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ENERGY ASSESSMENT FOR MEMBERS

Author / Contact :

Fuad Al-Tawil

fuadaltawil@yahoo.co.uk

01626 87 2721

Teign Energy Communities Ltd.
Registered Office: Deer Park Farm, Haccombe, Newton Abbot, TQ12 4SJ
A Community Benefit Society regulated by the Financial Conduct Authority, no. 7210 ; VAT number 239534684

Contents

To find meaning of **acronyms**, please use the search facility in your document reader. Enter the acronym in brackets and search backwards, e.g. enter "(**CI**)" to find that is stands for "Carbon Intensity".

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Section 1. Introduction and Notes

What is the E-Pack?
The TECs Energy Assessment pack (**E-Pack**) puts you in charge of reducing your energy consumption and your Green House Gas (**GHG**) emissions. Only you know your circumstances, so you are best placed to decide what action to take.

The E-Pack is a way of helping you understand the different options available to solve your level of GHG emission reductions. Instead of listing lots of measures which could help, the E-Pack describes steps you can take to work out what measures are most effective and appropriate for you.

Is this for me?
Anyone can use the E-Pack. You decide how much you want to do and why you are doing it.

TECs' vision is to raise our awareness of Energy use and its GHG impact, so we become as familiar with it as we are with money. This means you need to be prepared to know as much about your Energy and GHG emissions as you do about your money. Knowing where our money comes from and how we spend it is second nature to most people.

The E-Pack has a number of apps and tools to help you on this journey of learning. How much you learn is entirely your choice. Like everything, the more effort you put into learning something, the more informed your decisions can be. The E-Pack learning programme is suitable for anyone from beginner to Energy/Climate Expert, but it is not an exam as there are no right/wrong actions.

Who can do it?
Whether you live in a house, flat or run a business/organisation, you will be able to use most of the notes and devices as a DIY pack. The E-Pack works best when everyone living/working in the place buy into the process and are motivated. Most of the assessments only need basic practical skills. Some assessments will need more knowledge and are more effective if introduced by someone with experience.

Although most of the E-Pack material, apps, tools and support are free to TECs members, we are happy to share elements of this with non-members. If you are interested please contact us.

As a starting point, to find out where you stand and where you need to get to in terms of Climate Change, we have made the TECs' Carbon Footprint Tracker app available to everyone. This app has been designed to provide meaningful information, yet be as simple to use as possible. It is particularly useful for anyone who wants to find out more about their Energy use and associated GHG emissions. It is, however, only the start of the journey which we hope will raise questions about what to do next. Questions the rest of the E-Pack should help answer.

How is this different to other programmes?
The main differences between this assessment and most others offered commercially or free on the web are:

- it is completely personalised measuring your specific Energy use and GHG emissions. **You will also be able to set your own targets for what you want to achieve**.
- it provides you with measurements to determine the effectiveness of possible actions.
- it is comprehensive covering every aspect of your Energy consumption and GHG emissions.

The process, tools, apps and support are there to help you achieve the best assessment of your Energy use for the level of input and skill you want to put into it. The assessment is not intended to compete with or replace those carried out by certified professionals as it does not carry any certificates or guarantees. Its effectiveness is largely dependent on the person carrying it out, their approach, motivation and to a lesser degree, experience.

How does it work?
We'll give you simple methods to measure your Energy consumption (and associated GHG emissions). Once you know your personal usage, you can compare this with national averages or other comparable statistics to set **realistic objectives**. By identifying where you use the most Energy and emit the most GHG, you can decide where you would be most effective in reducing these and by how much.

The E-Pack covers the following areas of energy use:

Electricity; **Heating**; **Water**; **Transport** (Private & Public); **Food**; **Stuff** (Goods & Services); **Offsetting;** and **Payback.**

Let's get started
We strongly recommend that you first try TECs' Carbon Footprint Tracker if you are looking to reduce your Carbon emissions. This will provide you with a quick way to get an overview of you Carbon emissions in each of the areas covered by the E-Pack.

The Carbon Footprint Tracker should help you identify the areas you want to focus on. Before you move on to the more detailed E-Pack assessment, here are some important points to consider:

- Decide what you want to achieve and why this is important to you. In other words what motivates you to understand your Energy consumption better?
- Ensure that everyone living/working in the place is aware of the process and is involved to some degree.
- **Be realistic, do one area at a time**. Set achievable targets and move on only when you feel happy you have met or adjusted these to suit changing circumstances. This is not a race, but a long journey.

You are not alone! If you contact TECs, someone will discuss how the E-Pack can work for you. This may lead to a visit to your home/building to explain the step-by-step guide, running through an example in the area you are interested in. Most people start with electricity. We will then leave the pack with you for about a month.

Certain elements of the process are time of day/week/year and weather dependent, so it is worth doing some parts of the assessment more than once at different times/conditions or with greater detail. This is very much an ongoing process as it is easy to slip back into old habits, or if circumstances change.

What will I need?
As a TECs member, most of the devices you will need can be loaned for a month or so from TECs. We are happy to provide information on where you can buy some of these.

- General (clip-on) Electricity Monitor, or use smart meter if already fitted.
- Accurate Electricity (plug-in) monitor to measure low currents of individual equipment.
- Indoor Thermometer/Humidity Meter / Datalogger (**THDL** and **TDL**).
- Draught Detector (candle, smoke-stick), please be mindful of fire hazards when using these.
- Thermal Imaging Camera (**TIC**), this comes with a smartphone.
- Infrared Thermometer (**IRT**).
- Where appropriate, the Heat Flux and Temperature Tool (**HFTT**) for measuring fabric U-Values.
- An infrared tape-measure and building dimension calculator.
- Various cables: USB charging; THDL/TDL downloading; mains extension.
- Reference books.
- We can e-mail you all E-Pack information: Section 2 of these notes; Using the monitoring tools; and Spreadsheets for temperature analysis.
- Using your login on the TECs website, you can access the E-Pack Application (**app**), this is a more convenient method of recording your data and automatically links back into the Carbon Footprint Tracker.

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We kindly ask you to:

- Look after the equipment you borrowed and return it within 4 weeks.
- Contact us as soon as you have any problems or questions.
- Let us have your comments on how you got on with the pack, we want to improve it.
- On returning the pack, let us have your estimate of how much you hope to save (in kWh or kg of GHG emissions) in a year.
- A year later, tell us what you actually achieved and how, we'll send you a reminder if you like.
- Respect the copyright arrangements for documents referenced at the footer of these.
- Follow the licensing arrangements agreed with TECs on the use of the apps provided. For TECs members, these are limited to personal use only and your login should not be shared without prior permission from TECs.

Acknowledgement

The work involved in compiling this Energy Assessment Pack was carried out by volunteers from HaRE CIC, TNA CIC, TECs and most recently ACT. The equipment was purchased from funds provided by Haccombe with Coombe PC, HaRE CIC and TECs. In particular the author is grateful for input from Joddy Chapman, David Suckley, Jules Stringer, Tony Oldroyd, Helen Chessum, Jules Stringer, Michael Simmons and Paul Scholes.

The E-Pack builds on material and references from a number of sources including:

- Kingsteignton Transition Together (**KTT**) which takes a group of individuals through a journey to explore how they can reduce their household energy consumption. KTT was a project initiated by the Energy group of Transition Newton Abbot CIC (**TNA**).
- The course and materials on Whole House Retrofit organised by Regen in 2018, this is part of a 3 year EU funded programme called Zero Building Catalyst (**ZEBCat**).
- Many of the tables and data used are available from building regulations/standards, manufacturers' literature or data available on the internet. Where relevant references have been provided, to the best of TECs' knowledge, none of these have associated copyright requirements.

Important Disclaimer

All advice, tools and apps provided by TECs are intended to help you make more informed decisions.

Every effort has been taken to ensure the accuracy and completeness of the information and advice we provide. While we are happy to share the public sources used and analysis undertaken, we cannot take responsibility for any actions you choose to undertake.

Similarly, the tools and apps are provided on the basis of no legal liability to TECs or anyone officially acting on TECs' behalf.

When using or referencing any of the information, advice, tools or apps provided by ACT, you are doing so with the understanding that you alone are responsible for all direct or indirect consequences of actions you take. TECs and its official representatives cannot be held liable.

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Section 2. Step by Step Guide

Please first re-read the notes and this guide every time you plan to use it. It's easy to forget!

The following is intended to help you make the most of the E-pack. It has been put together following feedback from a number of users. **It is important to follow all the steps in the correct order**.

1. **Why am I doing this Energy Assessment?**
   Decide whether your priority is to reduce your Carbon Footprint (i.e. reduce your contribution to Climate Change) or to save money on your utility and general bills. Both may be important, but different actions may be more effective if one is more important than the other. There are many other reasons you may want to take action, for example to improve living conditions or repair/protect the building fabric.
   Make sure you involve everyone in your home/business and come to a consensus on priorities. The Carbon Footprint Tracker will help with this.

2. **What is my current energy usage?**
   You need to get bills or make other calculations going back at least one year and calculate your average annual consumption for each area in terms of kWh (a unit of Energy), weight, volume, distance or £ spent. The E-Pack Assessment app, available to Members, covers the different areas, someone from TECs can help you to use this if you are not familiar with such on-line apps.

3. **How am I using my Energy?**
   Measure and/or use the information provided in the Assessment app. Try to be as honest as possible about all the areas and occupants' behaviour. Being systematic may take a little longer, but is well worth it. Experience will help identify and prioritise where Energy can be used more effectively. If however, you don't have this experience or don't know someone who can help, then ask if TECs can help. There are some useful tips and information for each of the areas in the rest of the E-Pack notes.

4. **Keep monitoring and TAKE ACTION**
   The best time to do certain assessments is in winter, but some things only become obvious in summer. It is also important to do the assessment more than once to see if the measures undertaken have made a difference. The hardest thing for all of us is to change how we do things, our behaviour . This is why we believe it is useful to get a good understanding of Climate Change and why it is considered an Emergency by all science-based analyses including the 2018 IPCC report.

You probably already know how to use less Energy in your home/business and have done many of the 'standard' things, e.g. insulation and using low energy bulbs. The E-Pack is a gentle nudge for you to start tackling those bigger jobs and your own behaviour in advance of it becoming an urgent necessity. By measuring Energy consumption and the impact of any actions to reduce it, you are more likely to make better choices.

Getting stressed or feeling guilty about your lifestyle is unlikely to help. Instead, measure your lifestyle, compare it with your objectives, and decide if and by how much you want to reduce your Carbon Footprint.

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What's included?

The notes in this document are the starting points for the programme and each of the areas covered. From here you will be guided to the various apps, tools and additional information.

You can choose to do some, or all the areas covered. For each area you chose read the notes in the appropriate section and familiarise yourself with the Assessment app for each area. If you are unsure about where to start get some advice from TECs.

Starting with Electricity is probably convenient for most people. It's easier to measure and helps give you a better sense for Energy use and its impact. It'll help you improve your Carbon sense.

We have deliberately avoided comparisons with others, although there are very many such diagrams which give UK average figures of energy consumption or GHG emissions. Use the Carbon Footprint Tracker app to determine yours, so you focus on making the progress you want to make. In any case, **Your household/organisation/business circumstances will be different** from an average one.

The E-pack provides you with the basic information needed to work out your Energy consumption or Carbon Footprint. It also gives you some basic comparative and numeric information. However, it does not provide solutions specific to you on how to reduce your consumption, for this you can set your own actions. TECs can help with some of this, but you'll learn more from the process by assessing your own solutions/actions.

Measuring YOUR consumption remains the only way to identify effective actions. These actions will be specifically tailored to your situation.

Enjoy!

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2.1 Some useful information on Energy and associated emissions

- Energy bills are given in kWh (kilo Watt hour) also referred to as a "unit" of Energy.
- 1 kW (or kWh) = 1000 Watt hour (or Wh)
- Energy (in kWh) = Power (in kW) x Time (in hours).
- Every 1 Watt on all the time is costing you £1.30 a year (assuming a unit price of 15p).
- 2kg of CO2 is about 1 cubic m of greenhouse gas. This is similar to an 8 mile trip in an average petrol car (2015 UK data) which generates 2 kg of CO2 from the exhaust. Another 2kg for every 8 miles from associated processes like making, maintaining and scrapping the car.
- As a rough guide, 2 kg of CO2 are emitted into the atmosphere from using (based on UK data for 2019):
    - ~7.2 kWh of grid electricity, excluding device efficiency (~50-350%);
    - ~7.6 kWh of oil (or ~0.8 L), excluding boiler/engine efficiency (~25-80%);
    - ~9.3 kWh of natural gas, again excluding boiler/cooker efficiency (~30-95%).

  You'll need to multiply the specific efficiency by the amount of energy to get a correct reflection of how much useable energy you are getting.

Please refer to the Assessment or the Carbon Footprint Tracker apps for official Carbon Intensities (**CI**) of different fuel types, some of these will vary from year to year.

Green House Gas (**GHG**) emissions represent a number of different gases which cause atmospheric temperatures to rise by trapping more sunlight. The largest component of these GHGs is Carbon Dioxide (**CO2**). Other GHGs, such as Methane, make a significant contribution as they are more 'potent' despite being shorter lived.

The shorthand for GHG emissions often used, including in the E-Pack are: Carbon; CO2 equivalent (**CO2e**).

Energy can be measured using different scales, most people are familiar with Calories (**Cal**) or more accurately a kilocalorie (**kcal**) where:

1 kWh = 860.421 kcal

How we calculate GHG emissions

The GHG emissions are calculated on a consumption basis. That is, we include all emissions associated with the item or activity you have entered, irrespective of where these emissions occurred. Put another way, we include the embodied emissions (also referred to as scope-3 emissions or cradle emissions) associated with manufacturing an item or in providing a service, not just our use of these.

Emissions associated with end-of-life (i.e. waste or grave emissions) for items are included in Services, e.g. council tax.

We do not currently include embodied emissions from renewable sources other than as a part of the capital spend to install these. An alternative methodology we could have used is to calculate a CI for these (e.g. PV has a CI of ~ 0.05 kgCO2e/kWh over its expected life). Because this varies significantly both over time and country of origin, we have not used this methodology.

2.2 Electricity

The electricity you consume from the grid and any renewable generation you have connected 'behind' your grid meter will have a variety of uses. Enter these for each year in the Electricity tap of the app. You'll need to break the total consumption down to a meaningful level so that you can take action to eliminate those areas that are wasteful or unnecessary. You can register this in the Electrical Items tab of the app.

Measure
Use your meter, smart meter or wireless monitor for calculating your average electricity consumption throughout the year (in kWh !). It works best if you record this monthly. You could get very detailed half hourly readings if you have a smart meter. Quarterly readings, as in electricity bills, are just about adequate provided they are actual readings and not estimates.

You should also measure your Base Load, that is the electricity you are consuming 24/7. Use your electricity meter (or the **Wireless Energy Monitor** provided). Read the meter (in kW) just before you go to bed and when everything is switched off as normal. Assuming your central heating is off and your fridge is not on its maximum cycle you should be reading 50-150W. The wireless monitor is not very accurate, so reading a smart meter or your normal electricity meter would be better.

The **Plug-in Monitor** gives a more accurate measure of both the instantaneous standby/active Power consumption as well as the Energy used over a period (e.g. a day or a washing cycle). You can work out the consumption of 'wired in' appliances (e.g. cooker, central heating pumps) by estimating these based on typical examples. Alternatively, you can use the Wireless Energy Monitor, please ask TECs for advice so you do not take any risks with electrical wiring.

Analyse
It is not useful to compare total electricity consumption with a UK average because we use electricity very differently. The largest consumption areas are likely to be Heating/Ventilation, Electric Vehicle, cooking and refrigeration. For these and many of the other devices powered by electricity you will need to enter their annual consumption in the app. Where you cannot directly measure individual elements of consumption using the tools provided, the app includes some typical examples as a guide, so that you can make a better estimate. You can ask TECs how this can be done or try and find out from others or the internet.

Actions
Know the electricity consumption of everything in your home/business, measure these or use the examples provided for typical values.

Focus your effort on the bigger things first, you can be more effective and have a greater impact. There are lots of urban myths about Energy Saving (and Renewable Energy generation) in the home/business. So, it is worth having the numbers and information before making a decision.

Some actions you decide on will cost money, but it costs nothing to turn things off when you no longer need them. If you decide to replace inefficient appliances, make sure you calculate their **Pay Back Period**. There is no point replacing an old-style bulb you rarely switch on. On the other hand, a single 11W energy saving bulbs left on all the time is consuming nearly 100 kWh p.a., so replacing it with a 5.5W LED would halve that consumption. This could be saving you as much as £10 p.a. for one bulb.

You can of course generate your own electricity using solar PV, wind or hydro systems. These can still break even financially even without the Feed-in Tariff subsidy, but much depends on the size/location of these and your electricity consumption volume/patterns. You can ask TECs for more information on this. Also see our guide for using PV systems with a residential battery system, as well as other useful guides.

If you generate your own electricity from renewables and use/store it without exporting it to the grid, only this will replace the grid electricity you would otherwise have imported. Any electricity exported to the grid is not calculated as your own reduction in GHG emissions. However, this is calculated to contribute to a reduction in the overall UK grid CI. You can find out more about this subject Greenwash in the Electricity Market especially if you cannot have your own generation and storage.

2.3 Heat

There are several ways we can heat our buildings and water or cook. Here we want to focus on space heating, one of the largest areas of energy consumption in buildings.

For most people the heating fuel source is mains gas, but many will use one or more other sources such as electricity, wood, Liquified Petroleum Gas (**LPG**) or coal. Although the total heat energy you use will be determined by your behaviour (temperature and frequency of heating amongst other aspects), the fabric and construction of the building will largely influence where this energy is lost.

Each fuel source will have a different CI, what device you use to generate heat will also influence how much useful heat you get. You'll need to identify all of them in the app provided.

Measure
Work out your average annual Heat Energy consumption in kWh. Use your gas, electricity or oil bills to do this. Enter these into the app, but make sure they are based on actual meter readings or volumes purchased rather than estimates. The app will perform the necessary conversion for each fuel source, e.g. litres of heating oil, kWh for gas and electricity or weight/volume for wood or LPG.

If you cannot separate out the energy used for water heating and cooking (e.g. if you use multiple sources and/or share one or more of these with other uses), ask for help on this or simply assume that these two account for about 15% each of the total energy per fuel type. For example, if you use gas for heating your space, water and for cooking, you can assume that the space heating element accounts for 70% of your total gas consumption.

You will also need to enter the efficiency of the electric/gas/oil/biomass heaters. This can vary significantly as indicated in the Some useful information on Energy section. You are paying for this in fuel costs and GHG emissions, but not feeling the full benefits of heating your building.

Analyse
Compare your building's heat energy consumption and how you use it with an equivalent sized one. You can compare it to different heat energy consumption models. You can do this using the "Heat Loss" tab in the app. The "Simple" calculation gives you an initial rough comparison based on readily available information about your building and how you heat it.

Finding out how this heat is lost through the fabric of the building is a bit trickier. Most of the heat is lost through inadequate insulation of the building itself, but also excessive/uncontrolled ventilation. You can ask for help on how to identify these relatively quickly using the Thermal Imaging Camera (**TIC**) and other tools provided. To be most effective and accurate, this needs to be used when it is cold outside and requires a degree of interpretation of the building fabric and the tool settings. See "Using Monitoring Tools for Heat" document and ask for help from TECs. This document also provides some general information on humidity and ventilation.

The "Detailed" calculation in the "Heat Loss" tab of the app gives you an estimate of the heat energy lost through different elements of your building. This can help you work out an estimate of savings for different remedial measures. The cost of these measures (e.g. higher levels of insulation) can then be used to work out the Carbon or financial pay-back period.

You will need to complete the "Building Elements" tab in the app. There you are able to record measured/look-upped properties for the different elements of your building, the % of total heat lost for each will be based on the U-Values, average weather/heating conditions, ventilation and solar gain.

Actions
The "Heat Loss" tab of the app calculates how much heat energy you could save if you turned your main thermostat down by 1^{o}C, this is based on your building, its location and how you use the heating system. On average this saves 8-12% on your energy consumption and GHG emissions.

Having appropriate insulation and ventilation is not only important in terms of energy wasted and preservation of the building fabric, but also it can provide greater comfort and lower health risk from airborne pollutants including mould spores and cooking gas fumes.

Many UK buildings often have less than optimal heating and ventilation settings, because of poor installation and/or incorrect usage. This can have a significant impact on heat energy consumption and level of risk to our health. There are some things to look out for when you do your analysis, if you are unsure ask TECs about these.

There are several 'green' solutions offered commercially but also promoted by government. Some, like heat pumps, may not be suitable for poorly insulated buildings. You should always calculate a realistic heat energy output of the solution offered and compare this with your current heat energy requirements as used in the "Heat Loss" tab of the app. The 'quality' of heat energy generated will also be a key factor in determining if your existing radiators and controls will be appropriate or need replacement.

This can be a complex area for many, so professional advice should be sought from reputable heat engineers/designers. The information provided by your own analysis and the use of tools and app will provide an invaluable baseline if such a professional assessment is to be done correctly. TECs can support you in this process.

Making your place more Heat Energy efficient will cost money, but it costs nothing to use sufficient heat only where and when you need it.

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2.4 Water

The biggest use of energy associated with water is heating it. There is also energy associated with treating our fresh and waste water as well as pumping it.

It requires over 3,000 times more Energy to heat a volume of water compared to heating the same volume of air by the same temperature. Luckily most of us don't have to heat as much water as air, swimming pools and hot-tubs being exceptions to that rule.

While currently there is enough rainfall in the South-West, unpredictable changes in weather patterns may cause seasonal shortages in the future. The South-East on the other hand already has serious water shortage problems supplying an average 150 L/person/day.

Almost 60 times more energy is used to heat water from 10°C to 50°C compared to delivering the fresh water to your tap and safely disposing of the used water.

The Assessment app includes placeholders for Energy required for heating your water. This will help you determine if the way you use and heat water could avoid unnecessary energy use.

Measure
If you don't have a water meter, you'll be paying a flat water and sewage rate based on the rateable value of your property. In most cases, having a meter will not only reduce your payments, but make you more aware of how you use this and be able to spot leaks.

The app will help you work out your annual Hot Water Energy consumption in kWh. Most of this will be your hot water usage for showers, baths and washing.

The hot water used in appliances like dishwashers and washing machines will usually be heated by the appliance itself. These energy consumption figures will be covered under Electricity.

Analyse
An average UK household uses about 4,000 kWh annually for its Hot Water. While the average UK household uses about 130 kWh for its Cold Water supply/disposal in the same period.

You'll need to work out where the hot water energy is used. You can do this by counting/estimating the number of weekly showers/baths. If you need help with this, please contact TECs.

Actions
Heating your hot water efficiently is important, but you can save more if you use it wisely and minimise heat losses (i.e. lagging any hot water tanks/pipes). Where timers and thermostats are used in hot water storage, it is worth checking that these work correctly and are optimally set. Heating more than you need/use will waste this energy even if you have very good lagging.

If you have a solar PV system, chances are you are exporting the vast majority (~80%) to the grid. You can install devices which will automatically transfer any surplus to your hot water tank if you have one with an 'immersion' heating element. Whether this is cost effective will depend on a number of factors, so do ask.

Unless you already have a thermal solar system there are likely to be 'better' alternatives, except in special circumstances. Solar thermal can be more expensive in both installation and maintenance than using surplus PV generated electricity.

Rainwater/grey water harvesting systems could be options to consider in certain circumstances. These are particularly useful for watering gardens as the cost of such systems would be relatively low compared to use within the building. This is because of the additional health risk mitigation, plumbing and pumping requirements if used within the building. You'll need to do the calculation to ensure that you are not increasing you GHG emissions with certain systems used within buildings, especially in the case of a retrofit system.

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2.5 Transport

Transport has received significant attention as a source of GHG emissions and pollutants in urban areas. We are 'encouraged' to drive electric cars, fly less and use public transport more. But even this general advice now seems to be put into question for various reasons. Our transport choices are often driven by time, convenience and cost. We need to include GHG emissions as another criteria for our choice, an increasingly important criterion.

To help you work out what the energy and GHG emission impact is, you will need to break down your transport usage to the different modes. You will already have done most of this when using the Carbon Footprint Tracker. The app will help you record and calculate this at a more detailed level.

If it were not for the GHG emissions and the resulting Climate Change, fossil fuels are a very cheap source of energy. For example, a tank full of petrol provides us with the same energy as one person, working for 8 hours a day, 365 days a year, for almost 3 years. Paying the minimum wage, a tank of petrol would cost us ~ £70,000.

Measure
Work out your annual travel mileage. Use the "Travel Plan" app to help you break this down for the different modes of transport throughout the year. If you don't record your mileage monthly, you can use your MOT certificate to see the total annual mileage in your car. It is still worth doing a Travel Plan as you can see at a glance where most of your travel is, this will help you prioritise.

Measuring monthly will help you make a more informed decision if (when) you move to an Electric Vehicle (**EV**). This is because you can see if there are seasonal variations in the journeys you take, but also because you'll know the typical range of your journeys.

Analyse
Both the Travel Plan and Carbon Footprint Tracker apps can help you compare your GHG emissions if you were to change your mode of transport for the same distances travelled. You will need to consider the feasibility of making such a modal shift for your circumstances.

You may also want to experiment with a different style of driving and recording the fuel consumption figures over a month, comparing it with a month of similar journeys. There is significant saving to be made by simply changing your style of driving, speed is an obvious one, but there are several others. Driving at 70mph rather than 80mph, can reduce your fuel use and CO2 emissions, by ~25%.

Action
Look at you Travel Plan and calculations to work out where you can find convenient alternatives which will reduce your GHG emissions (and often, but not always) your costs. The easiest alternatives are the short distance journeys (under 3 miles) where you could walk, E-cycle or take a bus. Not only do they save £, GHG emissions, pollutants, but they are also good for your body & soul.

Battery Electric Vehicles (BEV) are becoming a viable option for some. Simply swapping your car for an EV may not reduce your Carbon Footprint, you'll need to consider a number of things to make sure it is the right option for you. Please talk to someone from TECs about how to work out the best options for you. Also see our EV guide.

Public transport always seems to cost more than using the car. That is because we often only compare the cost of fuel for the car with the price of the ticket. The real cost of using the car (especially one with an internal combustion engine) is probably double what we pay for fuel, especially in terms of £. Other costs include the amortised capital or 'embodied' cost of the vehicle, annual maintenance, insurance and MOT.

The potency of Green House Gasses released at higher levels from air travel is about double that of burning fossil flues at ground level, however, flying is not always the worst option in terms of GHG emissions. It is also a question of vehicle occupancy and distance travelled. You can use the Carbon Footprint Tracker to compare these.

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A Community Benefit Society regulated by the Financial Conduct Authority, no. 7210 ; VAT number 239534684

2.6 Food

Energy intensity and GHG emissions of food will depend on a whole host of factors. In the past the focus has been on food miles. Although an important contributor, it is no longer considered to be the largest, especially in terms of GHG emissions.

The Carbon Footprint Tracker is therefore based on the type of diet as a rough estimate of your GHG emissions using national averages. For example, a diet with a high meat and dairy content will contribute significantly to emissions, but by how much would depend on your actual spend for those items.

The "Food" tab of the app will help you establish a more accurate picture of your diet. It will allow you to further categorise spend on food & drink items. For those who want to get even greater detail or insight, we have provided a range of references.

Ideally, we'd want to quantify the impact of additional factors such as seasonality, locality and processing of food & drink. Unfortunately, the accuracy of the data to support this is not consistent or readily available. Instead we have included references to the type of actions you can take to minimise your environmental impact.

Measure
This can become a very complex area, so unless you have a reason to delve into it, we suggest you focus on measuring the largest contributors to your emissions on food. Use the "Food" app to help you do the second stage breakdown. It may be helpful to look at your typical weekly/monthly shopping basket to estimate an annual average spend which you can enter into the app.

You can also use the more detailed lists and links we have provided to do further detailed analysis, please ask TECs for help on this if you require it.

When you have completed a more detailed measurement, you can adjust the entry in the Carbon Footprint Tracker accordingly.

Analyse
An average annual UK household budget for food & drink is about £**5,800**. This equates roughly to £2,600 per person and 1.6 – 2.2 t of GHG emissions for an average mixed diet.

Although not a precise measure of likely GHG emissions, the following criteria are likely to reduce these:

- Minimise the consumption of meat, especially red meat. This has a significantly higher Energy Intensity and GHG emissions than a plant-based food with the same nutritional value.
- Buy seasonal, unprocessed foods. This will avoid high energy use to grow, process or store these.
- Try and find out where your food comes from and buy as local as possible. This is likely to reduce the distance the food has travelled. It can also tell you more about the ethical and environmental impacts of the food & drink you consume.

Even if you don't use the more detailed lists of product categories, it is worth looking at these to spot any items with a particularly high level of GHG emissions which you consume a lot of.

Actions
Diets are not just there to keep us alive, we also want to enjoy what we eat and drink. But it is worth knowing a little about what is essential for a healthy diet. Our bodies need protein, carbohydrates and trace elements in various compounds. Different foods give us varying amounts of these essentials. The energy needed to produce the same essential elements can vary significantly (e.g. 100 fold) depending on what foods we choose. Protein in particular can be an energy intensive source if we get this mainly from meat, especially red meat.

Become a more discerning shopper. It is our behaviour as consumers that food producers, distributors and retailers will respond to most directly. Knowing what you are eating can only be a good thing. It also helps you better gauge how much food you really need and therefore end up throwing less away. Some 15% of edible food and drink is thrown away by households in the UK.

Meat and dairy products are a more 'energy intense' way to provide us with the essential energy we get from our food. Meat is about 10 times more energy intensive than dairy products and 26 times less efficient than pulses (e.g. beef vs. lentils). These factors can vary significantly if you know your meat has been largely fed on local grass or has not destroyed rainforest.

While organic food can be kinder to animals, encourage wildlife and reduce our intake of certain chemicals, it does not necessarily result in a lower Carbon Footprint. Much more significant is 'growing' the food in the appropriate place and consuming it seasonally, to minimise the impact on Climate Change.

Maintaining a healthy diet is affordable by almost everyone in the UK. Enjoying the luxuries of great tasting food should not make you feel guilty. A rebalancing of where we buy our food, the mix of ingredients and how much we end up throwing away is often all it takes.

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2.7 Stuff (Goods & Services)

Calculating an accurate level of GHG emissions for goods and services could be the most challenging of all the areas we consume energy.

To reflect the total GHG emissions of goods, wherever they are generated, means we have to include the sourcing of the materials used (including raw material extraction), their processing/manufacture and shipping/distribution. Calculating this to any degree of accuracy, when there are so many different products, materials and processes, is almost impossible. Nevertheless, it is possible to provide an indicative level of emissions. We have opted to do this based on government and academic data published for the UK.

Services are even more complex, behind each service there are goods used to deliver this. Our approach in the Carbon Footprint Tracker is to use government data for all services in the UK and allocate these per person, hence the fixed value used in the Carbon Footprint Tracker.

Here we have provided a more detailed breakdown to help you identify the goods and services you spend the most on. This should help you refine the amount of GHG emissions for these and thereby get a more representative figure. You will be able to identify which common goods fall into the following categories:

- Low price and high GHG emissions
- High price and low GHG emissions
- Average price to level of GHG emissions

Most calculators, including government data for goods, do not include the Carbon Footprint of what we import. Imports exceed exports by about 25-50% in value (excluding fuel imports). So our real Carbon Footprint is likely to be higher as we import many of the products we buy. The TECs apps include some of the emissions generated in other countries, the 'embodied' GHG emissions

Measure
The TECs Carbon Footprint Tracker is simple to use as you only need to enter your total annual expenditure on new Goods. These results represent a guide for you to compare your consumption in this area year on year. Use the 'Goods" tab of the app to refine this.

We also provide a look-up facility for certain goods. It is worth looking at these to spot any items with a particularly high level of GHG emissions which you consume a lot of.

Analyse
This area is likely to be one of the biggest contributors to our Carbon Footprint. It is probably also the hardest to measure accurately and to tackle in terms of overall reductions. However, a small change in how we use and dispose of things can achieve significant reductions.

It is possible to analyse each item in terms of its raw materials, where/how it is manufactures and transported. Some manufacturers are starting to provide this information, in particular the 'embodied' GHG emissions associated with sourcing and production. Look out for these on the web or ask TECs if you want to know the embodied emissions for particular items.

Action
There is nothing wrong with making our lives easier and more comfortable with things round the house or at work. Keeping track of all the things we have bought over the years is sometimes difficult, so often we stop using them or even buy another one because we've forgotten that we already have it. Try to consider how important it is to buy something new and how often you are likely to use it. Can you **reduce** and **re-use** the things that make you feel good?

If all fails and you find yourself with lots of things you simply cannot use, why not **re-cycle**? Not just the material to the recycling bins, although this is a good last resort. There are many ways of exchanging, passing on or selling things others can use.

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2.8 Offsetting

Offsetting our GHG emissions seems a reasonable option. It is something that has been available for some time with schemes becoming more transparent, publicising their Gold Standard credentials.

But what is offsetting and how effective is it?

There are two types of offsetting considered here:

- We can sequester CO2 from the atmosphere, by removing it using natural means (photosynthesis of plants) or engineered mechanical/chemical means referred to as Carbon Capture Utilisation and Storage (**CCUS** or just **CCS)**.
- We can generate low-carbon energy which is used by us or others to replace energy with higher GHG emissions. It is also possible to replace systems with more energy efficient ones.

Both are valid provided we account for their full life-cycle emissions. Too often offsetting schemes are presented either without a GHG impact analysis or one which only considers part of the total lifecycle emissions. Even more worrying is that technologies such as heat pumps and EVs are often 'sold' as low-carbon without stating the full life-cycle emissions to allow an informed decision. In other words, how much GHG do I reduce, at what cost and under what circumstances.

The E-Pack and its various apps/tools help you measure many of the GHG emissions associated with what you do and what you buy. We have included all the embodied emissions ,where possible, even those that happen outside the UK, so that you have a more meaningful guide when deciding what to do/buy.

Measure
If we are to get close to net-zero emissions by a certain date (2030 to avoid runaway Climate Change), offsetting could play its part. However, we need to know what the actual Carbon reduction impact of an action is.

Even then, we have to accept that most of these measures will only buy us more time as the emission-offset will progressively get less effective as we decarbonise. Even planting trees is only likely to buy us a few decades because when these die or are burnt, they will release much of their sequestered Carbon back into the atmosphere.

The E-Pack app provides a means to calculate the different offsetting options.

Analyse
Global net annual GHG emissions are running at ~50 Gt per year, the UK's contribution is ~0.5 Gt p.a. excluding net exported emissions. The latter could add a further 0.13-0.25 Gt p.a. to UK's actual emissions. These are significant amounts of GHG emissions which represent the cumulative decisions we make as individuals.

Use the E-Pack app to calculate offsetting and sequestration measures you are considering.

Just like calculating the impact of these decisions to save on emissions in the 6 previous areas, we need to weigh up the cost-benefit or effort-benefit of an offsetting action. This can be difficult, especially when including the embodied emissions. Please ask TECs for help with this, but you can also find out more in the section on Payback Calculation.

Action
Planting trees is a well-established offsetting mechanism. The type of plants and where these are planted will make a significant difference to how much CO2 is sequestered. As a general guide:

- Sequestration through new forestation could slow GHG emissions, it is part of the UK's plans to reach net-zero by 2050. However, this will only buy us a little more time (a few decades) rather than address the fundamental requirement to reduce GHG emissions in the first place. This is because these trees will release much of the sequestered CO2 when they die as part of the natural Carbon Cycle.

- Taking an average for the UK of ~13 tonnes/Ha/year as a rule of thumb when assessing a mixed afforestation scheme's contribution. That is ~44 kg/mature tree/year. This assumes an average of ~300 mature trees per Ha (starting with ~3,000 new trees). These trees would need to be maintained for at least 30 years.
- For new or restored permanent, ungrazed grassland schemes, where the dry matter is not removed, a typical average may be ~1.5t/Ha/year. It is much more difficult to provide a number for this as the sequestered Carbon will be within the soil. That means, soil condition and type of grasses/vegetation will have a significant impact. The most significant impact can be achieved through restoration of peatland. This can sequester more Carbon any other natural habitat.

Investing in new renewable generation, either your own behind the meter, or in larger schemes, can be an effective way to offset GHG emissions. Make sure you calculate the energy (in kWh) that will be generated rather than the capacity of generation (in kW) when assessing the impact on GHG reduction. You'll also need to use the prevailing CI of the grid. This is likely to reduce year on year, so offsetting in this way will become less significant as we decarbonise.

A more effective offsetting measure is to invest in overall heat loss from buildings. So, retrofitting our homes or even behavioural changes on how/when we heat buildings, can be very effective measures.

Other popular actions regularly publicised include buying 'green' energy, investing in 'green' schemes or 'low-carbon' technologies. These all sound good, especially if they include an 'ethical' or 'environmental' dimension. Before you decide on what to invest in, make sure you have enough information about the degree of benefit you are likely to get. Environmental or ethical benefits are very important, but they may not reduce GHG emissions. You should be particularly aware of Greenwash, especially in the electricity and gas supply markets, but also when it comes to offset schemes.

The more we invest in decarbonising our energy sources, the more expensive it becomes to decarbonise further. Reducing our energy consumption is a much cheaper (and often simpler) option, but it does require us to change our behaviour.

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2.9 Payback Calculation

You can calculate the effectiveness of any action you take. First you need to decide what value matters to you, it could be financial (£), Climate Change (kg CO2e) or both. You may have other criteria such as comfort, time or the ecology which will help you decide what the most effective action is for you.

Pay-back or break-even is measured in terms of time, how long it takes to get back the original amount. So, if we are measuring GHG emissions, we need to calculate the time taken to avoid the level of emissions equivalent to the amount originally used to produce the goods or activity (the embodied Carbon).

Payback time in years = Embodied emissions of new thing / (annual emissions of old thing – annual emissions of new thing)

If the expected life of the action, that is how long it will last, is less than the break-even time, the action will not achieve its purpose! In fact, it would cause more harm (GHG emissions) than good. We therefore need to make sure that the pay-back time is always much shorter than the expected life of the project.

The same calculation can be applied to monetary value by replacing "emissions" with "£". If you can put a measure on the value to you of something, you can work out how effective your action is likely to be. This is particularly useful when deciding on the most cost-effective way to reduce GHG emissions. So measuring the £/ t of emissions avoided as calculated in the offset/sequestration tab of the E-Pack app is good way of comparing different options.

Monetary value of avoided emissions is another calculation well worth doing when considering measures. You can use this to compare the value of using your money to avoid emissions. The price may be for a new measure or item to replace an old one.

Value in £/kg of avoided CO2e = price for new * (annual emissions of old x expected years of new – (embodied emissions of new + annual emissions of new x expected years of new))

The result should be positive at the very least, ideally as high as possible to get best value for your £s spent. If it is negative, it means you are increasing your emissions.