Notes on the transport of food

It is generally considered better to buy locally grown food i.e.to avoid foods that have been transported any great distance and this note looks at the benefits of doing this, primarily from the point of view of greenhouse gas emissions.

To put this into perspective - according to Mike Berners-Lee, in his book *How Bad are Bananas?* - overall, 8.6% of the carbon footprint of food, as it leaves a UK supermarket, is due to transport; and 25% of this is due to a small number of products that have been airfreighted. Interestingly, he estimates that 7.3% of emissions are due to packaging. So these two aspects of supermarket food have similar carbon footprints. Some may be surprised at the fairly low figure for transport.

It is not easy to find out the country of origin of some foods, particularly basics such as flour and other grains. Nor is it easy for many processed foods – ready meals, some canned foods and the like.

Not surprisingly, "buying local" and "food miles" are not as straightforward as they might seem.

Consider tomatoes. Locally grown tomatoes in the summer, with no artificial heating, are definitely "good" i.e. low carbon. If we want tomatoes outside, say, June to October, then there are some British ones around, lots of Dutch ones, and some Spanish and Moroccan ones and some from even further away. Virtually all commercial tomatoes are grown under glass or plastic, but the Spanish and Moroccan ones have been grown using only the sun's heat, while the out-of-season British and Dutch tomatoes have been grown in greenhouses heated by gas or electricity. So, which are "best"?

Or lamb. Because of the better climate, and its less dense human population, New Zealand sheep graze almost exclusively on natural grass, with few other inputs. British sheep generally have to have additional feed in the winter, and often graze on "improved" grassland that has been fertilized. Despite the freight distance, some studies have shown that NZ lamb has a smaller carbon footprint when it arrives at the UK butcher, and others have shown that UK lamb has. So, whatever the correct answer, it is presumably a close run thing.

Transport Emissions

There are numerous sources giving CO_2 emissions of various transport types, and some vary quite considerably. For the purpose of this note, the figures produced by the Department of Energy and Climate Change have been used, as they have presumably been calculated in a consistent manner, and so their relative values are likely to be realistic. These figures for freight include the emissions involved in extracting, processing and transporting the fuel, so called WTT (well to tank) emissions.

- Air freight – long haul — 1,419 gm $CO_{2\,e}$ per tonne per km**
- Container ship — 19 gm $CO_{2\,e}$ per tonne per km
- Container ship (refrigerated) — 34 gm $CO_{2\,e}$ per tonne per km
- Train (UK) — 32 gm $CO_{2\,e}$ per tonne per km
- Van up to 3.5T Gross weight (Av payload) — 645 gm $CO_{2\,e}$ per tonne per km
- Large Truck
  - (Average all HGVs, average payload) — 138 gm $CO_{2\,e}$ per tonne per km
  - (Average all HGVs, fully laden) — 106 gm $CO_{2\,e}$ per tonne per km
  - (Artic. truck, average payload) — 104 gm $CO_{2\,e}$ per tonne per km
  - (Artic. truck, fully laden) — 76 gm $CO_{2\,e}$ per tonne per km
- Large Truck (refrigerated)
  - (Average all HGVs, average payload) — 162 gm $CO_{2\,e}$ per tonne per km
  - (Average all HGVs, fully laden) — 124 gm $CO_{2\,e}$ per tonne per km
  - (Artic. truck, average payload) — 122 gm $CO_{2\,e}$ per tonne per km
  - (Artic. truck, fully laden) — 89 gm $CO_{2\,e}$ per tonne per km

**Most estimates are about 500-600. However, DECC include the Radiative Forcing Index, which is a factor which DECC takes as 1.9, which is applied to emissions at above 30,000ft, to take account of the significantly higher impact they have.

The absolute figures are not too important for this note, only the approximate comparisons. Air freight emissions are clearly huge, whatever the correct technicalities of the method of calculation.

The various different emissions for road transport are shown, as it demonstrates the difficulties of comparing different methods of transport, and indeed comparing transport with, say, heating greenhouses or using fertilisers.

In order to help compare international freight emissions, some distances are listed here:-

Airfreight distances

- Nairobi to London 6,750 km
- Mexico City to London 9,000 km
- Cape Town to London 9,500 km

Sea distances

- Cape Town to Southampton 11,000 km
- Abidjan (Ivory Coast) to Southampton 6,400 km
- New York to Southampton 5,800 km
- Miami to Southampton 7,100 km
- Rio de Janeiro to Southampton 9,200 km
- Haifa to Southampton 5,800 km
- Auckland to Southampton (via Panama) 20,500 km
- Valencia to Southampton 2,800 km

Road distances

- Valencia to Dover 1,650 km
- Almeria to Dover 2,100 km
- Rome to Dover 1,700 km
- Marseilles to Dover 1,100 km
- Frankfurt to Dover 600 km

So, what are the implications of these figures? Here are some examples:-

Trucking produce to Dover from Almeria in southern Spain (a major source of tomatoes, peppers, other salad crops and melons, grown under plastic, and requiring minimal, if any, heat input), and assuming a fully laden refrigerated HGV (Heavy goods vehicle) is used, gives rise to emissions of **260 gm $CO_{2\,e}$** per kg of produce {124 x 2,100/1,000}. If this produce was shipped from Miami to Southampton, it would give rise to **241 gm $CO_{2\,e}$** per kg of produce {34 x 7,100/1,000}. If shipped from Haifa, or Alexandria, the emissions would be **197 gm $CO_{2\,e}$** per kg. Clearly there is likely to be further transport within the countries to be added, sometimes significant distances.

As can be seen from the various transport emissions shown above, those for smaller road vehicles are much higher per tonne than for larger ones. In fact the DECC figures give emissions of 745 gm $CO_{2\,e}$ per tonne per km for small diesel vans of up to 1.3 T gross weight. Compare this with 76 gm $CO_{2\,e}$ per tonne per km for a fully laden articulated truck, and it is clear that it is difficult to generalise on the emissions from transporting produce within UK, when a vehicle of either extreme, or anything in between, may be used, depending upon circumstances and distance. For instance a small van travelling 200 km will give rise to **149 gm $CO_{2\,e}$** per kg of produce {745 x 200/1,000}, only a little less than the **197 gm** due to shipping from Haifa!

These emissions pale into insignificance compared to those emitted by the air freighting of produce, which is becoming increasingly common as more wealthy people demand out of season produce. Flying vegetables from Kenya, say, gives rise to **9,600 gm $CO_{2\,e}$** per kg of produce {1,419 x 6,750/1000}; and from Cape Town **13,500 gm $CO_{2\,e}$** per kg.

[In passing, although this note is concerned with food, it is interesting to note that, according to Mike Berners-Lee (see above), the emissions due to one red rose on St Valentine's Day are **350 gm $CO_{2\,e}$** if flown from Kenya, and **2,100 gm $CO_{2\,e}$** if produced in Holland (but see below about CHP).]

As regards transporting goods, then, it is evident that the distance travelled is obviously important and it is not normally difficult to find out the country of origin of food. But the method of transport is just as important, and that is not so easy to ascertain. Shipping from Egypt or Israel gives rise to lower emissions than trucking from southern Spain, and possibly even from trucking inefficiently for a comparatively short distance within the UK.

Tomatoes

So, back to the tomatoes mentioned above. We like tomatoes, but unfortunately they can only be produced in the UK from about June to October without the help of artificial heat. They are grown commercially under plastic or glass. Also they cannot be stored for a long time. A number of studies have been carried out of the "carbon footprint" of growing tomatoes commercially out of season in Northern Europe, and they come up with varying estimates generally between 2,000 and 4,000 gm $CO_{2\,e}$ per kg (though some are much higher). This is due almost entirely to the need to heat the greenhouses. In season, emissions are small, as for any other or vegetable grown using sunlight: of the order of 250 to 500 gm. For commercial growing the main emissions are due to pesticides, fertiliser and in many cases glass or plastic housing. Home grown are very low indeed.

In the Almeria area of Spain tomatoes, and other vegetables, can be grown commercially throughout the year, under plastic, without heat other than the sun. We have seen above, that the emissions due to trucking tomatoes to the UK is about 260 gm $CO_{2\,e}$ per kg. So, from an emissions point of view, it is preferable to buy Spanish or Moroccan tomatoes out of season, rather than those grown using heated greenhouses in UK or Holland. So, look at the labels, but don't buy local out of season. In passing, organic tomatoes grown with heating give rise to higher emissions than non-organic because of the additional area required to grow the same weight of fruit.

BUT, just to add a further complication, tomato greenhouses in Northern Europe are increasingly using Combined Heat and Power (CHP) systems to heat their greenhouses, which reduces emissions due to tomato growing. One Dutch study estimates that a system that sells electricity to the grid and uses the waste heat to heat the greenhouses cuts the net emissions of growing tomatoes out of season by about 50%. In the UK, the Wissington sugar factory in Norfolk generates its own electricity using gas, and the potentially wasted heat is used in their huge tomato greenhouse. In addition some of the CO_2 produced by the power station is pumped into the greenhouses to help plants growth. In both these cases the calculation of emissions due to growing tomatoes depends upon how one allocates emissions between electricity generation, tomato growing, and in the latter case sugar production. So perhaps they aren't so bad, emissionswise, at least.

What should one do?

Considering transport, how should one go about buying food? Here are some suggestions and guidance.

- Buy fruit and vegetables only when they are in season, particularly those that grow in northern Europe. Buy produce as locally grown as possible within the UK. If a product obviously has a short shelf life – salad crops, asparagus, strawberries, for instance - and it is available out of season it has either been grown in a heated greenhouse or travelled a long way, quite likely by air.
- Find out where it was grown, particularly if you feel the need to buy out of season produce. It will be written on a supermarket packet, and if a market stallholder doesn't know, you can usually find the box that it was carried in. You can make an assessment as to whether it is likely to have travelled by air, sea or land; or indeed been grown in a heated greenhouse.
- Fruit such as oranges and bananas, though grown long distances from the UK, are not normally transported by air, and so their transport gives rise to comparatively low emissions; similarly for out of season apples. Grapes are also generally seafreighted, or trucked, from within Europe.
- It is more difficult to find out how some tropical fruit travel. Papaya and mango appear to be airfreighted generally, while avocado pears are increasingly being moved by sea, as storage techniques improve.

- Buy local or frozen fish and shellfish. Fresh fish or shellfish from outside Western Europe are likely to have travelled by air. Buy local or frozen, therefore. Though this note only concerns transport, buying Marine Stewardship Council (MSC) certified produce ensures that it is from a sustainable fishery.
- The production of meat and dairy gives rise to large emissions, which is not the subject of this note. Meat is not generally airfreighted because of its weight and the fact that it can be frozen. So the additional emissions due to its transport do not tend to add significantly to its overall impact. The same applies to most dairy products.

To conclude

As can be seen, buying food in a way that minimises greenhouse gas emissions from transport is not as straightforward as might be thought.

The production of most meat and dairy products gives rise to high levels of greenhouse gas, even without transport emissions. The production of most grain, pulses, fruit, vegetables and fish does not need to give rise to high emissions; but it probably does when grown very intensively, or out of season.

Eating fruit and vegetables when they are in season in the UK is the best way to minimise their emissions; concentrate on those grown locally within the country. Assessing emissions from out of season produce can be tricky, as the production process and emissions of different transport modes, as well as the distance transported, can be very significant. A rough assessment of transport emissions can be made using the information in this note.

Brian Shorter, October 2015