A Low Carbon Route Map

Planning and Measuring Emission Savings for Climate Challenge Fund Projects. 2011 (version 1.0)

Food

KEEP SCOTLAND BEAUTIFUL®

The Scottish Government

Introduction

All over Scotland and beyond, people are working together in communities to reduce CO_2e[1] emissions. These are early days and there is still much to learn about what works – lots of new approaches and ideas to be tried and explored. Any community thinking of developing carbon reduction projects will be at the forefront of the journey to a low carbon society. This means that while there is much to learn from others' successes (and occasional failures) some of this is uncharted territory in which you'll be pioneers.

The Route Maps aim to help you and your community develop projects that are relevant, engaging and have maximum chance of success. The Route Maps cover three areas to help you start your community's low carbon journey:

1 - Surveying the landscape: Before starting any new journey it's important to learn as much as possible about what lies ahead. Here you'll find information on the scale of emissions from food production and consumption, a breakdown of where these emissions come from, an overview of the measures available for reducing emissions, and information on some of the other benefits of reduction measures.

2 - Estimating and measuring your emission savings: Here you'll find advice to help you estimate what the emission reductions from your project will be (if you are at the planning stage) – and also advice on how to measure your emission savings once your project is underway.

3 - Information: This section provides links to sources of further information and advice, and also provides lists of emission factors and data for estimating emission savings.

A warning:

- The Route Maps don't replace the detailed Climate Challenge Fund guidance on completing an application – read that as well!

Every community is different. The aim of the Route Maps is not to tell anyone the 'best' way to do any project (because there is no one 'best' way) but to help you develop projects that work for your community.

Good luck – enjoy the journey!

The *Low Carbon Route Maps* were originally researched, written and designed by Osbert Lancaster of Footprint Consulting Ltd, Evan Williams of Environmental and Resource Economics Limited, and Alan Speedie Associates Ltd for the Climate Challenge Fund, in July 2009. This Route Map has been updated by Ecometrica and KSB staff in October 2011.

[1] CO_2e is used to refer to different greenhouse gases in a single unit, and is used throughout the Route Maps to refer to all relevant greenhouse gases. CO_2e is the amount of CO_2 which would have the equivalent global warming impact as the quantity of greenhouse gas in question. E.g. methane is 25 times more potent as a greenhouse gas than CO_2, so 1 kg of methane can be expressed as 25 kgCO_2e. The main greenhouse gases which are likely to be relevant to CCF projects are: carbon dioxide (CO_2), which predominantly arises from fossil fuel combustion and land use/land use change, methane (CH_4) which predominantly arises from fossil fuel combustion, livestock digestive systems, and waste disposal in landfill sites, and nitrous oxide (N_2O) which predominantly arises from fossil fuel combustion and the application of nitrogen fertilisers in agriculture.

1 - Surveying the landscape

Food projects are some of the most interesting types of low carbon projects — everyone needs food and everyone has opinions on it, so it's something that people are often keen to get involved with. There are many different sorts of projects — from growing food to changing shopping choices, from simple steps an individual can take, to large projects involving a whole community.

At the same time, the relationships between food and climate change are complex. There are many reasons for this — there are so many sorts of food (from lamb to lettuce, from bread to bananas), each can be produced in different ways (lettuce in heated greenhouses in winter or in your garden in summer) and in different places (lamb from a hill farm a few miles away to lamb from New Zealand). And of course, even food produced a long way off can be transported in different ways — by air freight or by sea. When one starts to consider not just greenhouse gas emissions, but also other environmental and social issues such as pesticides and fair trade it can become even more complex.

In this Route Map we'll try to keep things simple — focussing on practical actions that community projects can do, and providing the information you need to have confidence that your projects are making a difference.

Scale of emissions

Almost every action, from growing food to processing it, transporting it and disposing of the waste, releases gases that cause global warming.

The total emissions associated with the food we eat in Scotland add up to around 12 million tonnes of CO_2e (excluding emissions from land use change). This accounts for around 14% of the total greenhouse gas emissions associated with Scotland's consumption[2].

Where do these emissions come from?

The largest share of the supply-chain emissions (40% of total food related emissions) is from agriculture – how the food is produced on the farm. The next biggest shares are from food manufacturing (12%) and food transport (12%). The disposal of waste food accounts for 1.6% of emissions – although we can reduce emissions by much more than this by reducing the production of food which is then wasted[3].

Figure 1 shows the breakdown of supply chain emission sources associated with food consumption.

[2] These figures are derived from Audsley et al (2009) and the Stockholm Environment Institute 2009.
[3] The figures for the breakdown of supply chain emissions associated with food consumption are derived from figures in Garnett (2008).

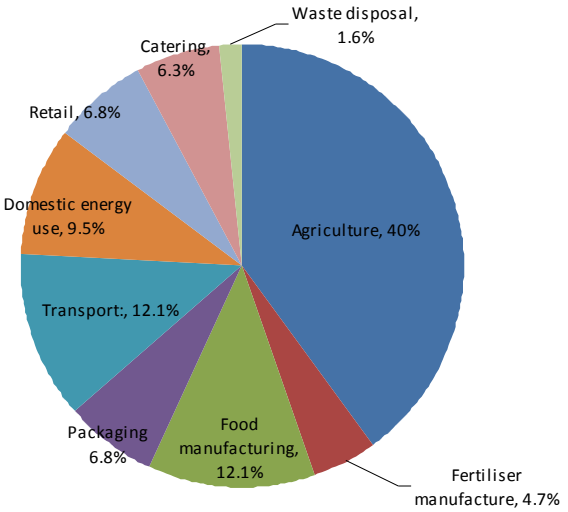

Figure 1.

Agriculture

The main emissions from the agricultural sector are from soil management (from using fertilisers, ploughing in of crop residues, the cultivation of organic soils etc) and methane (CH_4) emissions from ruminant livestock (cattle and sheep). Emissions from fossil fuel use for energy on the farm are relatively minor in comparison, however this source of emissions could be more significant for some crops, typically salads and Mediterranean vegetables such as aubergines, if they are grown in greenhouses heated and lit by non-renewable energy.

Figure 2 shows the breakdown of emissions from the agricultural sector in the UK.

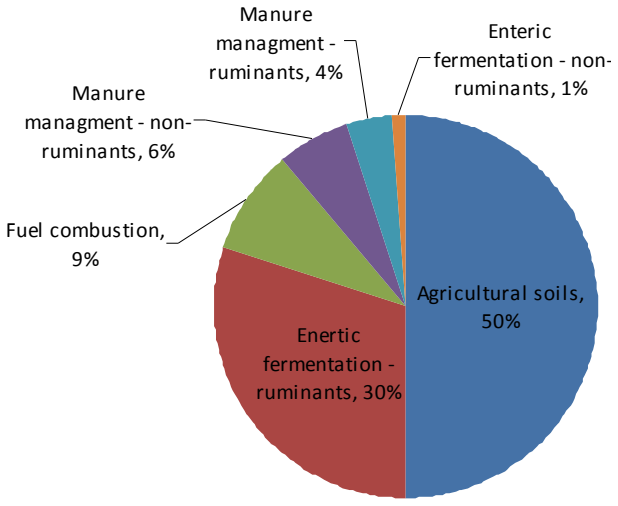

Figure 2.

The numbers shown above are for agriculture in the UK, rather than for the world-wide agricultural systems which supply the UK (see Table 1 in the Information Section). However, the numbers give an indication of the largest sources of agricultural emissions associated with the food we eat. A further point to note is that the figures above don't include the emissions

from land use change (e.g. deforestation) which can be caused by our demand for food. It is difficult to measure the land use change emissions associated with our food consumption. It is worth being aware that if these emissions were included then the total emissions associated with the food we eat would be a lot higher.

Transport

The transport of our food accounted for about 19 million tCO_2e in 2002, of which 10 million tonnes were emitted within the UK, representing 8.7% of total emissions in the UK road sector[4]. The other 9 million tCO_2e is emitted getting this food to the UK. How this is split between different modes of transport as shown in Figure 3.

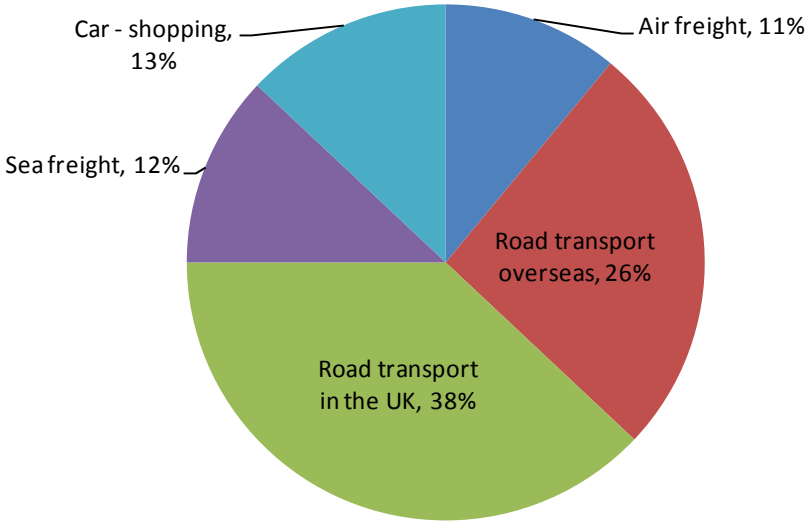

Figure 3.

A small proportion of the food imported into the UK comes by air – accounting for less than 1% of total food 'tonne kilometres' (the weight of food and how far it has travelled). However, this 1% accounts for 11% of all food transport CO_2e emissions, therefore cutting the small amount of air freighted food that we purchase could have a significant impact on our food emissions. It is worth noting that 13% of food transport related emissions is caused by shopping by car. This is an area we could reduce by shopping more locally on foot and reducing the number of car trips.

Refrigeration

Food refrigeration is also an important source of emissions throughout the food chain. This includes the storage, distribution, retailing and home storage of perishable foods including fruit and vegetables, chilled products and frozen goods. It is estimated that the 'cold chain' accounts for around 15% of total food chain emissions[5]. (This 15% is not shown separately in Figure 1 as it's already included in food manufacturing, retail and so on.)

[4] Defra (2005).
[5] Garnett (2008)

In the home

Activities in the home account for around 9% of food emissions. This includes cooking, refrigeration, freezing and washing up – all of which use energy. Emissions from these activities can be reduced by making sure you have energy efficient equipment and not using it more than you need to. This is covered in the Route Map on Energy.

Waste

Over 2 million tonnes of food is wasted in Scotland every year – about a third of this is household food waste[6]. This contributes to greenhouse gas emissions in two ways. When food waste is sent to landfill it degrades and can generate methane. Disposing of 1 kg of food waste to landfill generates approximately 0.45 kg of CO_2e[7]. A much bigger impact comes from all the emissions associated with producing the food in the first place. This is sometimes referred to as 'embodied' CO_2e. If we didn't have to produce the food wasted by households about 2% of total embodied emissions from Scottish consumption would be avoided, or approximately 18% of total emissions associated with food consumption.

WHAT CAN WE DO ABOUT IT?

As can be seen from the information above, there are lots of different sources of emissions associated with food, from agriculture through to waste disposal. It is not always easy to say which foods are more climate friendly because there are so many factors to take into account. For example, how do you choose between lettuce which is transported from Spain and lettuce grown locally in a heated greenhouse? Later on in this Route Map you'll find some ways of estimating the difference – but there are some simple rules of thumb for reducing food emissions:

- Reduce the amount of food that is wasted, for example, by using leftovers and planning meals.
- Eat less 'high carbon' food, and more 'low carbon' food, such as vegetables and cereals.
- Eat food that is in season.
- Less processed and less travelled is generally better.

These different ways of reducing the emissions associated with food are discussed in more detail in the following sections.

Reducing food waste

Scottish households produce around 566,000 tonnes of food waste every year, and this equates to embodied emissions of around 2 million tonnes of CO_2e that was emitted in producing the food[8]. That food waste also generates methane (a powerful greenhouse gas) when sent to

[6] Scottish Government (2010).
[7] Zero Waste Scotland (2011)
[8] Love Food Hate Waste campaign (2011).

landfill. Some household food waste can't be avoided - for example, vegetable peelings, tea bags and chicken bones, but over half of all food waste is avoidable.

The main reasons that food is thrown away are that we cook too much and don't eat it all; and that we buy too much and don't use it before it goes off. This waste doesn't just contribute to global warming – it hits our pockets. The cost of avoidable waste is around £480 per household per year[9].

Projects to reduce food waste could provide information and advice to individuals, households and members of community groups. This could range from providing simple information leaflets through to cookery classes which include advice on shopping and cooking to avoid waste and to make good use of leftovers. Successful projects will probably focus not just on CO_2e but will meet the needs and interests of people and partner organisations as well – for example, helping save money, providing opportunities for socialising, and learning new skills.

There will always be some food waste, and composting could be promoted to reduce emissions compared with sending it to landfill. Projects to encourage and support home or community composting could also be linked with food growing activities. Food composting, while not difficult, must be done properly to avoid health risks and attracting vermin. Larger projects may need to be licensed. For advice, see the Information Section. Local authorities are keen to encourage food (and garden) waste composting and may be able to advise and support your project.

Choosing a climate friendly menu

Even small changes to our diets can make big changes to our emissions. Vegetables and cereals tend to have low associated emissions, and a diet based on these foods will generally have low climate change impacts (though seasonality and transportation should be borne in mind too).

A more climate friendly menu could also mean a tastier, more nutritious diet than many of us eat at the moment – and it could be cheaper too. For meat and dairy products, it could include eating less overall but choosing higher quality products. For fruit and vegetables a climate friendly menu will vary through the year, adding interest to our meals and reconnecting us to the seasons.

Projects promoting and supporting climate friendly menus might have much in common with and could be combined with projects to reduce food waste. Projects might also be able to link in with local traditions, including reviving interest in local varieties of fruit and vegetables, building links with local farmers and growers and, of course, with growing food in gardens and allotments.

Something to be aware of is that there is some debate about whether organic food has lower emissions than non-organic or 'conventionally' produced foods. Some studies have found that organic foods have higher emissions than other forms of production[10], while other studies have reached the opposite conclusion[11]. Answering this question is very difficult as it involves estimating a number of uncertain factors such as the amount of carbon stored in soils and the

[9] WRAP (2009).
[10] For example ADAS (2009).
[11] For example FAO (2010), and Hirschfeld et al (2009).

amount of indirect land use change caused by using more extensive farming methods. Organic food may have lower emissions, but it is not possible to say this with certainty.

Growing food locally

Growing food locally can reduce emissions, where it reduces the distance food travels – so long as extra inputs (such as greenhouse heating, artificial fertilisers, and transport to allotments) do not outweigh the benefits. Food freshly harvested from gardens and allotments will also avoid the refrigeration used when storing and transporting fruit and vegetables.

Gardening has a number of benefits for physical and mental well-being – local food projects could link up with projects and organisations interested in these issues. Cultivating underused or waste land can also provide opportunities for bringing the community together, as well as making the place look better.

These are just some possible food projects for CO_2e reduction. You may want to adapt one of these approaches, or some other project that you think is inspiring, or you may have some great ideas for a completely new approach. You may have several ideas for projects – and need to choose which ones to develop.

Whatever the case, before diving into detailed planning, it is worth stepping back and seeing how your possible projects match up, not just against CO_2e savings, but also against other criteria that may make the difference between a flop and success.

Other benefits

Food projects which reduce CO_2e emissions can also have other benefits – environmental, social and economic.

Environmental

Other environmental benefits of food projects can include enhancing the amenity value of waste or under-utilised land for allotments, and helping to reduce the amount of space taken up by landfill sites. .

Social

Social benefits can include improved health through healthier eating, increased exersise and reduced exposure to hazardous chemicals for workers and consumers. Diets which are more 'climate friendly' can also be good for you, e.g. eating more vegetables.

Economic

Growing more food locally creates jobs and helps boost the local economy. For example, farmers' markets are generally welcomed by existing retailers who find that their business increases due to the extra shoppers.

2 - Estimating and measuring your emission savings

This section provides information on how to estimate the CO_2e savings from your project, either at the planning stage, or during/after the implementation of the project. Estimating the CO_2e savings is important for a number of reasons:

1. The Climate Challenge Fund application process asks for an initial estimation of possible CO_2e savings in order to evaluate project proposals.
2. Estimating CO_2e savings is useful at the project planning stage, and during the implementation of a project, as it helps to identify the most effective activities for reducing emissions, and it also helps to identify project activities which may inadvertently increase emissions (and which can then be minimised).
3. Going through the process of making an initial estimation of savings at the planning stage also helps to identify the key pieces of information that are needed to calculate actual emission savings. These pieces of information may have to be estimated or assumed at the planning stage, but can subsequently be collected from community participants while the project is running. Thinking about this early on means that opportunities to collect information aren't missed.
4. The results from calculating CO_2e savings may be useful for motivating the project's participants, and CCF projects are required to report their savings to Keep Scotland Beautiful and the Scottish Government. Funders need information on the savings achieved by projects to support the case for future funding rounds.

The basic starting point for estimating emission savings is to think about what emissions would have been if your project wasn't happening (this is called the 'baseline') and then to think about what emissions will be once your project is happening (this is called the 'project scenario'[12]). The difference between the baseline and the project scenario is the reduction in emissions achieved by your project. Figure 4 illustrates the way emissions savings are determined by the difference between baseline and project scenario emissions.

[12] The "project scenario" is the situation that exists when your project has been implemented. For example, if your project is promoting allotments then the project scenario is the situation in which people are growing more food on allotments. This can then be contrasted with the "baseline", which is what would have happened if your project hadn't been implemented, e.g. the situation in which less food is grown in allotments and more food is bought from shops.

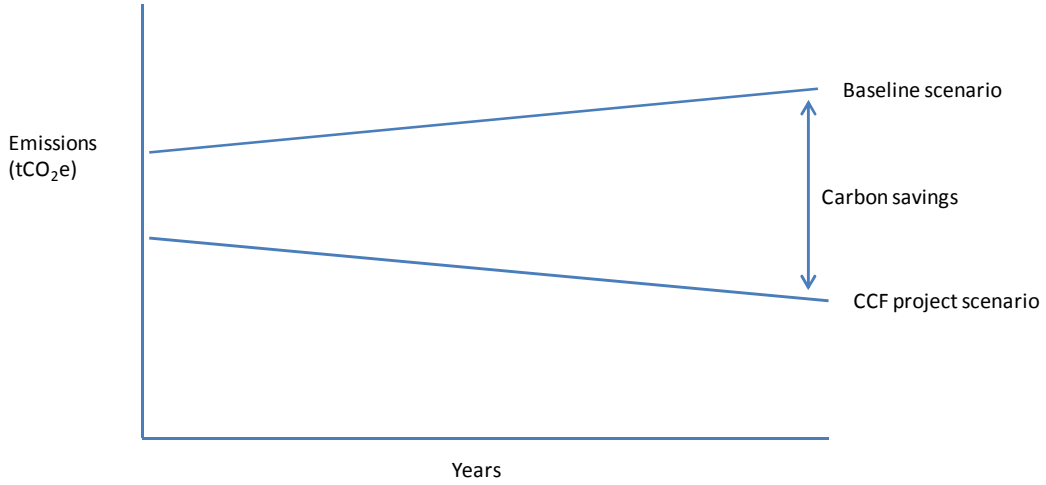

Figure 4.

Two worked examples are presented below to illustrate how emission savings can be calculated.

Example 1. Opening a community allotment

In this example a project is developing a new community allotment so that more people can grow their own food. The allotment area is 1,500m², and it is estimated that the typical yield from the allotment will be around 3kg of fruit and vegetables per m² per year[13]. This means that the expected output from the allotment is around 4,500kg of fruit and vegetables per year (3kg multiplied by 1,500m² = 4,500kg of fruit and vegetables).

Step 1 – Calculate Baseline emissions

The baseline emissions can be estimated by calculating the emissions from buying 4,500kg of fruit and vegetables from shops or supermarkets (as it is assumed that this is what would have happened in the absence of the project). 4,500kg is multiplied by an average emission factor for fruit and vegetables (2.09 $kgCO_2e$ per kg of fruit and vegetables[14]) to give annual baseline emissions of 9,405 $kgCO_2e$.

Amount of fruit & vegetables purchased	x	Average emission factor for purchased fruit & vegetables	=	Baseline emissions
4,500 kg	x	2.09 $kgCO_2e$ per kg	=	9,405 $kgCO_2e$

Step 2 – Calculate project scenario emissions

The project scenario emissions can be estimated by calculating the total emissions from growing fruit and vegetables at the allotment. The weight of food grown (4,500kg) is multiplied by an emission factor of 0.54 $kgCO_2e$ per kg of food grown[15] (which is the emission factor for the inputs used at allotments, e.g. seed, fertilisers, pesticides etc) to give annual project scenario emissions of 2,430 $kgCO_2e$ per year.

[13] This figure is based on NSALG (2010), and is provided in the Information Section.
[14] This factor is derived from Audsley *et al* (2009), and is provided in the Information Section.
[15] This figure is from Carter 2010, and is provided in the Information Section.

Amount of fruit & vegetables grown in allotment	x	Average emission factor for allotment grown fruit & vegetables	=	Baseline emissions
4,500 kg	x	0.54 $kgCO_2e$ per kg	=	2,430 $kgCO_2e$

Step 3 – Calculate the annual emissions savings in tonnes CO_2e

The annual project emission *savings* can then be calculated by subtracting the project scenario emissions (2,430 $kgCO_2e$ per yr) from the baseline emissions (9,405 $kgCO_2e$ per yr) to give a figure of 6,975 $kgCO_2e$ per yr. The units can be converted from $kgCO_2e$ to tonnes of CO_2e by dividing 6,975 by 1,000 to get 6.97 tonnes of CO_2e.

Baseline emissions	-	Scenario emissions	Convert kg to tonnes	=	Annual savings
9,405 $kgCO_2e$	-	2,430 $kgCO_2e$	÷ 1,000	=	6.97 tonnes of CO_2e

Step 4 – Calculate the lifetime emission saving of the project

The only remaining thing to do is to think about how long the allotment will be used for. As a reasonably conservative estimate it is assumed that the allotment will be used for 10 years. The annual emission saving figure of 6.975 tCO_2e/yr can be multiplied by 10 (years) to give total lifetime emission savings of 69.7 tCO_2e[16].

Annual saving	x	Lifetime of actions	=	Total lifetime savings of the project
6.97 tCO_2e	-	10 years	=	**69.7 tonnes of CO_2e**

As illustrated in the example above, it is important to think about any extra emissions that happen in the project scenario, such as emissions from fertiliser used at the allotment, as these effect what the total savings from the project will be. Another possible source of emissions in the project scenario is from people driving to the allotment, and it's worth estimating what the size of these emissions might be (guidance on estimating emissions from transport is available in the Travel Route Map) and if they are significant, then to think about ways of reducing them. For example, people may be driving because they need to carry their gardening tools to the allotment, but if the project provided a tool shed then these journeys could be reduced.

[16] Any disparities in the figures are due to rounding.

Example 2. Reducing the amount of wasted food

In this example a project is planning to run a cookery course and produce an information leaflet to help people reduce the amount of food they waste. It is estimated that 20 people will attend the cookery course and reduce their waste by 15%. The leaflet will be distributed to 500 people, but it is estimated that only 20% of the people receiving the leaflet will actually change their behaviour and reduce their waste by the smaller amount of 5% .

Step 1 – Calculate Baseline emissions

For the **cookery course**, the baseline amount of wasted food can be estimated by multiplying 20 (people) by 330kg of waste[17] (which is the average amount of food waste per household) to get 6,600kg of food waste per year. This figure is then multiplied by the total emissions from food waste which is made up of the embodied emissions factor for typical food waste, 3.59 $kgCO_2e$ per kg of food, plus the emissions factor for landfilled food waste, 0.45$kgCO_2e$ per kg of food waste. This gives the annual baseline emissions of **26,664** $kgCO_2e$. (Please see the 'Tip for thinking about the emissions from food waste' below for more discussion on the distinction between the embodied emissions of food that is wasted, and emissions from the disposal of wasted food).

Average weight of food waste per household	x	Number of people participating	x	(Embodied emissions for typical food waste + emissions from landfilled food waste)	=	Baseline emissions
330 kg	x	20	x	(3.59 $kgCO_2e$ + 0.45 $kgCO_2e$)	=	26,664 $kgCO_2e$

The baseline emissions for the people who change their behaviour as a result of receiving the **information leaflet** can be calculated in the same way. 500 (people receiving the leaflet) multiplied by 20% (proportion changing behaviour) gives 100 (the number of people actually making a change). 100 multiplied by 330 gives 33,000kg, the amount of food waste in the baseline. And this figure is multiplied by 3.59 + 0.45 (the emission factors for embodied and landfill emissions) to give **133,320** $kgCO_2e$, which are the annual baseline emissions.

Average weight of food waste per household	x	Number of people participating	x	(Embodied emissions for typical food waste + emissions from landfilling food waste)	=	Baseline emissions
330 kg	x	100	x	(3.59 $kgCO_2e$ + 0.45 $kgCO_2e$)	=	133,320 $kgCO_2e$

Step 2 – Calculate project scenario emissions

The project scenario emissions for **the cookery course** can be estimated by multiplying 330 kg (annual baseline household food waste) by 85% (100% – 15%, which is the expected reduction in waste) to get 280.5 kg of waste food per household. This is then multiplied by 3.59 + 0.45 (the emission factors for embodied and landfill emissions) and then by the number of

[17] This figure is from WRAP (2009), and is also provided in the Information section below.

people taking part in the cookery course, to get annual project scenario emissions of **22,664** $kgCO_2e$ per yr.

Average weight of food waste per household **after** cookery course	x	(embodied emissions for typical food waste + emissions from landfilling food waste)	x	Number of people participating	=	Baseline emissions
(330 kg x 85%)	x	(3.59 $kgCO_2e$ + 0.45$kgCO_2e$)	x	20		
280.5 kg	x	4.04 $kgCO_2e$	x	20	=	22,664 $kgCO_2e$

The project scenario emissions for the people who change their behaviour as a result of receiving the **information leaflet** is calculated in the same way. 330 kg (annual baseline waste per household) is multiplied by 95% (100% – 5%, which is the estimated reduction in waste) to give 313.5 kg of food waste per household. This can then be multiplied by the emission factors (3.59 + 0.45) and by the number of people participating (100) to get annual project scenario emissions of **126,654** $kgCO_2e$ per yr.

Average weight of food waste per household **after** info leaflet	x	(embodied emissions for typical food waste + emissions from landfilling food waste)	x	Number of people participating	=	Baseline emissions
(330kg x 95%)	x	(3.59 $kgCO_2e$ + 0.45$kgCO_2e$)	x	100		
313.5kg	x	4.04 $kgCO_2e$	x	100	=	126,654 $kgCO_2e$

Step 3 – Calculate the annual emissions savings in tonnes CO_2e

The annual emission savings from the **cookery course** are calculated by subtracting 22,664$kgCO_2e$ (project scenario emissions) from 26,664 $kgCO_2e$ (baseline emissions) to give **4,000**$kgCO_2e$ per yr, which are the annual emission savings. The annual emissions savings from the **information leaflet** are calculated in the same way, with 126,654 $kgCO_2e$ per yr (project scenario emissions) subtracted from 133,320 $kgCO_2e$/yr (baseline emissions) to get **6,666** $kgCO_2e$ per yr, which are the annual emission savings. (The units can then be converted from $kgCO_2e$ to tonnes by dividing by 1,000, i.e. 4,000 is divided by 1,000 to get 4.0 tCO_2e, and 6,666 is divided by 1,000 to get 6.666 tCO_2e.)

	Baseline emissions	-	Scenario emissions	Convert kg to tonnes	=	Annual savings
Cookery Course	26,664 $kgCO_2e$ per yr	-	22,664 $kgCO_2e$	÷ 1,000	=	4.0tCO_2e per year
Information Leaflet	133,320 $kgCO_2e$ per yr	-	126,654 $kgCO_2e$	÷ 1,000	=	6.666 tCO_2e per year

Step 4 – Calculate the lifetime emission saving of the project

Initially it may look like the leaflet leads to larger emission savings as the annual savings associated with the leaflet are higher. However, as noted above, it is important to think about how long each change in behaviours lasts for. In this example it is estimated that the change caused by the cookery class will last for 10 years, and the change caused by the leaflets will last for 2 years (as passive forms of communication like leaflets tend of have less impact). The lifetime savings from the cookery course are calculated by multiplying 10 (years) by 4.0 tCO_2e per yr to get lifetime savings of 40 tCO_2e[18]. The lifetime savings from the leaflet are calculated by multiplying 2 (years) by 6.666 tCO_2e per yr to get lifetime savings of 13. tCO_2e.

	Annual Saving	x	Lifetime	=	Lifetime savings
Cookery Course	4.0 tCO_2e per year	x	10 years	=	40 tCO_2e
Information Leaflet	6.666 tCO_2e per year	x	2 years	=	13.33 tCO_2e
Total savings for both activities					**53.33 tCO_2e**

Collecting information to measure actual emission reductions

The examples above are described from the perspective of a project which is at the planning stage, and is estimating what their emission savings might be. There are a number of estimated pieces of information, such as the amount of fruit and vegetables that are grown, how much people reduce their waste by, how long the allotments will be used for, and how long the change in behaviour will last. All these pieces of information should be checked or updated with better information once the projects are being implemented, or once they are near completion. For example, the project could conduct a survey to ask how much fruit and vegetables are actually produced, or how much people manage to reduce their waste by, and how long they stuck with the new behaviour. Going through the process of calculating emission savings at the planning stage can help to identify all the key pieces of information that should be collected once the project is up and running - and this can help to avoid conducting a survey and then discovering that a key piece of information wasn't asked about!

The Climate Challenge Fund Application Guidance Notes suggest that projects should think about collecting information for key indicators. For food projects the key indicators could include:

1. Quantity of food waste.
2. Quantity of food grown at allotments/gardens.
3. Quantity of 'high carbon' and 'low carbon' food consumed.

Tip for recording assumptions. It is important to record all the assumptions you make when calculating your emission savings, and any justifications/reasons for the assumptions. For instance, in the waste reduction example the embodied emissions of the leaflets produced (i.e. the embodied emissions of the paper) were not included as it is assumed the emissions are

[18] Any disparities in the figures are due to rounding.

too small to be relevant – but it would be good to record this assumption, and to show that it has been considered. It is perfectly acceptable, and often necessary, to make assumptions when estimating emission reductions, but it is important to be transparent about any assumptions, and to be able to explain why they were made.

Tip for comparing emission savings to total food emissions per person. Once you have estimated your project's emission savings you will have a figure in tCO_2e. One useful way of explaining or communicating what this saving means is to express it in terms of some other activity, such as the number of cars off the road, or the emissions from typical household energy consumption. As we are looking at food projects in this Route Map, we could use the food emissions per person in Scotland (which are estimated to be 2.390 tCO_2/yr) as a comparison. So for example, the lifetime savings from the cookery course are equivalent to the annual emissions from 17 people's food consumption (39.996 tCO_2e divided by 2.390 tCO_2e = 17).

Tip for thinking about the baseline and project scenario. It's worth being aware that you don't have to calculate the total baseline and 'project scenario' emissions for any particular emission source, e.g. total emissions from all fruit and vegetables consumed. Sometimes it is easier to just count the emissions that change as a result of the project, as was the case with the allotment example, where only the amount of food grown in the allotment was counted in the baseline and project scenario. An alternative approach would have been to estimate total fruit and vegetable consumption and emissions in the baseline and project scenario, and subtract project scenario emissions from baseline scenario emissions to get the emissions savings achieved – and this should give exactly the same answer. Since the answer should be the same whichever approach is used, you can choose which to use based on what is easiest for you.

Tip for thinking about the emissions from waste. The emissions associated with food waste are made up of two components: one is the embodied emissions from producing the food which is wasted; and the second component is the emissions from disposing of the waste food, e.g. to landfill. Projects that reduce the amount of food that is wasted reduce both the emissions from producing food, which is subsequently wasted, and the emissions from disposing of the waste (in contrast, projects which divert food waste from 'high carbon' disposal methods to 'low carbon' disposal methods, e.g. by composting instead of landfilling, only reduce the emissions associated with waste disposal). When quantifying the emission savings from waste reduction projects it is important to include the reduction in the emissions associated with producing the food that is wasted (particularly as this is often a larger source of emissions than actual waste disposal). This tip applies to any kind of waste reduction project, not just those focused on food waste.

Information Section

GHG emissions from food

'How Low Can We Go' report for WWF and the FCRN. Audsley et al (2009). (p41 – p43)
http://assets.wwf.org.uk/downloads/how_low_can_we_go.pdf

Food Climate Research Network
http://www.fcrn.org.uk

Composting

Zero Waste Scotland. 'Guide to Home Composting'.
http://www.zerowastescotland.org.uk/homecomposting

Food waste

Zero Waste Scotland's 'Love Food Hate Waste' campaign web site.
http://www.wasteawarelovefood.org.uk

WRAP (2009) 'Household Food and Drink Waste in the UK'
http://www.wrap.org.uk/downloads/Household_food_and_drink_waste_in_the_UK_-_report.0866cdad.8048.pdf

Zero Waste Scotland. Emission factors for waste disposal.
http://www.zerowastescotland.org.uk/carbonmetric
(Excel spreadsheet download is under "Related Documents on right-hand side of page)

Stuart, T, (2009) 'Waste: Uncovering the Global Food Scandal' Penguin Paperback
http://www.penguin.co.uk/nf/Book/BookDisplay/0,,9780141036342,00.html

Seasonal food

'Eat Seasonably' campaign
http://eatseasonably.co.uk

Growing food

Friends of the Earth Scotland. *http://www.foe-scotland.org.uk/growyourownfood*

Scottish Allotments and Gardens Society. *http://www.sags.org.uk/*

Grow Your Own Working Group. *http://www.scotland.gov.uk/Topics/Business-Industry/Food-Industry/own*

National Society of Allotment and Leisure Gardeners Limited. http://www.nsalg.org.uk/

Community Food and Health Scotland.

http://www.communityfoodandhealth.org.uk/about/

Healthy eating

Food Standards Agency
http://www.food.gov.uk/

Emission factors

Below are some useful emission factors and data for estimating emissions savings. Table 1 includes a range of information, for example the average yield from an allotment, the average emissions from allotment produce etc. The factors in the table can be used in estimating the savings from food growing projects, waste reduction projects, and composting projects.

Table 1. Data and emission factors

Average yield of fruit and vegetables from an allotment	3.0	kg food/m^2	Derived from NSALG 2010
Average emissions from allotment produce (excluding any transport emissions)	0.54	$kgCO_2e$/kg	Derived from Carter 2010
Average embodied emissions from fruit and vegetables	2.09	$kgCO_2e$/kg	Derived from Audsley et al 2009
Average embodied emissions from food (production and transportation)	3.59	$kgCO_2e$/kg	Defra 2011[19]
Emissions from landfilling food waste	0.45	$kgCO_2e$/kg of waste	Defra 2011
Emissions from composting food waste	0.1	$kgCO_2e$/kg of waste	Derived from IPCC 2006
Average food and drink waste per UK household	330	kg waste/household per year	WRAP 2009
Average food and drink waste per person	111	kg waste/person per year	Derived from Love Food Hate Waste campaign (2011) and Audsley et al (2009)
Average avoidable food and drink waste per UK household	210	kg waste/household per year	WRAP 2009
Average emissions from Scottish food consumption – per person per year	2,390	$kgCO_2e$/person per year	Audsley et al 2009

[19] It's important to be aware that Defra update these factors every year, usually in July or August, so it is worth looking for the most up-to-date factors on the web site.

Table 2 provides emission factors for a number of different types of food, broken down by where in the world they are produced. These factors can be used to estimate the savings from buying UK produced food compared to food from other parts of the world. The factors can also be used to estimate the emissions savings from consuming less of some types of food and more of others.

Table 2. Embodied emissions from different types of food[20]

	$kgCO_2e/kg$ food		
Type of food	**UK**	**Rest of Europe**	**Rest of the World**
Apples	0.46	0.62	1.27
Beans, green	2.24		15.45
Beef	17.52	17.70	32.00
Bread	1.62		
Cabbages	0.32	0.69	0.92
Carrots and turnips	0.51	0.66	
Cauliflowers and broccoli	2.80	3.20	3.45
Cereals	0.53	0.71	
Chicken	4.10	4.26	3.75
Cucumbers	5.47	1.88	
Eggs	4.24	4.39	
Fish	7.74		
Leguminous vegetables	2.24		
Lettuce and chicory	1.66	1.44	14.44
Milk	1.72		
Oats	0.55	0.17	
Pears	0.46	0.62	1.27
Pig meat	6.42	6.58	
Potatoes	0.38	0.74	
Raspberries and other berries	1.21	1.37	2.04
Rice			5.05
Sheep meat	21.09		17.32
Strawberries	1.21	1.53	2.01
Tomatoes	5.47	1.88	
Wheat	0.75	0.91	0.95

[20] All the emission factors in the table are derived from Audsley et al 2009, except for the emissions for bread which are from Kingsmill (2011). Blanks indicate that no data is available.

References

ADAS UK Ltd., Campden BRI, Cranfield University, EuGeos and North Wyke Research (2009) *Scenario building to test and inform the development of a BSI method for assessing greenhouse gas emissions from food,* for Defra. http://randd.defra.gov.uk/Document.aspx?Document=FO0404_8543_TRP.pdf

Audsley, E., Brander, M., Chatterton, J., Murphy-Bokern, D., Webster, C., and Williams, A. (2009). *How low can we go? An assessment of greenhouse gas emissions from the UK food system and the scope for to reducetion them by 2050*. WWF- UK. http://assets.wwf.org.uk/downloads/how_low_can_we_go.pdf

Carter, C. (2010) *Global Warming Potential of produce grown on an allotment using a life cycle assessment approach Case Study: Wellesbourne Allotment,* MSc Thesis, University of Surrey.

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Garnett, T. (2008). *Cooking Up a Storm. Food, Greenhous Gas Emissions, and Our Changing Climate.* http://www.fcrn.org.uk/sites/default/files/CuaS_web.pdf

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NSALG (2010) *Allotment Gardens: Food and Health,* National Society of Allotment and Leisure Gardeners, available at www.nsalg.org.uk

Scottish Government (2010). *Scotland's Zero Waste Plan.* http://www.scotland.gov.uk/Resource/Doc/314168/0099749.pdf

Stockholm Environment Institute (2009). *The Need for Sound Carbon Accounting in Scotland.* http://www.censa.org.uk/docs/SEI_Carbon_Accounting_Scotland.pdf

WRAP (2009). *Household Food and Drink Waste in the UK.* http://www.wrap.org.uk/downloads/Household_food_and_drink_waste_in_the_UK_-_report.0866cdad.8048.pdf

Zero Waste Scotland (2011). Carbon Factors Spreadsheet. http://www.zerowastescotland.org.uk/carbonmetric