

# Carbon Literacy Guide



## Section Three: Introduction

Where emissions come from and how to reduce them

2018

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“

*How could I look my grandchildren in the eye and say I knew what was happening to the world and did nothing.*

”

David Attenborough

# What can we do about it?

There's no doubt that climate change is an important issue that requires urgent attention. The first stage in knowing what to do is to be aware of how almost all of our everyday activities have an impact in terms of carbon emissions. This may give the impression that it's all down to individuals but in order that we can easily and positively make low carbon choices, action by government is also really important. We'll look at what's being done at this level first, before exploring the impact everyday choices can make.

## National action

Action on climate change in Scotland is a devolved matter and is therefore overseen by the Scottish Government. In 2009 the Scottish Parliament unanimously passed the 'Climate Change (Scotland) Act' which set in law targets to reduce Scotland's GHG emissions as well as setting out the framework by which progress is monitored and reported on.

In 2018 the Scottish Government produced a new 'Climate Change Plan' which details actions, policies and proposals that will be taken in the period 2018 - 2032 to reduce Scotland's carbon emissions. Also, in 2018 new Climate Change Bill will pass through Parliament to update the 2009 Act.

<http://www.gov.scot/Resource/0053/00532096.pdf>



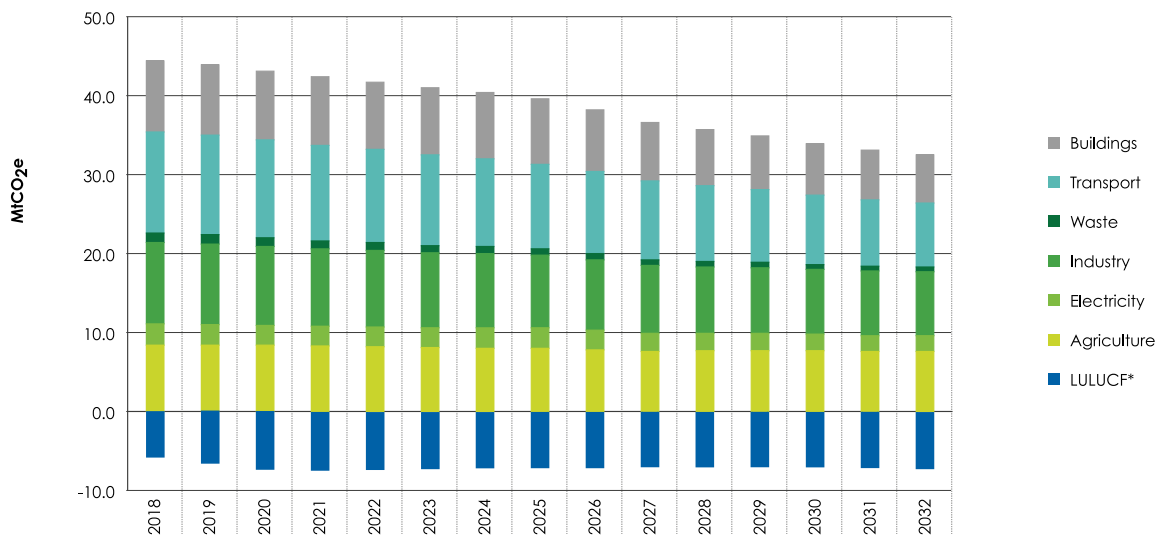
The Climate Change Commission is an independent UK wide body that reports on the progress being made in reducing emissions and also provides advice on meeting the targets set out in the Act

## Targets

The Climate Change (Scotland) Act sets a target of 80% reduction in Scotland's emissions, compared to 1990, by 2050, plus an interim target of 42% by 2020. It's widely anticipated that the interim target will be met early and the new Climate Change Bill will set a more ambitious target for 2050.

The Climate Change Plan 2017 - 2032 sets a new interim target of a 66% reduction in emissions by 2032. It does this by setting 'emissions envelopes' for different sectors out to 2032.

Pathway to 2032<sup>1</sup>



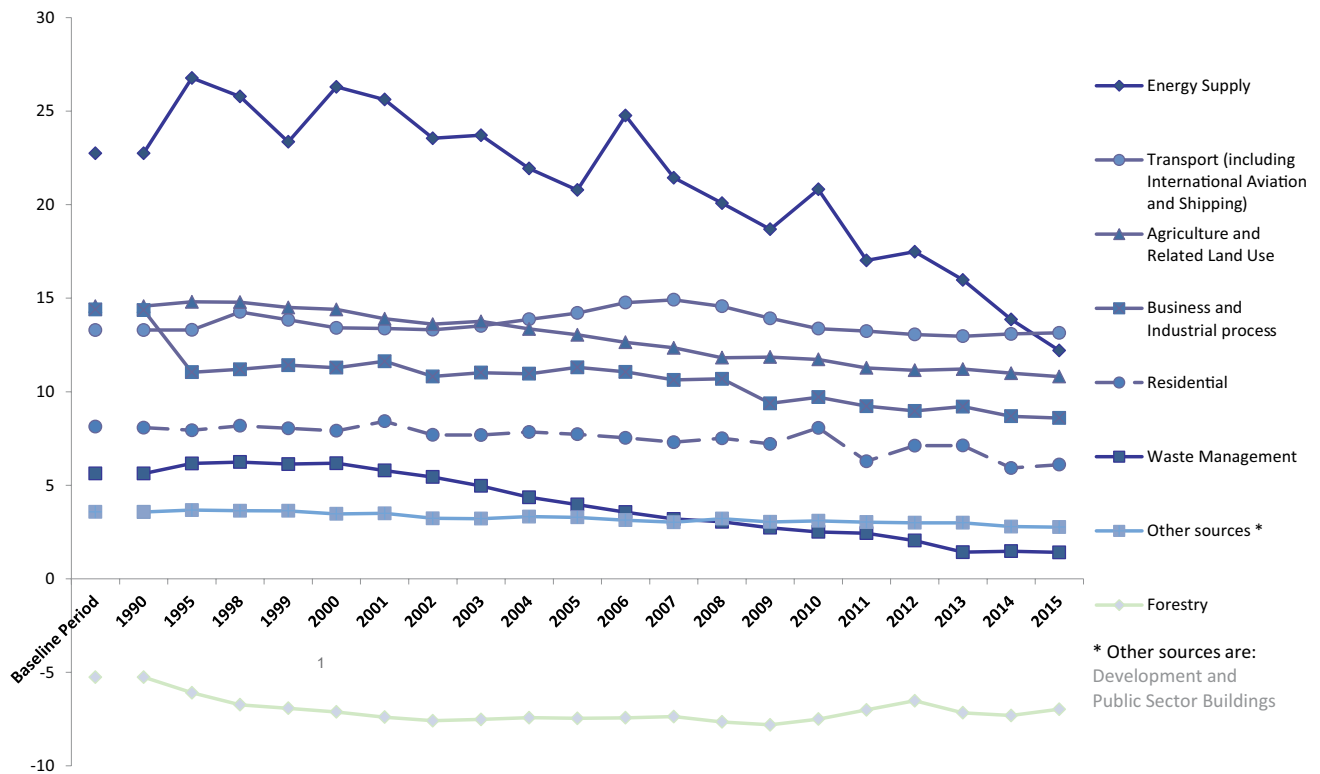
\*Land Use, Land Use Change and Forestry

<sup>1</sup> The Scottish Government's Climate Change Plan, Third Report on Proposals and Policies 2018-2032 (RPP3) | The Scottish Government. [ONLINE] Available at: <http://www.gov.scot/Publications/2018/02/8867/downloads#res-1>

## Progress

In 2018, the most up-to-date figures for Scotland's Greenhouse Gas Emissions relate to 2015. Figures are published every summer relating to the year ending 18 months previous (i.e. 2016 figures will be published in summer 2018). The graph below shows progress in Scotland's emissions reductions by sector.

Main Sources of Greenhouse Gas Emissions in Scotland, 1990 to 2015. Values in MtCO<sub>2</sub>e<sup>2</sup>



**Energy supply** - this relates mainly to the generation of electricity, and this is where the biggest emissions reductions have been achieved - there has been a 48% fall in emissions since 1990. The closure of coal power stations in Scotland has contributed most to this decline.

**Transport emissions** - are now the biggest source of emissions in Scotland. They have seen very little change since 1990, and actually increased between 2014 – 2015, due to an increase in road traffic.

**Business and industrial process** - saw a sharp fall in the 1990s and overall a 49% reduction since 1990. This is due to a decline in manufacturing and the iron and steel industry in Scotland.

**Residential** - refers mainly to fuels burnt to heat homes (e.g. mains gas, or oil and LPG) – this fluctuates a lot, depending on the weather.

**Waste management** - has seen significant reductions of 75% since 1990, mainly due to the capture of methane from landfill sites, but increased recycling rates have also contributed.

It's important to note that the above figures and progress refer only to emissions occurring within the territory of Scotland – emissions associated with things we import are not captured. When thinking about our personal/household emissions it is important to consider this wider carbon footprint.

<sup>2</sup> Scottish Greenhouse Gas Emissions 2015, | The Scottish Government. [ONLINE] Available at: <http://www.gov.scot/Resource/0052/00520839.pdf>



## Adaptation

In addition to action to mitigate climate change through emissions reductions, actions to adapt and build resilience to changes in the climate are also important. The Committee on Climate Change (CCC) also has a role advising the Scottish Government on vulnerability to climate change in Scotland, and produced a report in 2017 identifying the recommended areas for action in Scotland<sup>3</sup>. Key risks identified were:

1. Vulnerability to flooding.
2. Water scarcity.
3. Heat related impacts on health and wellbeing.
4. Risks to the natural environment.
5. Food price volatility.
6. New and emerging pests and diseases, especially for Scotland's forestry.

Scotland's Climate Change Adaptation Programme (SCCAP) was established in 2014 and sets out plans, policies and priorities to adapt to the impacts of climate change.

<http://www.gov.scot/Publications/2014/05/4669>

Adaptation Scotland is a Government funded programme that supports the public sector, businesses and communities to adapt to the impacts of climate change.

<https://www.adaptationscotland.org.uk/>



<sup>3</sup> UK Climate Change Risk Assessment 2017 Evidence Report, | Committee on Climate Change. [ONLINE] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf>

## What's it got to do with me?

Nearly all our day-to-day actions have carbon emissions associated with them, because at some point it is likely that fossil fuels have been used as an energy source. In addition to burning fossil fuels, there are many other sources of carbon emissions such as reduction in forest cover or emissions from agriculture and sewage.

When considering our own personal impact, rather than concentrating on the primary activities such as energy production, transport and waste disposal as above, it's useful to look at how our everyday activities of cooking, eating, traveling, heating and lighting our homes, using equipment and buying goods result in the production of GHGs. The information in this section should help you identify where the opportunities lie to reduce emissions personally or through a CCF project.



## What is a carbon footprint?

A carbon footprint is the overall carbon emissions resulting from the actions of an individual, household or organisation for a set period of time, usually a year. The graphics below show some of the key emission sources that might be included in a household's carbon footprint.

One year



Production of grid electricity



kWh of electricity used

Clean water and sewage



Litres of water used

Production, transport, retail and waste disposal of goods



Kg of goods bought and thrown away

Natural gas or other fuel for heating and hot water



kWh or litres of fuel

Use of services including education and health



Public transport services



Passenger km or passenger miles

Petrol or diesel fuel for car



Litres of fuel used

Production, transport and waste disposal of food



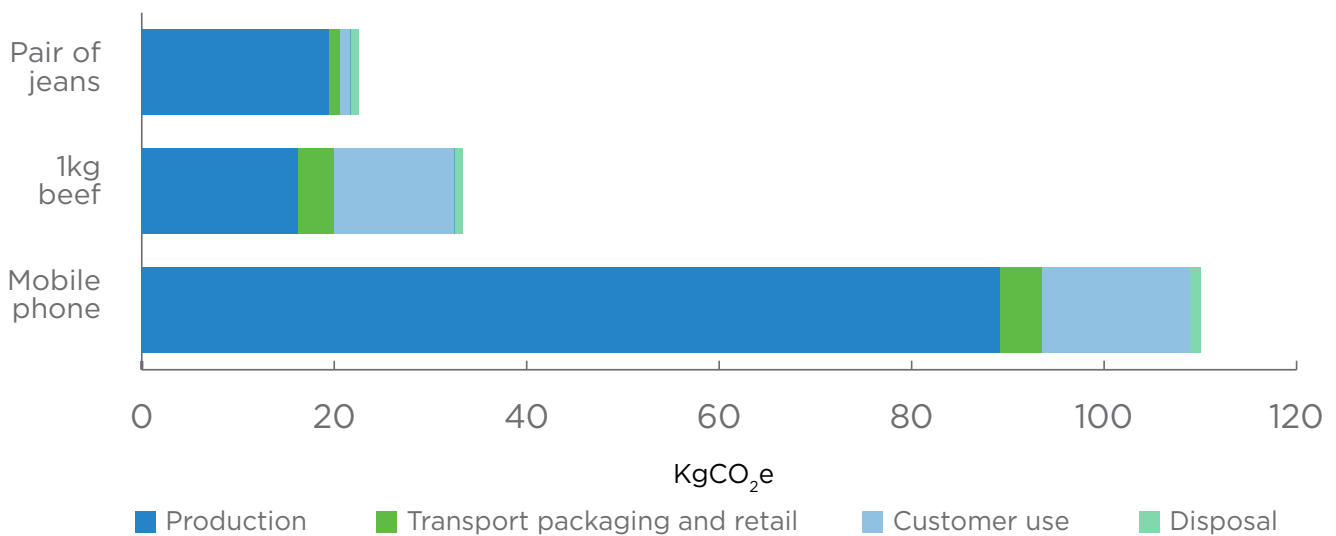
Kg of food bought and thrown away

In some cases, it is easy to see where the carbon emissions come from. For example, using natural gas in a boiler to heat the home produces carbon emissions directly from the combustion of natural gas. The amount of natural gas used can be easily measured in kWh used.

For other sources it is relatively easy to measure the household 'share' of carbon emissions, even though they don't happen directly in the home. For example, the carbon emissions from public transport are easily calculated from the passenger kilometres travelled – this is the average share of each user per kilometre of public transport used.

For other activities, the carbon is less obvious and we must consider what's known as the 'embodied carbon' of a product or service. This is because carbon emissions are released during production and disposal of a product. The following diagram shows three examples of goods and services where most of the carbon emissions are embodied in the product itself, rather than resulting from the product being used. Only the carbon emissions in light blue are under the direct control of the user; all the others are produced in other parts of the supply chain.

### Embodied carbon



We can't affect embodied carbon emissions directly but we can make choices to reduce our consumption, or to choose alternatives with lower embodied carbon emissions. For example, making a bolognese sauce with half beef and half vegetables, buying second hand jeans or getting your mobile phone repaired.



### What is embodied carbon?



Embodied carbon refers to all the carbon emissions emitted during the whole lifecycle of an item, from extraction and processing of materials, manufacture, transport and retail, customer use and end of life disposal. Embodied carbon is also sometimes referred to as whole lifecycle emissions.





## How are Greenhouse Gas (GHG) Emissions measured?

To be able to understand the impact of our actions to reduce GHG emissions it is important to be able to measure these emissions – so we know our starting point and to see if we're making a difference. As mentioned in 'Section 2' there are many different gases that produce the greenhouse effect but that this guide focusses on the three key gases that make up the majority of climate change impact.

Carbon  
Dioxide

Methane

Nitrous  
Oxide

We've already seen how each of these gases has a different 'Global Warming Potential' (GWP). To help us compare these different gases taking this into account, we use a measurement called carbon dioxide equivalents, which convert all GHGs into a single unit. This is written as CO<sub>2</sub>e and is usually measured in kilograms or tonnes. One tonne of CO<sub>2</sub>e has the global warming impact of one tonne of carbon dioxide but it can be made up of any of the 7 Kyoto Gases. For example, a tonne of methane (CH<sub>4</sub>) would be converted to 25 tCO<sub>2</sub>e because methane has 25 times the GWP as carbon dioxide.

As a shorthand, GHG emissions can be referred to more generally as 'carbon emissions'. This is usually taken to mean carbon dioxide equivalents and can therefore refer to a mixture of GHGs. Saying 'carbon emissions' is easier and quicker. This terminology will be used from now on in this guide. Think of it as multiple currencies being converted into Euros – carbon is the common currency for greenhouse gases and it uses the units CO<sub>2</sub>e.



### What are carbon emissions?



Carbon emissions is a shorthand way of saying greenhouse gas emissions. We refer to 'carbon' emissions because carbon dioxide is by far the most common greenhouse gas and all other GHGs are expressed relative to CO<sub>2</sub>, using carbon dioxide equivalents (CO<sub>2</sub>e). An amount of any mixture of GHGs can be expressed in tonnes of CO<sub>2</sub>e.

# How do we calculate carbon emissions from our actions?

The calculations to estimate how much carbon is produced by an action can all be summarised as:



**Activity data** refers to a measure of the amount we do an action. The table below shows some everyday activities and how we measure their impact :

Activity	Where do emissions come from?	How could we measure it
Having a shower	Burning natural gas in boiler	kWh of gas used
Boiling the kettle	Fossil fuels burned to generate electricity	kWh of electricity used
Eat breakfast	Fertilisers, farm machinery, transport etc	Kg and type of food eaten
Throw junk mail in the bin	Mail breaking down anaerobically in landfill	Kg of waste thrown away
Drive to work	Burning petrol or diesel in car	Miles driven
Buy book	Producing raw materials and manufacturing book	Number of items purchased

A carbon **emission factor** tells us how much carbon emissions doing one unit of an activity will produce. Emission factors are publicly available numbers, published by the UK Government and other sources that enable us to convert activity units into carbon emissions. Examples of some emission factors are provided in the table below.

Emission source	Emission factor	Units
Natural gas	0.209	kgCO <sub>2</sub> e/kWh of natural gas
Grid electricity	0.517	kgCO <sub>2</sub> e/kWh of electricity
Milk	1.37	kgCO <sub>2</sub> e/kg of milk
Paper	0.87	kgCO <sub>2</sub> e/kg of paper
Petrol	2.658	kgCO <sub>2</sub> e/litre petrol
Books	0.94	kgCO <sub>2</sub> e/kg of books

The key to getting carbon calculations correct is to make sure that the activity units match the emission factor units. For example:



However, the difficult part of the process is usually to get accurate activity data in the correct units. For example:



In this example, it is not possible to calculate the carbon emissions directly because the units of the activity data and the emission factor do not match. Instead, the user needs to translate their activity data units from bags to tonnes and this requires a conversion factor. It is possible to find a density factor for household waste (it is around 0.26 kg per litre<sup>4</sup>). Therefore an 80 litre bag will weigh around 20.8 kg. To convert this to tonnes, you need to divide by 1,000.

It should be noted that for most calculations of carbon emissions, there is uncertainty about the final number because of the emission factor and/or the conversion factor. Therefore, it is recommended that you do not try and calculate carbon emissions to high degree of accuracy – the nearest kg for small quantities or nearest tonne for larger quantities is sufficient detail.



## How do we calculate carbon emissions?

Carbon emissions are calculated by multiplying activity data, such as kWh of electricity or km travelled by car, with the appropriate emission factor. Emission factors are published by the Government for a very wide range of activities. Sometimes a conversion factor will be required to convert activity data into a compatible unit. Commonly used emission and conversion factors can be found in the CCF Carbon Reporter Tool.

<sup>4</sup> UK Conversion Factors for Waste | SEPA.

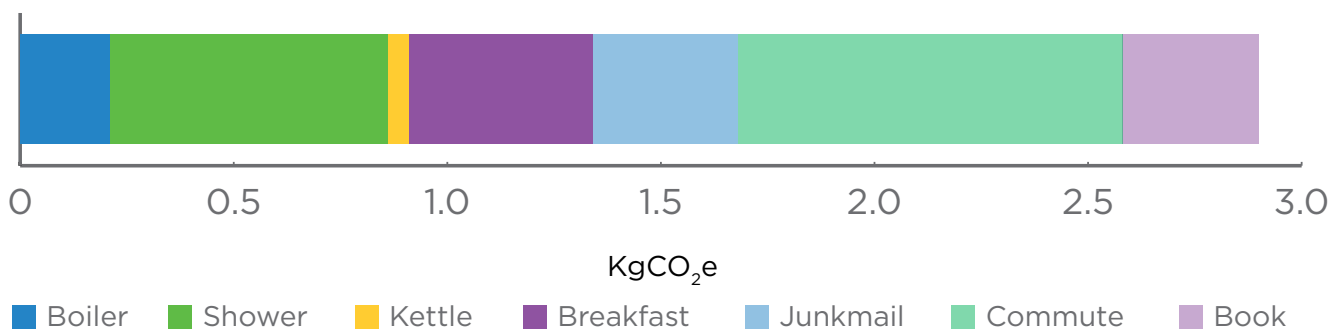
## How much carbon?

When we hear facts and figures around carbon emissions in the media, this is normally being reported at a country level, so it can be difficult for individuals and communities to develop a sense of scale about what carbon they can control and manage. Price is not a particularly good indicator - some things that produce a large amount of emissions are very low cost, for example cheap clothes. A big part of carbon literacy is gaining an instinctive understanding of the carbon impacts of everyday actions to help us make better choices.

Let's look at the carbon emissions that occur from a mix of daily activities that someone might do in a typical morning as an example. The table shows the activity that occurs and the estimated carbon emissions that might result.

Activity	Activity data	Estimated carbon emissions (kg CO <sub>2</sub> e)
Put the heating on for an hour to warm the house	Natural gas in kWh	0.2
Have a shower for 10 minutes	Grid electricity in kWh	0.6
Boil a full kettle for a cup of tea	Grid electricity in kWh	0.05
Have a quick breakfast of cereal and milk, throwing the uneaten part away	Weight of cereal and milk in kg and weight of waste	0.4
Pick up a handful of junk mail and put in the household bin on the way out	Paper kg	0.3
Drive three miles to work	Car miles	0.9
Buy a book	Weight of book in kg	0.3
<b>Total</b>		<b>2.9 kg CO<sub>2</sub>e</b>

The table and diagram show that these simple seven activities could produce around 3 kgCO<sub>2</sub>e – if they have the same morning routine every day this will equate to just over 1 tonne CO<sub>2</sub>e in a year.



### Opportunities to reduce emissions



Can you spot opportunities to reduce emissions in the tables above?

We'll see some ways this can be done later in this section.

## How do we express quantities of emissions?



There are many ways of translating kilograms or tonnes of carbon dioxide equivalents into more relevant units so that we can better visualise the impact of our actions. There are units of volume e.g. hot air balloons or double-decker buses and there are units of equivalence e.g. the number of miles travelled by car for the same quantity of emissions. However, we have avoided translating into alternative units because:

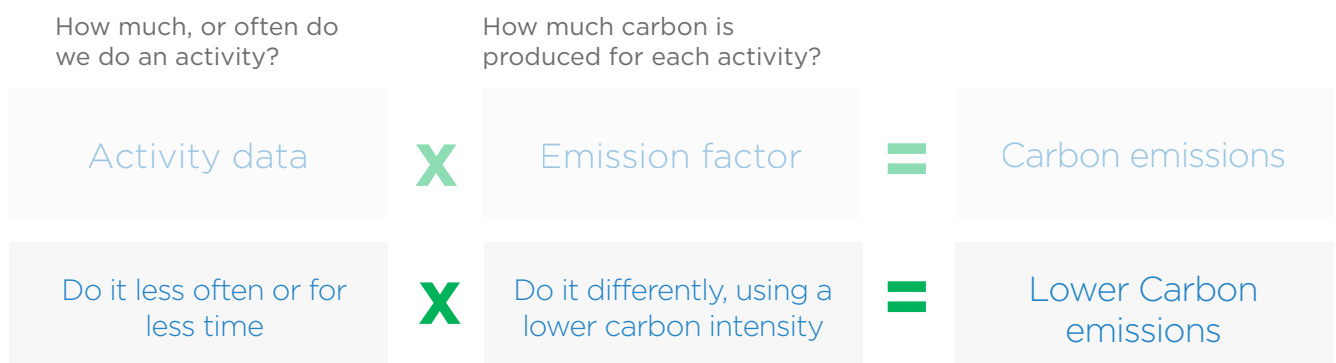
- 1) The translated units are often less accurate and require further transformation.
- 2) The translated units are often also meaningless in terms of formulating the impact of our actions in reference to each other.
- 3) Ones that use equivalence normalise emitting carbon for other activities, giving the impression, for example, that its OK to take that flight because you insulated the house.

Therefore, we have taken a decision just to use kg and tonnes of CO<sub>2</sub>e - as communities become more familiar with these units, they will start to have increased meaning.

## How do we reduce emissions?

It's easy to find lists of different actions you can take to reduce carbon emissions, but everyone's situation is different. The aim of this guide is to give you the knowledge you need to identify opportunities to reduce carbon emissions personally and in your community. This guide provides some examples of common carbon reduction actions but there is opportunity for innovation if you understand the principles.

Knowing that the quantity of carbon emissions from an activity is dictated by the activity data multiplied by the emission factor, there are two key methods for reducing the overall carbon emissions - these are shown in the diagram below.





## Doing it less

We live in a way that often produces wasted emissions, both obvious and invisible. The concept of doing less and using less does not necessarily mean sacrificing comfort; it is about being more efficient with fewer resources. Sometimes technology can help us with this, sometimes its about changing our habits/behaviours. There are also often compensatory effects to doing and using less. These might be positive health impacts from reduced car use and healthier diets, positive social impacts from joining groups to repair and mend goods rather than buying new, and positive financial impacts from reducing wasted energy and resources. Examples of 'doing less' include:

Insulating a house uses less fuel to keep it warm and comfortable



Reducing food waste by using up leftovers



Reducing car use through better journey planning



Buying and throwing away less stuff



## Doing it differently

We also live in a society that is very dependent on high-carbon fossil fuels, both to heat and power our homes and vehicles and to produce the food, goods and services that we consume. Doing it differently means taking alternative approaches to meet our needs that result in less carbon emissions. Again, sometimes there are technologies that can help us with this, sometimes it is about making choices as consumers and sometimes it is about working with others to find new solutions. Examples of 'doing it differently' include:

Generating electricity from renewable sources



Growing your own food locally



Switching car journeys for walking or cycling



Joining a tool library rather than purchasing new equipment

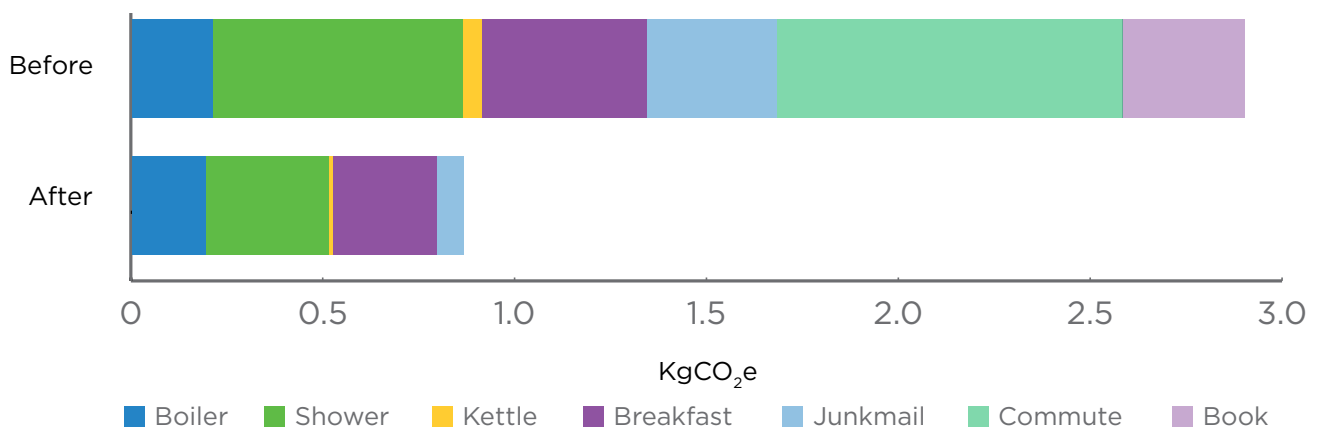


## How much of a difference can we make?

What is the impact of doing it less and doing it differently? The table below shows examples of how each of the daily activities can be changed and the estimated impact of these changes.

Doing things less/differently	Carbon emissions before (kg CO <sub>2</sub> e)	Carbon emissions after (kgCO <sub>2</sub> e)
Do it less: turn the thermostat down by 1°C – saves about 10%	0.21	0.19
Do it less: reduce shower time to 5 minutes – saves about 50%	0.6	0.3
Do it less: only boil water required – saves about 75%	0.05	0.01
Do it less: reduce amount of cereal and milk so none is wasted – saves around 35%	0.4	0.3
Do it less: return junk mail to sender and request to be removed from list – saves around 80%	0.3	0.1
Do it differently: cycle to work – saves 100%	0.9	0.0
Do it differently: choose a book from a book swap – saves 100%	0.3	0.0
<b>Total</b>	<b>2.9 kg CO<sub>2</sub>e</b>	<b>0.9 kg CO<sub>2</sub>e</b>

The graph below shows the impact of making these different decisions. The overall estimated carbon emissions are reduced by over two thirds – a yearly reduction of 730 kgCO<sub>2</sub>e. If this pattern was repeated across 1,000 people for a year, the savings could be around 470 tonnes of CO<sub>2</sub>e per year. This is how many CCF projects work; by persuading lots of people to make lots of large, medium and small decisions about their lives.



In the next section we're going to examine four areas of our carbon footprint. For each we will explore ways we can 'Do things Less' or 'Do things Differently'. We'll also see what policies and priorities have been set at a national level, and the information, organisations, incentives, funding and projects that are available to support our efforts to reduce emissions.



We support the Sustainable Development Goals.

Keep Scotland Beautiful is the charity that works with organisations and communities to help people to reduce carbon emissions, improve local areas and adapt to the impacts of climate change. It's part of our work to make Scotland clean, green and sustainable.



**Keep Scotland  
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Your charity for Scotland's environment

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