C and Wakeman T, *Wise Moves Modelling Report,* commissioned by the *Wise Moves* project, Transport 2000, June 2002

Annex one
Localism: The debate

The following paragraphs set down, in simple form, some of the arguments for and against localism. Clearly the issues are complex and in reality opinion does not divide neatly into two camps. Not all advocates of local food are concerned about food miles, and there are many critics of globalisation in its current form who would not call themselves localists. There are also many enthusiasts for globalisation who nevertheless believe that local food is a good thing.

The arguments 'for'

Critics of the existing globalised food production system include non-governmental organisations representing a wide range of interests and concerns. In summary, they argue that the globalised food supply chain:

Produces excessive greenhouse gas emissions: Heavy reliance on mechanised farming, fossil-fuel intensive pesticides and fertilisers, the long distance transport of foods and sophisticated processing use vast quantities of fuel which, in turn, generate greenhouse gas emissions. The longer food travels, critics argue, the more energy-intensive refrigeration it may need, and the more packaging. Plastic packaging will be oil-based and all forms will have used fossil fuels during the manufacturing process. The trucks used to take the resulting waste to landfill will also emit CO_2, while some packaging will also generate climate changing methane emissions as it decomposes. Intensive agricultural production of a few crops within a given region has replaced mixed cropping systems, and in so doing has reduced regional self-sufficiency and created a need to transport food over longer distances.

Fails the environment in other ways: Industrialised farming systems in the UK and overseas rely heavily on artificial inputs which damage the soil and water. Intensive monocultural systems reduce genetic diversity, lead to the loss of many indigenous seed varieties, and create an arid landscape which cannot support birds and other species. Forests and other natural habitats have been cleared and replaced with intensive agricultural systems.

Fails British farmers: The food and farming industry is controlled by large-scale intensive farmers, multinational manufacturers, and a handful of retailers with, it is argued, very poor returns offered to smaller farmers both in the UK and overseas. UK farmers are unable to compete with cheaper overseas produce, the result being that family farms are in decline, farmers are leaving their profession in droves, rural-based employment opportunities are scarce, rural shops and services are closing down, and parts of the countryside are turning into sterile leisure theme-parks comprising second-homes and commuter villages.

Fails the developing world: Developing world farming is controlled by multinational food and pharmaceuticals companies. Many of those producing successfully for export are the larger, highly industrialised farmers. A focus on cash cropping for export at the expense of production for indigenous markets undermines local food security and reduces the nutritional quality of people's diets.

Fails consumers: The apparent 'choice' offered by supermarkets is illusory – instead of genuine variety and diversity based on locally distinct foods and traditions, consumers are offered standardised exotica, with cosmetic perfection

taking priority over taste or nutritional quality. Our demand-led retailing system has helped create an abundance of heavily processed, fatty and sugary foods which damage our health. Although food is cheaper now than ever before, it costs consumers in other ways, through the taxes they pay to rectify the damage caused by rising levels of obesity and heart disease, and increasingly through the food system's generation of climate changing emissions and other forms of environmental damage.

Is not actually free trade: Because there is one set of trade rules for the rich and another for the poor. The distorted trade agenda means that traditional subsistence farming in developing countries is replaced by a vicious cycle of cash-cropping for export, the loss of indigenous self-reliance, declining household incomes and consequent increased reliance on cash-cropping for export. At the same time the EU and US subsidise their own farmers, who often dump surplus products on international markets, distorting the market and driving down local market prices for farmers.

Is unnecessary: We simultaneously import and export identical products, such as milk products or beef, with profits for some but environmental and other costs for society.

The arguments 'against'

Major retailers and manufacturers have responded to their critics by arguing that:

The CO_2 sums are wrong: Distance is an inadequate gauge of greenhouse gas production. The devil lies in the detail and the whole life-cycle of a product has to be considered before a judgement can be made regarding the merits of sourcing it more locally. For instance:

- The energy used to heat glasshouses for local crop production might outweigh the energy used to transport products from sunnier countries where no glass-housing has been required.
- Distance can be misleading – an apple sourced from New Zealand, say, will have been brought in by ship (a relatively low emitter of CO_2) whereas a French one will have arrived on a far more polluting truck.
- Air freighting can reduce impacts in other areas: it is possible that transporting produce by a slower, more sustainable mode (e.g. ship) might be more damaging than air freighting it; on a ship more time is spent in transit, which means more time in greenhouse gas intensive temperature-controlled storage. It may also mean that the product has a shorter shelf-life and there is therefore a risk that some food will be wasted, representing 'unnecessary' greenhouse gas emissions.
- Local can be misleading: a side of British beef, with the cow having been fed on numerous shipments of imported feed, may embody more transport-related CO_2 emissions than its imported Brazilian equivalent, which has eaten feed grown near to where it is reared.
- Small is inefficient: local food processing plants may be less efficient to run, in terms of cooking energy, heating, refrigeration and lighting than a larger, more distant plant, even though production at the former will mean less transport for the goods. The same may apply to local warehouses and consolidation centres.
- A year-round perspective is necessary: a Cox which has been stored at 2°C for over four months will have generated considerable quantities of emissions, perhaps more than a new-season New Zealand Granny Smith, shipped-in (a relatively low carbon mode) and stored for a matter of weeks, not months in transit. Long storage also leads to some food waste which itself represents wasted fossil-fuel energy and which, in its disposal, can generate methane.

There are other environmental factors to consider: For instance growing conditions in the UK might need more intensive use of fertilisers and pesticides, whereas an equivalent product grown in more favourable agricultural circumstances overseas will require fewer inputs. It is not always possible to make meaningful or objective comparisons between the importance of different impacts and ultimately any decisions will have to be based on somebody's judgement. Furthermore supermarkets are also working hard to improve the environmental standing of the food they sell through, for instance, the encouragement of Integrated Crop Management

by their suppliers and the elimination of genetically modified ingredients from their own-label food.

Trade is essential to the developing world: Whether we like it or not, international trade is here to stay and farmers in the developing world have been only too eager to engage with the cash crop economy. By trading with developing world farmers, the food industry provides opportunities for them to earn much-needed income. 'Traditional' indigenous systems (such as share cropping) based on pre-capitalist feudalist or caste hierarchies were often brutal and exploitative and, by contrast, many multinationals and retailers abide by strict ethical codes of conduct. Indeed, many provide education, housing and healthcare to farmers and their families.

Free trade isn't actually free: The analysis of the problems of free trade are similar to those articulated above. However the solution, it is argued, is not to dismantle the free market but to liberalise it properly. A truly free market would actually benefit developing world farmers because, by removing support for developed world farmers it would make the former more competitive and lead to higher rather than (as is now the case) artificially depressed prices. This in turn would enable poor countries to earn foreign exchange which could then be invested in developing other more profitable sectors of the economy, such as the manufacturing and services industries. They also point out that environmentalists cannot 'have it both ways'; they cannot complain that the current trade system does not allow the developing world to compete effectively and at the same time argue that no one should be trading at all.

Local food is not a sufficient priority for consumers: Supermarkets and manufacturers merely give people what they want and market research suggests that the provenance of food plays little part in most people's shopping decisions. Most people want a wide range of food that is convenient to prepare and any retailer who doesn't provide it will go out of business. Supermarkets have grown in power because they provide this convenience at low cost. To meet customers' demands for such food, and at a cost which is acceptable to the consumer and financially viable for the retailer, the latter has to source from wherever it is available. It is also the case that, where there is demand for local foods, supermarkets have also been active in sourcing and providing them. Most local shops rely as heavily on internationally sourced foods as the supermarkets.

The past was not a pretty place: Poor quality food was a fact of life in the past. We are now healthier than ever before and much of this is thanks to a better diet. Life expectancy in the UK has increased and is continuing to do so, we are growing taller and babies are born with higher birthweights – all signs of good nutrition. While some nutrition-related illnesses are increasing (such as heart disease, strokes and diabetes) others also caused by poor nutrition, including rickets and scurvy, are on the decline. Supermarkets are responding to our changing nutritional needs by developing healthier options, both of the '*Be good to yourself*' variety and through the provision of fresh fruit and vegetables, often in forms which make it easier for people to make healthier choices.

Localisation is not practically achievable: We cannot grow everything we need locally and we never have been able to. There has always been trade between regions, countries and continents. Even where some food can be supplied locally, it may not be sufficient to meet demand or consumer expectations of quality and price, and there will always be seasonal shortfalls. Sourcing some produce locally and some from further afield, while achievable, could lead to the development of two supply chains and arguably more environmental damage.

Logistically it wouldn't work: The existing system, whereby supplies are delivered to a regional or national distribution depot, consolidated with other products, loaded to maximum capacity onto an efficient heavy goods vehicle and delivered to store, with good use made of the return journey through the backhauling of packaging or a pick-up from a supplier, is highly efficient. The alternative – half-empty, far less efficient vans delivering direct to store, without interim consolidation – is not. Shelves would be half empty, congestion would worsen and greenhouse gas emissions would rise.

Glossary

Backhauling: Backhauling in its simplest form means that a retailer's vehicle collects goods from local suppliers after making a delivery to store, the aim being to eliminate empty (and therefore profitless) vehicle journeys. However, advanced Information and Communications Technology (ICT) has enabled backhauling systems to become increasingly sophisticated in the complexity of the routes they take, in their flexibility to change plans (for instance to detour a traffic jam) and in the functions they perform. Where a third-party logistics provider is involved, backhauling operations may span a variety of different sectors. For instance a 3PL may deliver a shipment of goods to a car plant and then, on the return leg, collect goods from local food suppliers.

Corporate social responsibility: The Department of Trade and Industry offers the following definition of a socially responsible corporation: *'It recognises that its activities have a wider impact on the society in which it operates. In response it takes account of the economic, social, environmental and human rights impact of its activities across the world and it seeks to achieve benefits by working in partnership with other groups and organisations.'*[401] Unison Scotland notes that *'CSR in its most complete sense would permeate all core and non-core activities, creating an intrinsic link between ethics and the actions of the company/organisation/body.'*[402]

Due Diligence: Most trade and consumer laws are subject to 'strict liability'. A party who contravenes these laws is culpable even if there is no guilty intent or knowledge on their part. However a defence, on the grounds of Due Diligence, is available if the party charged can show there was an effective system in place designed to ensure that all 'reasonable steps' were taken to prevent the offence being committed, and 'Due Diligence' was exercised to ensure that the system was effectively managed.

Efficient consumer response: An initiative set up by the food industry, with the aim of 'working together to meet consumer needs better, faster and at less cost'.

Embodied energy: The total energy involved in the production of food from raw materials to finished product.

Factory gate pricing: Suppliers and retailers agree a price for the goods which excludes the cost of transport. Traditionally transport costs have been included in the manufacturer's price. By establishing a factory gate price the retailer is able to review the importance of transport relative to the end price of the product. The retailer can look at ways of improving transport efficiency and compare prices between manufacturers. On many occasions this may mean that retailers pick up goods direct from the manufacturer, instead of receiving deliveries from the manufacturers into their (the retailers') RDCs. On the way to the manufacturer, retailers can make use of the empty outward journey by dropping off goods to a store, returning packaging for recycling and so forth, so removing the need for a separate journey.

Food industry: The term includes farmers, processors, manufacturers and retailers of all sizes.

Food miles: A phrase used to encapsulate concerns about the increasing distances our food travels, and the environmental and social consequences thereof.

Goods lifted: The actual tonnage of goods carried.

Goods moved: See tonne-kilometres.

Intergovernmental Panel on Climate Change (IPCC): A body established by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is open to all members of the UN and of the WMO.

Inventory: The amount of goods in the supply chain.

Just in time (JiT): Definitions abound. One defines it as *'the principle that goods are delivered at the right quantity at the right place immediately in advance of their requirement.'*[403] Another calls it a philosophy as much as a technique, *'based upon the simple idea that wherever possible no activity should take place in a system until there is a need for it. Thus no products should be made, no components ordered, until there is a downstream requirement.'*[404]

401 *Business and Society: Corporate Social Responsibility report 2002*, Department of Trade and Industry, London, May 2002, www.societyandbusiness.gov.uk/pdf/2002_report.pdf

402 See: www.unison-scotland.org.uk/briefings/csrethicsbrief.html

403 Hall D and Braithwaite A, *The Development of Thinking in Supply Chain and Logistics Management*, chapter in Brewer A, Button D and Hensher D, (eds) *Handbook in Transport 2: handbook of transport, supply chain and logistics*, Pergamon, UK, 2001

404 Christopher M, *Logistics and Supply Chain Management: strategies for reducing cost and improving service*, *Financial Times*/Pitman Publishing, UK, 1998

Locality: this is food from a specific provenance which is distributed widely. For instance Somerset Brie is available across the UK. Locality food is an issue more related to branding and marketing than to transport distance.

Locally sourced or **local food:** Food whose main ingredients are grown, processed and sold from or within a given radius. The Campaign to Protect Rural England and Waitrose limit this radius to 30 miles; others may adopt a county-wide or less rigid definition. Few, if any, organisations take into account inputs such as agricultural machinery, although many would endorse local sourcing of these where possible.

Locally focused or **more local** systems are approaches which favour sourcing from nearer to hand rather than from national or international sources. It is a relative, non-prescriptive term and could in some cases mean sourcing a product from France rather than from California.

A **local store:** An independently owned shop or a member of a symbol group or co-operative. Many multiple-owned store formats, such as Sainsbury's Local or Tesco Metro are also 'local.' However, their distribution systems are linked in with those of the retailers' bigger store formats and will be similar, if not identical to them. For the purposes of this study, and to differentiate clearly between systems to be explored, we do not include these multiple-owned local stores in this definition. We occasionally use the phrase **independently-owned store** to clarify the distinction.

Lower carbon food: A system focused on delivering lower carbon food is one which attempts to source, produce and supply food in ways that minimise carbon emissions. The ultimate objective is to achieve an absolute CO_2 reduction along the whole of the food supply chain, from plough to plate to landfill site, in keeping with IPCC (see above) recommendations. Strategies to minimise CO_2 impacts from transport (including the *shorter-plus* approach, defined below) will be balanced against those which focus on reducing other life-cycle emissions.

Local consolidation point (LCP): A small centre where goods from the local area can be consolidated before continuing on their journey, either direct to a store or to a RDC.

Payload: The revenue producing part of a cargo – in other words, the goods being carried rather than the weight of the vehicle.

Radiative forcing: The change in the balance between solar radiation coming into the atmosphere and infra-red radiation going out. Positive radiative forcing tends on average to warm the surface of the Earth, and negative forcing tends on average to cool the surface. The addition of greenhouse gases traps infra-red radiation, re-radiating it back toward the surface and creating a warming influence.

Regional food: Food from a catchment area such as the North-West, or Wales.

Regional distribution centre (RDC): The supermarkets each own a number of large warehouses or RDCs strategically located across the UK. The RDCs receive goods from consolidation points and from manufacturers, both from within and beyond the region. Goods are consolidated onto lorries and then delivered to stores.

***Shorter-plus* supply chains:** An approach in which there is a deliberate attempt to shorten the supply chain, taking into account and balancing geographical distance against other transport-related factors with a bearing on CO_2. This approach strikes a balance between the differences in emissions from different modes of transport (rail, sea, road, air) as well as different types of road vehicle, loading factors, route and so forth.

State aids: A form of assistance given by the state to an enterprise or sector. State aid comes in many different forms (not just as subsidies or grants) and no single definition will apply to all its manifestations. The European Commission is, however, very clear that any form of aid – whether provided directly by the state or indirectly through 'state resources' – is incompatible with the Common Market if it distorts or threatens to distort competition within the Community.

Third-party logistics provider (3PL): A specialist in logistics who provides a number of services. These include managing fleets and warehouses for retailers or manufacturers. Sometimes the 3PL uses its own warehouses and vehicles and sometimes it uses those belonging to the client.

Tonne-kilometres: A measure of freight, based on multiplying the weight of the load and the distance through which it is hauled. For instance a weight of 26 tonnes carried 100 kilometres represents 2600 tonne-kilometres.

Vehicle-kilometres: A measure of freight, based on multiplying the number of vehicles by the distance they travel. For instance ten vehicles each moving 100 kilometres represent 1000 vehicle-kilometres.