

Carbon Literacy Guide



Section 3.1: Home energy and community buildings
Where emissions come from and how to reduce them

2018

Contents

■	Where do emissions come from - home energy and buildings	4
■	What uses the most energy in the home?	4
■	Which type of fuel source produces the most emissions?	5
■	Doing it less: home energy	6
■	Doing it differently: home energy	8
■	Doing it differently: energy source	9
■	Summary	7
■	Home energy: government milestones	8
■	Support for low carbon action	9



“

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

”

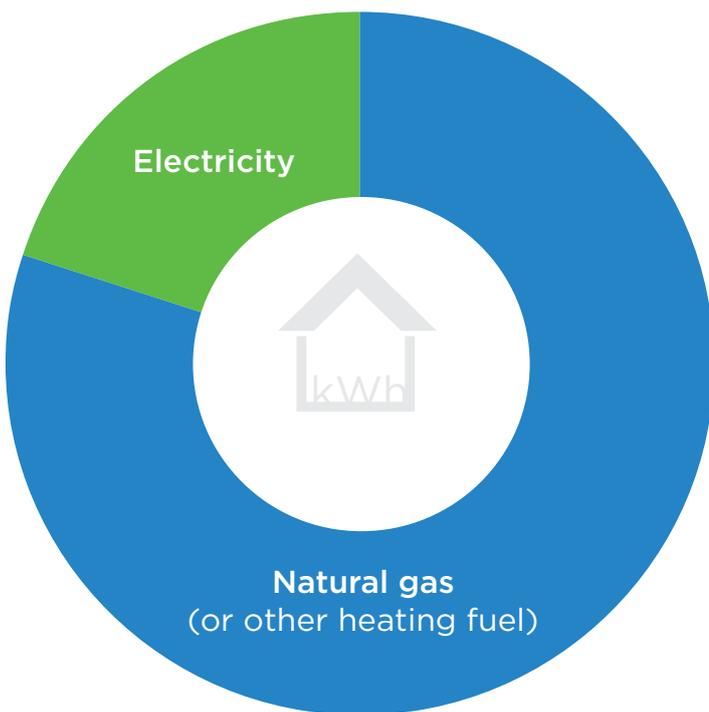
David Attenborough

Where do emissions come from - home energy and community buildings

We use energy to heat and light our homes, power our appliances and provide hot water – the same is true in community owned buildings. Communities and households across Scotland vary significantly in the type of fuels used for different functions. Some buildings use electricity as their only fuel source and the emissions are therefore produced at the power station rather than the home. Many buildings use natural gas, fuel oil, gas oil or other heating fuels to provide space heating and often hot water. These fuels are used at the building and the emissions are therefore produced directly.

The opportunities to reduce emissions are dependent on the carbon intensity of the fuel used and how much energy is being wasted, but the examples below look at an average house using electricity for lighting and home appliances, and natural gas for space and water heating. In this section we will concentrate on home energy use - the numbers will be different for community buildings, but the principles are the same. Improving the energy efficiency of a community building is an excellent opportunity to engage with users of that building to take similar steps at home.

What uses the most energy in the home?



Natural gas (or other heating fuel)

An average house uses around **16,500 kWh** annually

Space heating
Water heating

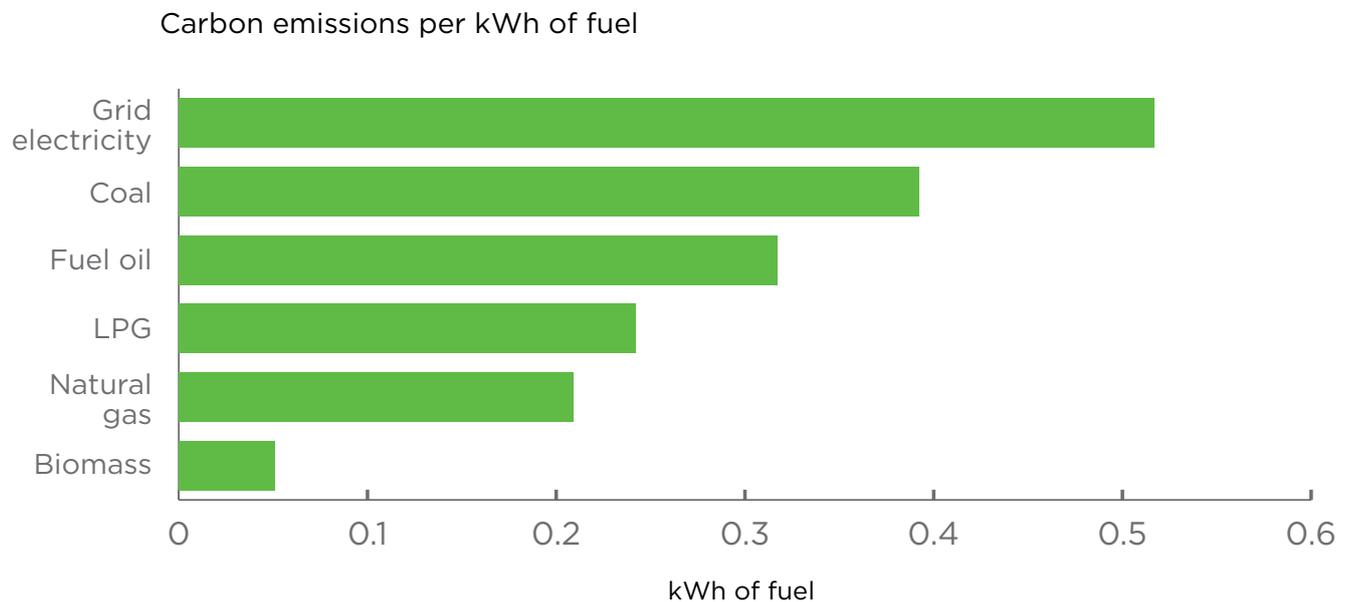
Electricity Adaptation

An average house uses around **3,300 kWh** annually

Cooking
Lighting
Cold appliances (e.g. fridges and freezers)
Wet appliances (e.g. dishwashers and washing machines)
Consumer electronics (e.g. computers and televisions)

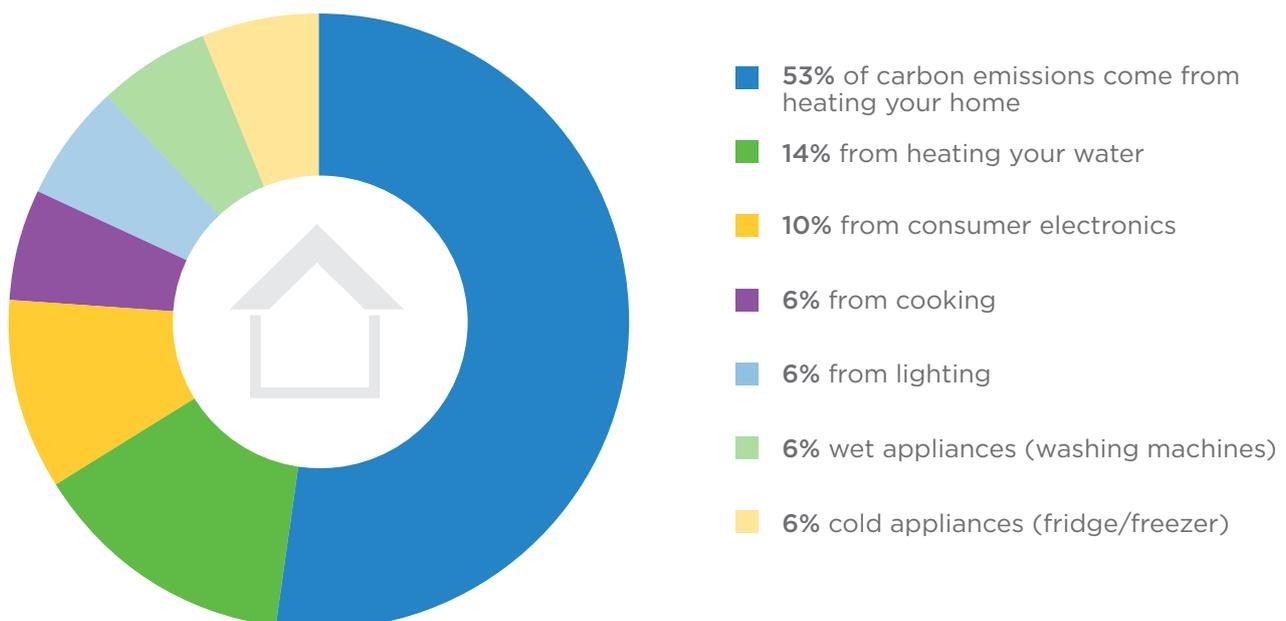
This shows that the majority of energy in the home is used for heating – both space and hot water. However, this is not the whole story because different types of energy produce different quantities of carbon emissions – this is called carbon intensity and is the amount of emissions produced per unit of fuel used.

Which type of fuel source produces the most emissions?



This graph shows that the grid electricity produces the most carbon emissions per unit – this is because around 50% of the electricity in the UK is generated using fossil fuels, and generation and transmission of electricity is not a very efficient way to use energy. The other heating fuels (coal, fuel oil and liquefied petroleum gas (LPG)) produce more carbon emissions per unit than natural gas, and are also more expensive. It's worth noting that longer term, as more and more electricity is generated from renewables, the Scottish Government aims to encourage more households to use electricity for heating. When produced by renewable energy electricity will be a low carbon source of heat.

Carbon missions from home energy





Doing it less: home energy

Not all the energy we use is useful: leaving lights on in rooms that are not being used, a full kettle boiled for one cup of tea, heat escaping through uninsulated lofts, are all examples of energy being wasted. When we talk about using less energy, we're referring to reducing energy wasted when it is not needed.

This section looks at heating fuels and electricity use separately but successful projects will look at opportunities for efficiency of all fuels used within a household.

Heating and hot water

The amount of energy used to provide heat and comfort is determined by two factors:



Time used



Heat lost or wasted

Time used

Better management of heating can allow us to reduce the time heating is used. Technology can help with this – e.g. heating timers allow us to only have the heating on when we're home, and thermostats mean the boiler will only run to achieve a comfortable temperature and not overheat the house. Behaviours are also important – e.g. **having showers instead of baths** reduces hot water usage and **turning the thermostat down by one degree**, and **putting on a jumper**, avoids overheating the house.

Reducing wasted heat

Insulation stops heat from escaping from a house, so reducing the amount of energy needed to provide a comfortable temperature. Walls and roofs can be insulated, **double glazing** and **heavy curtains** insulate windows and draught proofing round doors and windows stops heat escaping. Again, behaviours are important – **closing doors and curtains** keep the heat in.

'Doing it less' means reducing either the time a heating system is used, or reducing the amount of heat lost or wasted. We'll discuss the efficiency of the system in 'doing it differently'.

The two often go hand in hand – insulating a house could mean you can turn the thermostat down 1 degree and still be comfortable.

Electricity use

The amount of electricity used by our lighting and appliances is determined by three factors.

Power of appliance

Time used per day/
week (including on
standby)

Number of
appliances/lights

Time used per day/week (including standby)

Smarter behaviours can reduce the amount of time appliances are used - e.g. **turning off lights when not needed, only running the washing machine when it's full, only filling the kettle with the water you need, turning appliances off stand-by**, etc.

Number of appliances

We can make decisions about reducing the number of appliances we have, or use. For example, **replacing light fittings with those that use fewer bulbs** or instead of members of the family watching TV in separate rooms, **all watch the same programme together**.

Power of appliance

'Doing it less' means reducing the amount of time appliances/lights are 'on' or reducing the amount of appliances/lights we have. The power of appliances is measured in watts (W) or kilowatts (kW). The higher the wattage of the appliance, the more power it uses for the same time period. However, it is important to note that some high-power appliances are only used for a small period of time.

Halogen spotlights



50W

LCD flat screen TV



100W

Hairdryer



1500W

Fan oven



2400W

The information below shows the **potential savings** from a few simple behaviour changes:

Taking a shorter shower
(5 minutes instead of 10 minutes)



This could save around **£34** per year

Turning off lights
(saving 25% of energy)



This could save around **£20** per year

Washing clothes at a lower temperature
(30 degrees instead of 60)



This could save around **£10** per year

Filling a kettle with the required amount
(saving 50% of energy)



This could save around **£8** per year

Doing it differently: home energy

When we use energy at home what we're really interested in is the 'service' it provides. For example, electricity used by lightbulbs provides **light**, gas used by the boiler provides **heat**, the electricity used by a washing machine provides **clean clothes**, a vacuum cleaner provides **dust free carpets** and a T.V. provides **entertainment**.

When we think about how we can 'do it differently' we can either think about how we can get lower carbon energy or think about how we can get the 'service' but use less energy (and thereby less carbon). In both cases solutions to 'doing differently' are technological solutions.

Doing it differently: 'service'

If we can get the same amount of heat, light, clean clothes, dust free carpets or entertainment using less energy then that automatically means less carbon as well. To do this we need boilers, lightbulbs and appliances that can provide the same amount of service using less energy. This relationship between energy in and service out is described by the 'efficiency' of an appliance.

All electrical appliances have an energy rating from G-A+, where A+ rated appliances are the most efficient. Replacing inefficient appliances with more efficient ones can make a big difference, especially if they're on all the time (e.g. fridges) or used a lot (e.g. lightbulbs). For example, high power halogen spotlights can be replaced by much more **efficient LED spotlights** – for only 10% of the energy consumption, these produce the same amount of light.

Comparison	Halogen spotlight	LED spotlight
Power use (watts)	50W	5W
Estimated lifetime (hours)	2,000	15,000
Cost per lightbulb	Around £1	£1.50 - £3.50
Annual cost to run (assume 4 hours use per day)	£11.0	£1.10

Boilers providing heat and hot water also have an energy rating – a new 'A+' rated boiler is nearly 30% more energy efficient than a 'G' rated boiler. This means that a house can be brought to a comfortable temperature using less gas.

When we think about 'doing it differently' in relation to the services being provided, the result is using less energy and lower bills. So you could argue, from a carbon accounting point of view, that really this is just another way of 'doing it less', without thinking about it. We've chosen to think of it as 'doing it differently' to distinguish these 'passive' approaches from the more 'active' choices to use appliances less that are described above.

Doing it differently: energy source

While around 70% of households in Scotland are estimated to be connected to the natural gas network, this leaves 30% that do not have access and therefore use fuel oil, LPG, solid fuels such as coal, or electricity. All of these fuels are more expensive than natural gas and have higher carbon emissions per unit of heat they provide. The proportion of electricity from renewables is increasing but we still rely heavily on fossil fuels.

Solar thermal

Solar thermal panels are a way to heat hot water by capturing heat from the sun with roof panels. In Scotland these can provide most of your hot water demand in the summer, but much less in the winter. Households with solar thermal panels still need a conventional boiler, but they will heat their water from a carbon free source when the sun is shining. On average, in Scotland, installing solar thermal panels will reduce carbon emissions by 270 kgCO₂e per year if your normal fuel source is gas and 510 kgCO₂e per year if your normal fuel source is electricity.

www.energysavingtrust.org.uk/renewable-energy/heat/solar-water-heating



Biomass

There are several options for using biomass for space and water heating.

Wood burning stoves – these can reduce the amount a conventional heating system is used.

Biomass boilers – these completely replace fossil fuels with biomass in the form of logs or pellets. Space heating is provided through radiators and a hot water tank provides hot water.

Burning wood does release carbon dioxide, but if wood fuel comes from a sustainable source where trees are replanted, then it is considered carbon neutral as the new tree will absorb the same amount of CO₂ as is released. Greenhouse gases are released in the felling, processing and transporting of wood fuel so there is a carbon emissions factor for heat generated from wood fuel, however it is much lower (i.e. less carbon intensive) than fossil fuels, especially if you have a local supply of biomass.

On average, for a 4-bedroom house in Scotland, replacing an oil boiler with a wood pellet boiler will reduce carbon emissions by up to 8,300 kg CO₂e a year.

www.energysavingtrust.org.uk/renewable-energy/heat/biomass



Air source or ground source heat pumps

Air source and ground source heat pumps work on a similar principle to fridges and air conditioning units – but providing heating not cooling. Electricity is used to pump round a fluid which absorbs heat from the air or from the ground (via buried pipes). This can be used to heat the home with radiators, underfloor heating or blown air, and can also be used to provide hot water. Heat pumps use electricity, which has greenhouse gas emissions associated with it, but an air source heat pump typically generates 2.45 units of heat for every unit of electricity used, and a ground source heat pump typically generates 2.85 units of heat for every unit of electricity used. This means that heating is being provided in a less carbon intensive way.

On average, for a 4-bedroom house in Scotland replacing a gas boiler with a ground source heat pump will reduce carbon emissions by up to 3,300 kgCO₂e a year.

On average, for a 4-bedroom house in Scotland replacing an oil boiler with an air source heat pump will reduce carbon emissions by up to 2,700 kgCO₂e a year.

www.energysavingtrust.org.uk/renewable-energy/heat/ground-source-heat-pumps
www.energysavingtrust.org.uk/renewable-energy/heat/air-source-heat-pumps



Solar PV

Solar PV panels are the most common way householders generate renewable electricity – and the only viable option for most people. Solar PV panels work quite well in Scotland – they will generate even on cloudy days. A typical 4kWp array will generate 3,200 kWh over a year. If the householder is consuming less electricity than their solar panels are generating at a given moment in time, then they will be using carbon free electricity. If the householder doesn't use the electricity it is exported to the grid helping to lower the overall carbon intensity of grid electricity.

On average, in Scotland, installing solar PV will reduce household carbon emissions by 1,500 kgCO₂e.

www.energysavingtrust.org.uk/renewable-energy/electricity/solar-panels


Summary

Doing it less	Doing it differently
Install and use programmers and timers for heating system	Install low carbon heat technology - solar water heating
Install thermostats	Install low carbon heat technology - ground source and air source heat pumps
Turn thermostats down 1 degree	Install low carbon heat technology - biomass
Having a shower instead of a bath	Install low carbon electricity technology - solar
Insulate and draught proof	Choose more efficient lighting and appliances
Draw heavy curtains at night	Install a more efficient heating system
Turn off lights and reduce the number of lights used	
Learn to use appliances more efficiently - e.g. washing clothes at 30 degrees rather than higher temperatures, only fill kettle with water needed, dry washing outside where possible etc.	
Turn appliances off standby	
Reduce the amount of light fittings/appliances in the house	

Home energy: Government milestones

The Scottish Government has designated energy efficiency as a National Infrastructure Priority the cornerstone of which will be Scotland's Energy Efficiency Programme (SEEP).

The Scottish Government Climate Change Plan has the following:

OUR AMBITIONS IN THE ELECTRICITY SECTOR

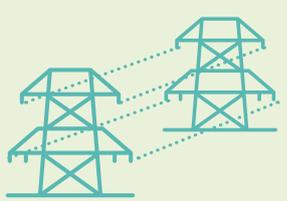
BY 2032 – SCOTLAND'S ELECTRICITY SYSTEM WILL BE LARGELY FROM RENEWABLE SOURCES INCLUDING ONSHORE WIND, OFFSHORE WIND, HYDRO, SOLAR, MARINE AND BIOENERGY



FROM 2020 ONWARDS, SCOTLAND'S ELECTRICITY GRID INTENSITY WILL BE BELOW 50g OF CO₂ PER KILOWATT HOUR



SMART GRID TECHNOLOGY AND BETTER CONNECTION WILL IMPROVE THE ELECTRICITY SYSTEM



AT LEAST 1GW OF RENEWABLE ENERGY WILL BE IN COMMUNITY OR LOCAL OWNERSHIP BY 2020



IN 2032, SCOTLAND'S ELECTRICITY SYSTEM WILL BE LARGELY DECARBONISED



BY 2032 WE AIM TO ACHIEVE

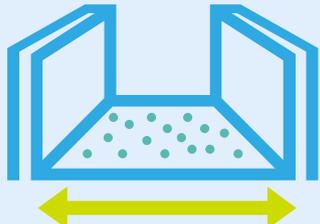
23% EMISSIONS REDUCTION IN THE RESIDENTIAL SECTOR



53% EMISSIONS REDUCTION IN THE SERVICES SECTOR

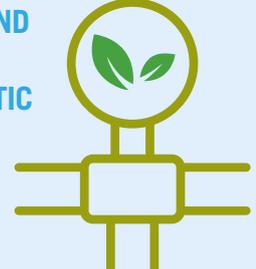


TO DO THIS, WE ARE AIMING FOR: 60% OF WALLS INSULATED BY 2020



LOW CARBON TECHNOLOGIES WILL SUPPLY HEAT TO:

- 35% OF DOMESTIC AND 70% OF NON-DOMESTIC BUILDINGS**



15% REDUCTION IN RESIDENTIAL HEAT DEMAND FROM ENERGY EFFICIENCY MEASURES



20% REDUCTION IN NON-DOMESTIC HEAT DEMAND FROM ENERGY EFFICIENCY MEASURES



Support for low carbon action

Greener Scotland

A good starting place to find out about reducing energy use at home.

<http://www.greenerScotland.org/home-energy/using-your-home-energy-well>

Home Energy Scotland

Impartial advice on making homes cheaper to heat through energy efficient measures and renewables. Home Energy Scotland also offer support to businesses.

<http://www.energysavingtrust.org.uk/scotland/businesses-organisations>

Energy Savings Trust

Provide information to make informed choices about renewables, home energy improvements, eco-driving and buying an efficient car.

<http://www.energysavingtrust.org.uk/tools-and-calculators>

Home Energy Scotland Renewables Loan Scheme

Interest free loans of up to £10,000 from the Scottish Government are available to owner occupiers in Scotland who wish to install a domestic renewables system or to connect to an approved district heating scheme powered by a renewable energy source.

<http://www.energysavingtrust.org.uk/scotland/grants-loans/renewables/loan-scheme>

HEEPS Loan Scheme

Offers home owners and private sector landlords interest free loans of up to £15,000 per property, and landlords with multiple properties are eligible for up to £100,000 in total. The repayment period varies based on the amount you intend to borrow but those taking out higher value loans will be able to pay back over 10 years.

Warmer Homes Scotland

Is designed to help vulnerable people make their homes warmer and more comfortable by installing a range of energy saving measures. Whilst it is primarily a 'Fuel Poverty' scheme, this links closely to carbon reduction. Householders or private tenants must meet a range of eligibility criteria.

Home Energy Efficiency Programme for Scotland Area Based Schemes (HEEPS ABS)

Are projects aimed at improving energy efficiency in certain areas. Projects are chosen by local authorities.

Scottish Energy Efficiency Programme (SEEP) (coming soon)

Will help local authorities to pilot new and innovative approaches to energy efficiency with community groups and businesses, helping reduce costs and improving warmth in homes, schools, hospitals and businesses.

Local Energy Scotland

Free, impartial advice service through which you can access the Scottish Government's Community and Renewable Energy Scheme (CARES).

<http://www.localenergyscotland.org/>

Community and Renewable Energy Scheme (CARES)

Provide advice and support for community owned renewable energy projects – includes advice from development officers, financial support, support for direct and shared ownership and support with community benefit from renewables.

<http://www.gov.scot/Resource/0045/00457861.pdf>

Green Homes Network

A network of more than 1,000 properties including sustainable eco-builds, historic stone cottages, listed buildings and everything in between. The network encourages householders to install renewable technology and energy efficiency measures by allowing people to speak to householders who've already done it.

<http://www.energysavingtrust.org.uk/green-homes-network-0>

Green Business Network

A network of businesses, community buildings and religious buildings that have installed energy efficiency measures and/or renewable technologies.

<http://greennetwork.resourceefficientscotland.com/Default.aspx>

Feed in Tarrifs (FiT)

This scheme pays you per kWh of renewable energy generated. Like the RHI (below) FiT payments are intended to make finances upfront costs of installation affordable via a loan as payments are guaranteed for up to 20 years.

<http://www.energysavingtrust.org.uk/renewable-energy/electricity/solar-panels/feed-tariffs>

Renewable Heat Incentive (RHI)

This scheme gives quarterly cash payments over 7 years if you install recognised low-carbon heat technologies.

The RHI is available for domestic and business installations. Payments are based on the size of the heating system installed.

<http://www.energysavingtrust.org.uk/scotland/grants-loans/renewables/renewable-heat-incentive>

Local Energy Challenge Fund

Supports large-scale low carbon demonstrator projects which show a local energy economy approach linking energy generation to energy use. This includes projects looking to develop innovative energy distribution and storage solutions that have an overall aim of creating more local value and benefit.

<http://www.localenergyscotland.org/funding-resources/funding/local-energy-challenge-fund/>

Low Carbon Infrastructure Transition Programme

Scottish Government ERDF programme offers a range of support mechanisms including project development, expert advice and funding (where applicable) is available through the Low Carbon Infrastructure Transition Programme (LCITP) to support the development of substantive private, public and community low-carbon projects across Scotland.

<http://www.gov.scot/Topics/Business-Industry/Energy/Action/lowcarbon/LCITP>

District Heating Loan Fund (DHLF)

Is open to local authorities, registered landlords, small and medium-sized enterprises (SMEs) and energy service companies (ESCOs). It provides loans of up to £500,000 per project for low-carbon, and renewable technologies. Since 2011, more than £10m has been lent to 40 different projects.

<http://www.energysavingtrust.org.uk/scotland/grants-loans/district-heating-loan>

Energy Efficiency Financing Scheme (Siemens and Carbon Trust)

Provides low interest loans for a range of energy efficiency and renewable technologies. Most organisation types are eligible for the scheme. Call Siemens 01753 434360.

<https://www.carbontrust.com/client-services/technology/implementation-and-finance/>

Big Energy Saving Network

Is made up of local community groups and charities across Great Britain that can advise on energy saving in the home, switching energy suppliers, different energy tariffs and available government support to help the most vulnerable get warmer homes and lower fuel bills. Funding has been made available through the UK Government to support community organisations to join the network.

<http://bigenergysavingnetwork.ning.com/home>

Community Energy Scotland

A registered charity that provides practical help for communities on green energy development and energy conservation.

<http://www.communityenergyscotland.org.uk/>

Resource Efficient Scotland (RES)

Scottish Government programme delivered by Zero Waste Scotland designed to help the public, private and third sectors reduce costs by implementing resource efficiencies in energy, water, raw materials and waste management. This includes free resource efficiency audits.

<http://www.resourceefficientscotland.com/content/one-one-support>

SME Loan Scheme (through RES)

Loans of up to £100k are available to support SMEs with a financial contribution towards energy, water and waste saving equipment and systems.

<http://www.resourceefficientscotland.com/content/loans-small-medium-businesses>

Energy suppliers

Energy suppliers often operate their own schemes and funds, often to support people in fuel poverty, and with debt relief. This is done directly by the energy supplier, or through an associated charitable trust. Scottish Power, for example, run a Hardship Fund for customers struggling to pay off debts, plus the Scottish Power Foundation, which funds community projects.



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
Beautiful**

Your charity for Scotland's environment

T: 01786 471333 E: ccf@keepscotlandbeautiful.org

f [facebook.com/ClimateChallengeFund](https://www.facebook.com/ClimateChallengeFund) **t** [@CCFScot](https://twitter.com/CCFScot)

www.keepscotlandbeautiful.org/ccf



ISO 14001:2015 Certification No.208826