

U116 Environment: journeys through a changing world

OU Carbon calculator user guide

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Contents

OU Carbon calculator user guide	5
1 The basis of the OU Carbon calculator	5
2 Using the calculator	6
2.1 Starting up	6
2.2 The calculator screens	6
3 Frequently Asked Questions	8
3.1 General questions	8
3.2 Your household	8
3.3 Room heating	9
3.4 Water heating	10
3.5 Appliances	10
3.6 Travel	11
3.7 Flying	12
3.8 Food	13
3.9 Income	14
3.10 Goods	15
3.11 Infrastructure	15
3.12 Targets	16
3.13 Decarbonisation	17
4 Non-UK residents	19
I don't live in the UK, will the OU Carbon calculator work for me?	19

OU Carbon calculator user guide

I The basis of the OU Carbon calculator


You may wish to print this Guide to refer to when using the calculator.

The OU carbon calculator aims to include all the greenhouse gases emitted in supplying what the UK consumes, including the emissions generated in producing imports. It then divides this total by the UK population to give the average emissions per person.

The calculator starts by assuming you are close to the UK average in all aspects of your carbon footprint. As you answer the calculator's questions, you can see how your choices make your individual (or personal) footprint change from the average. You can also change your answers to see how this affects your footprint in order decide how best to reduce it.

It is important that you realise that this calculator is a computer model mainly intended as an educational tool. It is designed to be fairly quick and easy to use and to explore options for reducing individual carbon footprints, rather than to produce the most realistic results.

2 Using the calculator

The OU Carbon calculator has been designed to be easy to use, and to help you it has built-in screen instructions. It also has popups, marked , which when you select provide brief guidance to answering the questions.

However, there are some elements that may need more assistance, especially:

- how to name and save files of your footprint choices and open them again
- how to set carbon footprint reduction targets to aim for
- the best sequence of calculator operations to do Activities 7, 11 and 13.

This guide aims to help you with these elements and to enable you to complete the carbon calculator activities within this course.

2.1 Starting up

The online calculator should be compatible with most common devices (Windows and Macintosh computers and tablets, even smartphones) and recent browsers (Chrome, Internet Explorer (IE9 and above), Firefox, etc.).

Launch the carbon calculator via the link on OpenLearn. It will open at the Welcome page with the ‘You’ footprint and ‘Average’ footprint set at the UK averages on both bar charts.

2.2 The calculator screens

After the *Welcome* screen, the nine tabs from ‘*Your household*’ to ‘*Goods*’ bring up screens with questions that enable you to calculate your existing personal carbon footprint (for Activity 7). As you answer the questions the results are displayed on the ‘You’ bar and summarised in a table on the ‘Summary’ screen (Figure 1). The Summary screen also allows you to name and save a set of answers and then reload them so you can return to them at any time.

The ‘*Infrastructure*’ tab is concerned with emissions from activities of government, industry, etc. and doesn’t involve any questions, although these emissions are affected by your answers on other screens.

The ‘*Target*’ screen enables you to set a Personal or a Government footprint reduction target and then try to reach it by changing your answers to the questions on the other screens Activity 11.

The ‘*Decarbonisation*’ screen has options for reducing your personal footprint via non-household emission reduction measures paid towards by you through taxes or carbon offsets, but undertaken by government or others (for Activity 13). Normally you shouldn’t use the Decarbonisation options unless you are unable to reach your footprint reduction target by individual or

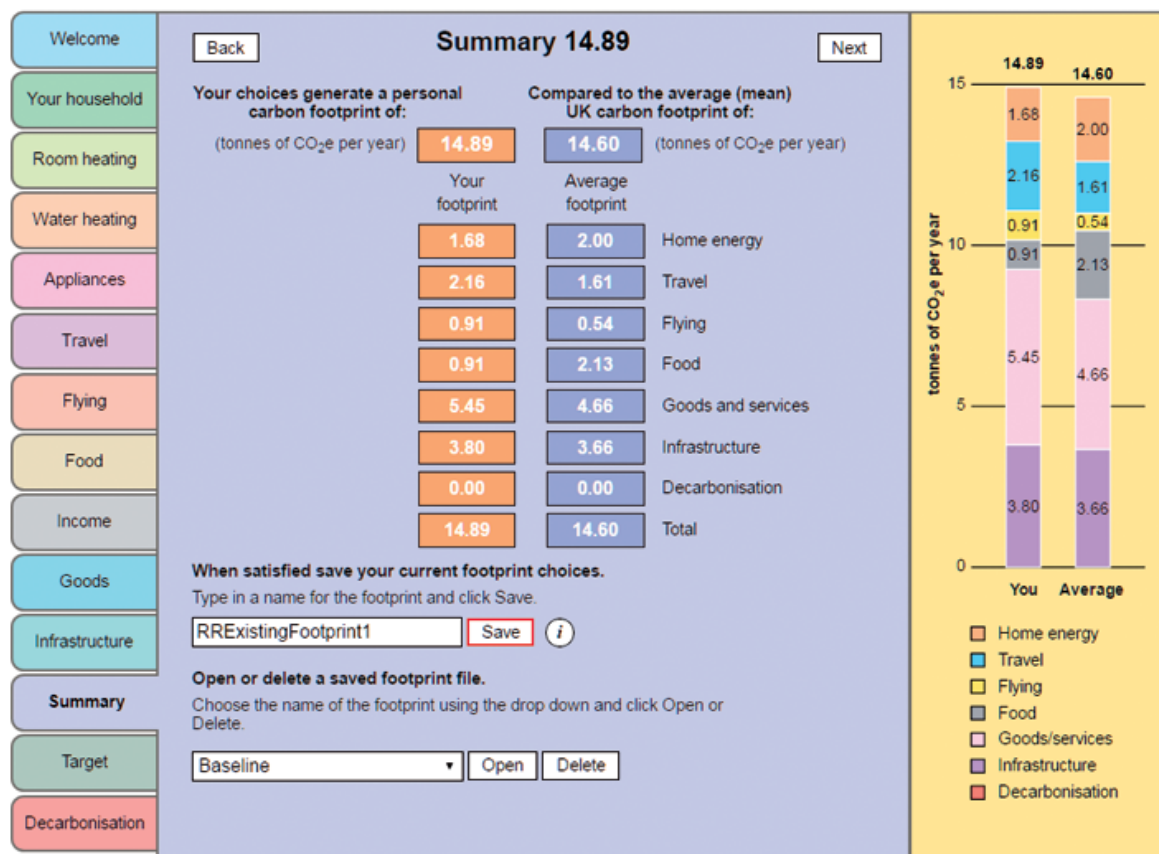


Figure 1 Summary screen: My existing footprint compared to the UK Average

household level changes. However, you can set a more challenging target to explore the options on this screen.

Box 1: Saving, opening and deleting calculator files

Select the **Summary** tab (Figure 1) and follow the instructions at the bottom of the screen. For example:

- To save your existing footprint file. Select the upper box, type the name of the file you want to keep (e.g. *ExistingFootprint1*). Select 'Save'
- To open *ExistingFootprint1* (or any other file that you've named). Select the down arrow in the lower box, select the file and select 'Open'
- To delete a file, select it and select 'Delete'.

3 Frequently Asked Questions

3.1 General questions

Why does the calculator not ask for real data?

Some calculators ask users for ‘real data’ such as annual gas and electricity use, MOT car mileage records, exact flight distances, and so on. However, many users have found them difficult and laborious to access, and in any case they only account for ‘direct emissions’, around 20% of the total consumption-based footprint.

As an alternative, the calculator uses national statistics for the most typical cases, then refines this level with further questions. The result is usually quite close to that obtained from ‘real data’.

3.2 Your household

Why count both adults and children in the household?

The calculator gives its results in terms of the user’s *individual* emissions, both direct and indirect.

However, in calculating an individual’s fair share it is necessary to ask questions which apply to whole households, because a great deal of consumption (and hence responsibility for emissions) is shared. Shared items include heating, lighting, vehicle use, kitchen equipment, furniture, the house itself, many services like rents or mortgage payments, and household income. Each of these shared factors has its own weighting, based on research data.

The result of this sharing is that although a household’s total emissions tend to rise with more people, the rise does not keep pace with the number of people, and so the emissions per person are lower with more people in the household.

In order to calculate an individual share, we have to know how many people do the sharing, but it is reasonable to ask, which people should we count? It is sometimes argued that babies and young children should be discounted because they do not individually generate emissions and are unable to make choices. On the other hand, children are all part of the national population and their households can be considered responsible for them.

The calculator takes the latter view, and asks users to enter all persons in the household size box in the Your Household section. However, if you wish you can ignore small children (say, under three years old) and enter only the other members in the box. Notice the difference this makes.

It is worth increasing home occupancy?

A very effective way of reducing your personal carbon footprint is to have more people living in your home e.g. by taking in a lodger.

But having more children is *not* a good way of reducing your personal footprint because, as Section 4.2 notes, ‘having a child probably adds more to your carbon footprint than any other decision you might make’.

3.3 Room heating

How do I find out the thickness of loft insulation?

For details go to <http://www.energysavingtrust.org.uk/home-insulation> select ‘Roof and loft’.

Have I got cavity or solid walls?

For details go to <http://www.energysavingtrust.org.uk/home-insulation> select ‘Cavity wall’.

How do I find out if a cavity wall has been filled?

For details go to <http://www.energysavingtrust.org.uk/home-insulation> select ‘Cavity wall’.

To insulate cavity walls, the installer drills holes around 22mm in size at intervals of around 1m in the outside wall of your home. The installer then blows insulation into the cavity. The installer fills the holes in the brickwork; you may be able to see them.

Is it worth installing loft or wall insulation?

Thicker loft insulation usually pays back quite quickly, wall insulation usually takes longer.

For details go to <http://www.energysavingtrust.org.uk/home-insulation> select the relevant insulation type.

Is it worth installing double glazing?

Double glazing usually takes many years to pay back, but has several other benefits.

For details go to <https://www.myglazing.com/> select ENERGY SAVINGS CALCULATOR

Or try <http://www.energysavingtrust.org.uk/home-energy-efficiency/energy-efficient-windows>

Why no mention of installing an efficient condensing gas boiler?

About 85% of UK homes have gas central heating and of these about 80% already have condensing gas boilers, which have been required for new or

replacement boilers since 2005. So if you have gas central heating system it is assumed you already have one.

3.4 Water heating

Is it worth installing solar water heating?

Solar water heating, or a solar thermal system, are a different technology from electricity generating solar photovoltaics. A solar thermal system provides an amount of hot water dependent on the size of the system and the amount of solar energy it receives, which is deducted from your hot water energy use. For most UK users 4m² (or two) standard solar thermal panels will supply about half a household's hot water, and all or most in summer months. But if you have a low hot water consumption (e.g. by taking fewer, shorter showers) it can provide a bigger proportion.

To find out how long a solar water heating system takes to pay back its installation costs, go to <http://www.energysavingtrust.org.uk/renewable-energy> select 'How do I generate my own heat?' then 'Solar water heating'.

3.5 Appliances

What are green energy tariffs?

Some electricity companies offer 100% low-carbon electricity, and it is sometimes argued that a customer of such a company has now abolished emissions from electricity consumption. This is not entirely convincing. All electricity supply companies are obliged to supply a certain proportion of low-carbon power, and there is intense competition for the 20% or so of renewable generation in the overall supply mix. The renewable energy supplied by the 100% Green companies to their own customers is no longer available to others. This suggests the effect is negligible.

Rather than make a choice for either 0% or 100% the calculator takes into account the fact that most 100% Green suppliers do invest in further renewable capacity from their profits, etc., and some (e.g. Ecotricity, Good Energy) are starting to invest in Green gas supply. So, green tariff electricity is assumed to produce 50% of the emissions of normal grid electricity. Furthermore, consumer financial preferences for renewable energy act as a signal to the government and industry to accelerate investment in this direction.

With solar PV panels, could I have zero electricity emissions?

You could. But the amount generated by a solar PV system is more or less fixed, so you'd have to use less than this to get into negative emissions. A typical three-bedroom house would have enough roof space for a small array, say 2kW of capacity. This could generate 1700 kWh a year. A couple with

one child living in such a house would typically use about 3500 kWh of electricity, so at 1800 kWh, net consumption would be almost halved, but not negative.

If the calculator does show negative emissions for appliances, this is deducted from the overall Home Energy total. The lower this total is, the larger the proportional contribution from a PV array.

How long for a solar PV system to pay back its costs?

For details go to <http://www.energysavingtrust.org.uk/renewable-energy>

select ‘How do I generate my own electricity at home?’ then ‘Solar panels’.

Or try <http://www.energysavingtrust.org.uk/scotland/tools-calculators/solar-energy-calculator>

Please note that the Feed-in tariff for domestic installations below 10kWp of 4.11p/kWh is reducing further after March 2017 (to 3.55p/kWh by Jan 2019).

To find out the latest tariff from Ofgem go to <https://www.ofgem.gov.uk/environmental-programmes/fit/fit-tariff-rates>

3.6 Travel

Business travel by car and public transport is excluded, because it is counted as a business activity and included in the Infrastructure component.

How to estimate car use?

You probably know the engine size, vehicle type and your typical annual mileage (e.g. from MOT certificates) of household vehicles. Car club (see below) and other people’s car details for lifts may be more difficult to identify. Fill out the table using the information that fits best.

Guidance on the meanings of vehicle size, type and mileage is provided in screen popups.

How is vehicle occupancy counted?

Household vehicles

If four people share a car journey, the emissions are generally considered shared and are therefore much less than if a single person undertook the same journey. The calculator assumes that the total vehicle mileages are equally shared among all members of the household. Any other assumption runs into awkward questions. All journeys are deemed to be in some sense ‘on behalf of’ the whole household, even though in some cases this is clearly untrue, as when (say) Dad drives to play golf. It is supposed that such personal uses are spread evenly, as with Mum going to the gym, or driving her daughter to a dance class. Commuting to earn money is reasonably seen as serving the whole household, as is taking children to school. It is impossible to unpick all these special cases and evaluate the proportions of responsibility, so by default emissions are considered equally shared.

Car clubs and lifts with others

Car clubs provide access to shared vehicles to members on a pay-as-you-drive basis. They provide much of the convenience of having a car without the hassle or costs of owning, repairs, insurance, servicing and parking. Car clubs tend to be organised on an area basis with cars located in clusters so that if one car is not available, a member will only have a short walk to access another car. Most car clubs enable members to reserve cars online or by smartphone app, unlock the vehicle with their membership card or smartphone app and drive off.

In the calculator for Car clubs (and Lifts with others), you have to specify occupancy (i.e. the number of people normally in the vehicle). Count taxi trips as lifts.

Is it worth buying an electric or hybrid car?

For information go to <http://www.energysavingtrust.org.uk/scotland/tools-calculators/buying-fuel-efficient-vehicle>

How to estimate public transport use?

Journeys by Public transport (and by Flying in the next section) are not shared, so are attached only to the individual.

The calculator does not distinguish between different modes of public transport, but takes averaged official emissions data.

How many hours a MONTH do you routinely travel on public transport?

Your regular weekly trips by train could be 10 miles to work and back five days a week and visiting relatives 50 miles every weekend, the total is about 22 days/month x 10 miles+ 4 weekends/month x 50 miles = 420 miles per month by train. At an average train speed of 60 to 80, say 70 mph = 6 hours per month. The UK average is about four and a half hours per month.

Approximately how many hours per YEAR do you travel by train, bus, coach or ship?

For some people it is a low number, but for others it can be high (e.g. two train trips from London to Edinburgh and back, 2×14 hours = 28 and quarterly to Bath 4×3 hours = 12; train and ferry to Brittany = 16 hours, various bus and coach trips = 40 hours; Eurostar to Paris 8 hours; total = 104 hours per year.

3.7 Flying

Business flights are excluded, because they are counted as a business activity and included in the Infrastructure component.

Why not use accurate flight distances?

There are many online calculators e.g. http://www.webflyer.com/travel/mileage_calculator/ that will provide actual flight distances between airports.

We have decided to use the quick and easy method of choosing flying from the UK to a broad regional area on a world map. Typical journeys to the different regions are provided in popups. This is avoid users having to access another web site while using the calculator.

If you fly to a particular destination less than once per year, use a decimal fraction. e.g. if you fly to New York (Eastern North America) about every three years to visit relatives, enter = 0.33.

3.8 Food

Why do diets containing meat and dairy products produce higher emissions?

Table 5c in Section 4.2 includes emissions associated with different foods and shows that producing each kg of beef, lamb or cheese generates high GHG emissions, while producing fresh carrots, potatoes and bananas generates low emissions. Chicken, pork and fish are somewhere in-between.

If you are someone who only eats meat (especially beef and lamb) occasionally but still fairly regularly eats eggs, dairy products and/or fish, there isn't an exact option provided. Probably the closest is 'Occasional consumption of meat, some dairy products, fish and/or eggs'.

Why doesn't growing lots of fruit and vegetables make a big difference?

'Growing your own' is sometimes thought to be a particularly significant contribution to reducing food emissions, but this is very rarely the case. It only works if it significantly *displaces* other parts of the diet, rather than supplementing them. Householders almost never produce staple foods, grains, oils or livestock products, but mostly fruit and vegetables, a small part of most diets and with a low carbon intensity anyway.

There is one circumstance, however, in which home/garden production can make a difference. This is where other behaviours are favourable, and the diet is already low in emissions built around a very high proportion of fresh fruit and vegetables.

Why no mention of 'food miles' or buying local food?

Extensive research on 'food miles' has shown that bulk food transport tends to be a small amount in the overall emissions, except for air-freighted products, a factor covered by the 'seasonal vegetables' question. So buying local doesn't make much difference to your carbon footprint.

Why no mention of organic food?

It might be queried why there are no questions on organic foods. This is because, for all their other benefits, according to the academic data they make little difference to the GHG emissions. Organic production reduces emissions

by avoiding carbon-intense fertilisers and pesticides, but generally has lower yields, so the emissions per unit of output are about the same. Emissions of nitrous oxide from natural nitrogen fixation are about the same as those from chemical fertilisers.

3.9 Income

Why is household income so important?

Emissions occur as a result of consumption activities, and the activities performed by, or generated by a household are usually paid for in money. Generally, the more money a household spends, the more emissions are generated. People usually do not know how much they spend, but they often know how much income per week or month they *have* to spend from bank statements, annual tax statements, etc. Most households do actually spend all or most of it, so this is used as a ‘proxy’ or close estimate of expenditure. It is sometimes called *household disposable income*.

For example, our household has two good incomes. We spend about £1400 per month on household bills, food, mortgage, etc. and about £1300 per month on clothes, holidays, repairs, house improvements, supporting our children, etc. and still manage to save about £100 per month. That puts us between the 7th and 8th group of monthly disposable incomes on the Income chart, but closer to the 8th group.

Income is not used to calculate emissions from home energy, travelling or food, because these are estimated directly from the answers in their respective sections. Income is only used to estimate emissions from Goods and Services, because there is no other way to do this without an exhaustive questionnaire. Goods and Services is the largest single category of household spending and also the largest category of emissions, so inevitably income makes an important contribution to the total carbon footprint.

What if I or we save or invest some household income?

Some people manage to ‘save’ some money rather than spending it, and it accumulates in a bank, building society, etc. This money does not disappear, but is used by financial institutions to invest in other activities. The emissions associated with these activities might be greater or less than those that would have been generated had you spent the money yourself. And eventually you might claim all that money back, with interest – and then spend it.

Nevertheless the calculator assumes that not spending directly tends to reduce your emissions somewhat. An assumption is made that on the whole British banks will lend money to British businesses, and since the UK economy has a rather lower carbon intensity, ‘saving’ is deemed to lower emissions. Deferred spending is good. The opposite is also true: that if you spend more than your income (thereby getting into debt, essentially simulating a richer person) your emissions are assumed to rise somewhat.

What's the difference between personal and household spending?

This is difficult for the calculator because it is difficult for most householders to clearly distinguish what is 'household spending' and what is 'personal spending'. The calculator assumes that most households are families with largely shared income and consumption.

3.10 Goods

How is 'green' or 'non-green' behaviour taken into account?

Emissions from goods and services consumption depend not only *how much* income you have to spend, but *how* the money is spent.

That is the function of the ten pairs of opposite broadly 'green' and 'non-green' consumption behaviours offered in the Goods (and Services) section. Note the green and non-green choices are *not* consistently at the left and right extremes.

For example, if you spend a lot on clothes and shoes and frequently throw away the old ones, or let them accumulate unused, you might select the far right button on the 'Keeping things repaired and maintained' vs 'Replace often with new things' pair. If you are the opposite type of consumer and rarely replace your clothes and shoes you might select the far left button. In you are in the middle or tend towards one or other behaviour you select the relevant button.

This is another question where estimates or even guess-work will have to be made.

3.11 Infrastructure

What is 'infrastructure' and why is it such a large component?

In principle the entire UK economy, including all its imports (plus international aviation and shipping) exists for the benefit of the whole UK population. From this perspective the population is collectively responsible for the emissions generated by the economy. However, some people have greater responsibility, others less. So a wealthy family with three cars, living in a large house and taking frequent holidays in exotic locations are likely to generate higher emissions per person, than a low income family, living in a small, efficient house, who use public transport and bicycles and take holidays at UK Festivals.

But there are some emissions that cannot be directly controlled by consumers. An important part of this is all the goods and services provided by the government and paid for through taxes. It includes roads, schools, the NHS, social services, defence, administration, public investment, etc. This

component is allocated almost equally to each personal footprint, although slightly less for high-income households which tend to spend more on private provision (e.g. private health or schools).

The other component of Infrastructure covers emissions not directly controlled by consumers or by the central government. It includes universities, cities and local authorities, non-profit organisations, and business activities that are unaffected by consumer choices.

The calculator takes the consumption perspective as far as it can, but there are many corporate choices beyond the knowledge of consumers, and clearly some businesses take strong initiatives to reduce their emissions, while others are indifferent. Consumers would not be aware of such differences, so the calculator takes the view that some ‘effective responsibility’—about 25% – should be allocated to the businesses themselves and other non-state suppliers of goods and services. This is calculated in the Infrastructure section, which varies with the user’s answers in the Income and Goods sections.

3.12 Targets

Why these reduction targets?

The calculator provides two types of carbon footprint reduction targets: Government and Personal.

The three ‘government’ targets of 30%, 46% and 54% are percentage reductions in the AVERAGE 2016–17 UK *consumption-based* carbon footprint per person. These reductions are approximately equivalent to percentage reductions of 35%, 50% and 57% in 1990 *territorial* GHG emissions set in UK government’s official ‘carbon budgets’ on the way for the UK to reduce its territorial emissions by at least 80% by 2050.

The Personal target is a percentage reduction on YOUR EXISTING FOOTPRINT and can be set at any level.

What reduction should I choose for a personal target?

This depends on the existing personal carbon footprint. If it is already well below average, there may be little scope to reduce it further. If it is high, but based on things the user cannot change easily like the size of their house or income, there also may be little scope for major reductions. But to make Activity 11 worthwhile it should probably be at least 20%.

What if I can’t achieve my reduction target?

Depending on your existing income and circumstances, it may be difficult, or impossible, to reach government reduction targets of 46% or more by changes in the Home energy, Travel, Food, etc. sections. People with a high household income may find there is not enough scope in other sections to reduce the high carbon footprint arising from their assumed spending on goods and services (or their savings and investments). In which case they will

need to consider using some of their income to pay for taxes or offsets in the Decarbonisation section (see below).

3.13 Decarbonisation

What is decarbonisation?

‘Decarbonisation’ means reducing or removing carbon dioxide emissions from economic activities. This is usually done through actions by government or industry, such as replacing fossil fuels by renewable sources or nuclear power; removing carbon dioxide from the atmosphere by carbon capture and storage; increasing industrial energy efficiency and producing, and perhaps subsidising, low carbon goods such as electric cars. You could say that some of the individual and household level actions in the calculator (e.g. home insulation) also achieve decarbonisation, but the term is usually reserved for larger-scale, non-household emission reduction measures.

The Decarbonisation screen provides some options that can contribute towards reducing your personal footprint by decarbonising the national or global economy. This is done via emission reduction measures by government paid by you through taxes or by carbon offsets voluntarily paid for by you but undertaken by others, often projects in developing countries.

Why support increased taxes for decarbonisation?

The calculator offers three choices regarding taxes. The government could increase tax on fuels and/or VAT and/or income, and use the proceeds to invest in low-carbon technology, particularly for the energy supply system. The effect of such measures is based on estimates by the Institute of Fiscal Studies (e.g. that a 1% general increase in income taxes could provide funds to reduce emissions by about 1.5 tonnes per person per year) and are necessarily approximate; but they give some idea of the scale of the effects that can be obtained by modest tax increases.

The tax increases are absolute. For example, a 1% increase in income tax would increase the (current 2017) basic rate to 21% and the higher rate to 41% and a 1.5% increase in VAT would increase it to 21.5% on most goods and services.

Why invest in voluntary carbon offsets?

Similar effects are obtained by what amounts to self-taxation, the purchase of voluntary carbon offsets or credits. Here, as a UK consumer, you are deliberately paying for others, usually in a developing country, to invest in low carbon projects, such as energy-efficient cooking stoves or lighting, to offset your personal emissions e.g. from taking a holiday flight.

It’s important that any percentage of your income you decide to invest in carbon offsets to reduce your footprint must be regular monthly or annual payments over more than one year, (-at least two to three years) and not a one-off payment to offset a single flight.

How does decarbonisation affect my personal carbon footprint?

Decarbonisation is given a separate line in the Summary and deducted from your personal footprint total. You could end up with a negative emissions score. This means that you are 'in credit' and can claim to be helping to heal the damage caused by GHG emissions.

Some analyses take into account 'historical emissions', suggesting that much of the accumulated CO₂ in the atmosphere was emitted by rich countries like the UK. Such countries might be considered to be in a state of 'carbon debt' that can only be redeemed by overseas payments to help other countries decarbonise their economies more quickly. From this perspective, a negative personal score can be seen as part of the UK's obligations to repay its carbon debts.

4 Non-UK residents

I don't live in the UK, will the OU Carbon calculator work for me?

The OU Carbon calculator is designed for people living in the UK. However, if you live in a north western European country, such as the Irish Republic, the Netherlands, Belgium, north and mid France, western parts of Germany or northern Italy with a similar winter climate to the UK, you can use the OU Carbon calculator.

If you live outside these areas, the OU calculator's results won't be accurate and some questions may not be applicable. We suggest that you use an alternative online calculator called [Carbonfootprint.com](https://www.carbonfootprint.com).