Energy

Energy in Scotland is changing and will continue to do so as we strive towards a low carbon future.

Summary

Key messages

- Scotland has some of the most stringent and challenging energy targets in the world to meet our climate-change targets.
- Scotland accounts for around 10% – some 36,600 gigawatt hours (GWh), of the UK's gross electricity consumption.
- Scottish renewable electricity generation made up approximately 32% of total UK renewable generation in 2013.
- An estimated 46.5% of gross electricity consumption in Scotland came from renewable sources in 2013 - up from 40.3% in 2012.
- Renewable energy currently supports nearly 12,000 jobs in Scotland.
- The oil and gas industry directly employs around 225,000 people across Scotland as well as supporting jobs in other sectors of the economy.
- In 2011, Scotland accounted for 60% of European Union oil production, and approximately a third of EU total hydrocarbon production.
- In 2011, 2.6% of Scotland's non-electrical heat demand was met by renewable sources compared to only 1% in 2009.
- Energy in Scotland is changing and will continue to do so as we strive towards a low carbon future.

State and trend

State: Poor - medium agreement, low evidence

Trend: Improving - medium agreement, low evidence

There is an explanation of the diagram and further information on how we carried out the assessments on the summary pages.

- These assessments are based on energy supply as a sustainable energy system, taking into account the needs of future generations.
- The assessment includes onshore and offshore energy production.
- These assessments are of the current "average condition"; some aspects are in a worse condition, and others are in a better one. Equally, some aspects are declining, while others are improving.
- Making any overall assessment is necessarily a simplification.

- We have stated how confident we are in the assessments based on the level of agreement between the specialists involved, and the quality and quantity of the supporting evidence.

Overview

We need energy to generate electricity, to heat our homes and to run our cars. It comes from a range of non-renewable and renewable sources such as coal, oil, gas, wind and water (Table 1). Over the last 200 years, most of our energy requirements have been met by fossil fuels. However, these are not renewable and will run out eventually. Burning fossil fuels also generates greenhouse gases. Relying on fossil fuels for energy generation is therefore unsustainable and we need to explore a wider range of energy sources in future – including using more renewable, sustainable ways of generating energy.

Table 1: The main energy sources and their impact on the environment.

Energy Source	Is it renewable?	Impact on the environment
Coal	No	Generates greenhouse gases and other air pollutants
Oil	No	Generates greenhouse gases and other air pollutants
Natural gas	No	Generates greenhouse gases and other air pollutants
Nuclear	No	Waste produced is highly toxic Leakage can damage human health and the environment
Biomass	Yes if the vegetation used is replanted	Generates greenhouse gases and other air pollutants Competes with other land uses
Wood	Yes if trees providing wood are replanted	Generates greenhouse gases and other air pollutants Competes with other land uses
Solar	Yes	Impact on landscape
Wind	Yes	Impact on landscape Competes with other land uses Impact on wildlife and habitats
Tidal	Yes	Impact on landscape Impact on wildlife and habitats
Wave	Yes	Impact on landscape Impact on wildlife and habitats
Hydroelectric power	Yes	Impact on landscape Impact on wildlife and habitats
Ground source heat	Yes	

The European Union have set a target that 20% of energy must come from renewable sources by 2020. The Scottish Government has set more stringent targets and is aiming for at least 30% by 2020. This includes targets for:

- renewable sources to generate the equivalent of 100% of Scotland's gross annual electricity consumption by 2020;
- renewables sources to provide the equivalent of 11% of Scotland's non-electrical heat demand by 2020.

The connection between energy requirements and the environment is important for everyone who lives, or does business in, Scotland.

The main pressures relating to energy are the impacts of climate change, the need to reduce greenhouse gas emissions, the expense of energy, and the need to make sure we have a secure, reliable energy supply.

Scotland accounts for around 10% - some 36,600 gigawatt hours (GWh) - of the UK's total electricity consumption. The vast majority of the UK's oil production, and around half of its natural gas production, is extracted from reserves under the continental shelf around Scotland. In addition a third, around 6 million tonnes, of the UK's coal production comes from Scotland. Scotland has a major economic stake in the production of hydrocarbon fossil fuels, and our coal, oil and gas reserves are valuable assets. The oil and gas industry currently employs approximately 225,000 people across Scotland, either directly in the industry or in supporting jobs in other sectors of the economy.

Scotland also has huge potential for renewable electricity generation. It has been estimated that Scotland could produce 206 GW a year of electricity through offshore wind, wave and tidal generation. This means that Scotland could produce up to 25% of Europe's total offshore wind and tidal energy, as well as 10% of its wave energy.

Currently, electricity generation in Scotland comes from a mixture of fossil fuels, nuclear, and renewables. Around a quarter of the electricity generated is exported to the rest of the UK.

In Scotland, the majority of energy produced is used to provide heat (non-electrical). Transport uses nearly a quarter of energy produced, while electricity uses just over 20% of energy produced.

Excluding transport, approximately 40% of energy (electricity and heat) is used by households while 60% is used by industry and business.

The source of energy and its production can have significant impacts on the environment (Table 1).

State

The demand for energy in Scotland has decreased by about 10% between 2000 and 2012, with a particularly marked reduction between 2008 and 2012.

It is unclear whether this reduction in energy consumption is because of the downturn in the economy or because of energy-saving measures.

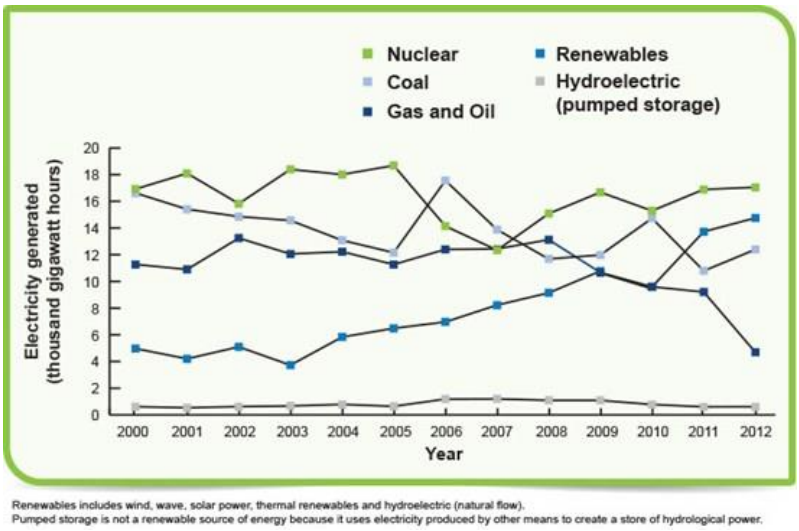

Figure 1: Electricity generation by source 2000 – 2012

Source: Scottish Government

Figure 1 shows there has been a large increase in the amount of electricity generated from renewable sources, and also that the annual contributions from nuclear, coal, gas and oil are relatively volatile. The contribution from pumped storage remains important at around 1.2% of electricity generated in 2012.

Table 2 illustrates the rapid rise in the contribution of renewable energy from the year 2000 and, in particular, the increasingly important contribution from wind power. With the exception of hydropower, all forms of renewable energy are contributing an increasing amount to total energy demand.

Table 2: Contribution of renewables to gross consumption 2000 to 2012

Year	Hydro	Wind (inc.amount of wave/tidal/solar)	Landfill	Sewage	Other biofuels	Total	Gross Consumption (GWh)	Renewables as a percentage of gross consumption
2000	4,665.3	216.7	68.5	*	21.1	4,971.6	40,801	12.2%
2001	3,737.5	245.2	109.3	*	110.4	4,202.4	40,446	10.4%
2002	4,455.4	406.1	157.0	*	80.1	5,098.7	41,619	12.3%
2003	2,902.0	448.9	228.0	*	145.5	3,724.5	41,238	9.0%
2004	4,474.8	848.4	339.2	*	169.8	5,832.2	41,364	14.1%
2005	4,612.2	1,280.9	395.4	*	197.2	6,485.7	41,923	15.5%
2006	4,224.9	2,022.9	424.0	*	291.0	6,962.8	41,309	16.9%
2007	4,692.9	2,644.0	486.5	*	402.7	8,226.1	40,718	20.2%
2008	4,709.2	3,330.0	501.7	*	600.0	9,140.8	41,132	22.2%
2009	4,863.8	4,558.3	533.8	21.1	778.2	10,755.2	39,028	27.6%
2010	3,313.3	4,861.8	534.2	20.6	861.2	9,591.1	39,669	24.2%
2011	5,331.8	6,991.9	506.5	35.3	862.6	13,728.1	37,871	36.2%
2012	4,843.6	8,263.6	548.6	35.4	1,064.8	14,756.1	36,602	40.3%

Source: Scottish Government

Scotland has two operational nuclear power plants, which are an important source of de-carbonised electricity and use fuel imported from abroad. Once fuel has been used in a reactor it can be reprocessed to provide additional energy, but this produces a significant quantity of radioactive waste that has to be safely contained for many years. In Scotland, waste is stored on the surface at the generation site rather than deep underground as is the preference in England and Wales.

Table 3 illustrates the extent of nuclear waste and the lifetime potential volume of waste.

Table 3: Radioactive waste in Scotland

Waste type *	Volume (cubic metres)		
	Stocks at 1 April 2010	Estimated future arisings	Lifetime total once all waste is packaged
Intermediate-level waste	8,080	17,400	41,500
Low-level waste	30,500	245,000	374,000

* Radiocative waste is categorised into four levels; no high-level waste is managed in Scotland.

Scottish energy policy has shifted away from nuclear generation. At the end of their operational life, Scotland's nuclear power plants will not be replaced. Both nuclear power plants currently have a decommissioning date of 2023.

Pressures affecting energy supply and demand

Energy faces pressures in relation to demand (the quantity of energy required) and supply (how energy is produced).

Population and households

Scotland's population is increasing, and how we live is changing (living longer but in smaller sized households). This is leading to increased demand for housing and for energy. Scotland's population was approximately 5.3 million in 2012. The latest projections suggest that this will rise to 5.76 million by 2035.The number of households grew faster than the rate of population increase (by 343,000, or 17%) between 1991 and 2012, indicating that household structures are changing, with fewer occupants per household.

Projections suggest that by 2035 the number of households in Scotland will increase to 2.89 million. This will further increase demand for housing and energy.

Road transport

Figure 2 shows that from 2005 to 2011, total personal transport fuel consumption in Scotland fell by 10%, while over the same period freight consumption increased by 5%.

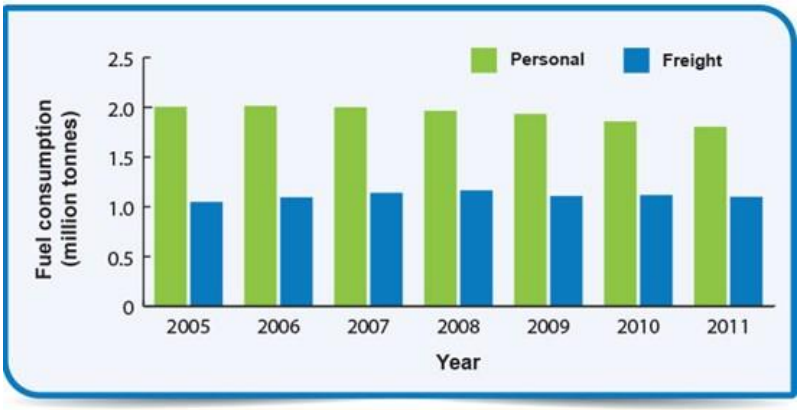

Figure 2: Road-transport energy consumption in Scotland: tonnes of fuel for freight and personal transport per year

Source: Scottish Government, Energy in Scotland Compendium 2014

Figure 3 shows that since 2007, total vehicle kilometres on Scotland's roads had been reducing year on year, although there was a marginal increase in the year to 2012.

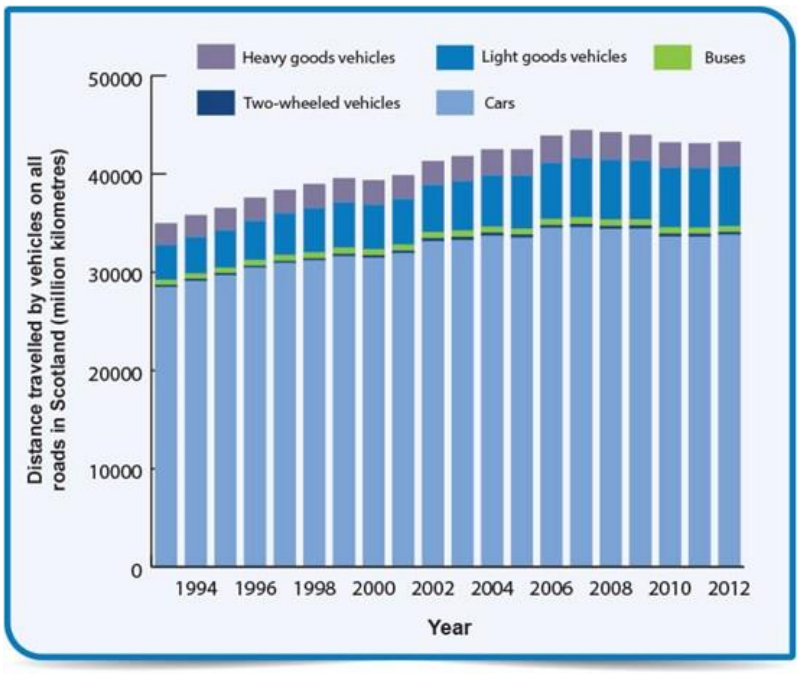

Figure 3: Distance travelled by vehicles on all roads in Scotland, 1993–2012

Source: Scottish Government, Energy in Scotland Compendium 2014

Electric vehicles have great potential for reducing greenhouse gas (GHG) emissions produced by road transport. However, not enough people are buying vehicles that use this technology. Electric vehicles need to become relatively less expensive to buy, easier and cheaper to refuel or recharge, and capable of travelling distances on one charge similar to cars powered by fossil fuels.

Energy reserves

There are significant coal reserves in Scotland, but burning coal (a fossil fuel) produces a lot of greenhouse gases.

However, mine waters in abandoned workings in Scotland's Midland Valley are a potentially important geothermal resource. Deep geothermal energy is an emerging technology that could be an important source of energy in Scotland in future. The Scottish Government has published a study on the potential of geothermal energy in Scotland. It estimates that there could be enough energy available in Scotland's abandoned mine workings to provide one third of Scotland's heat demand – however it notes that the actual contribution is likely to be significantly less because heat cannot be transported efficiently over large distances. Other potential sources of geothermal energy in Scotland were also identified including "hot sedimentary aquifers" and "hot dry rocks".

Scotland also has unconventional sources of oil & gas, including, shale gas and coalbed methane. The British Geological Survey has studied the shales of the Midland Valley and estimated the shale gas and oil resource – that is the total amount of gas and oil present in the rocks. However, further work is required to estimate how much of this resource is recoverable.

In 2011 Scotland produced more than 60% of oil in the European Union (EU) and approximately one-third of EU total hydrocarbon production. It is estimated that 15-24 billion barrels of oil and gas equivalent (boe) could still be recovered from within the UK's territorial waters, worth up to £1.5 trillion and generating between £41 and £57 billion in tax revenue between 2012 and 2018. This is equivalent to more than half the total quantity recovered since the 1970s).

However, continuing to produce and consume oil, natural gas and coal will make it more difficult to achieve Scotland's climate change targets. Also, the development of carbon pricing over the next few years could dramatically reduce the value of fossil-fuel reserves around the world. If international agreement is reached to support the practice of placing limits on greenhouse gas emissions and paying for the excess emissions, this will effectively monetise future carbon emissions and significantly devalue fossil-fuel reserves. Reducing the market value of fossil-fuel reserves could result in them becoming obsolete, and could also significantly reduce the economic viability of deep marine fossil-fuel reserves and reserves in other locations that are difficult to access, such as places that are highly valued for their habitats or species.

One option to make up for the shortfall in electricity generation when Scotland's nuclear reactors are decommissioned is a large new fossil-fuel-burning plant with integrated carbon capture and storage (CCS). Also, accelerating the upgrade and expansion of the transmission infrastructure could tap into potential wind and wave power.

What is being done

Scotland has some of the most stringent and challenging energy targets in the world, supported by policies, incentives and targeted support. Together, they aim to reduce Scotland's contribution to climate change, support new technologies in Scotland and reduce our reliance on fossil fuel.

Policy and legislation

Targets

To reduce GHG emissions we must decarbonise our energy supplies, and this means moving away from fossil fuels as well as making CCS a reality on an industrial scale.

The Climate Change (Scotland) Act 2009 contains ambitious targets to reduce GHG emissions while maintaining economic growth. Those relating to energy include:

- delivering the equivalent of at least 100% of gross electricity consumption from renewables by 2020, with an interim target of 50% by 2015;

- reduce final energy consumption in Scotland by 12%;
- operating CCS on a commercial scale by 2020;
- fitting CCS in conventional power stations by 2025-30;
- developing better interconnection and upgrading transmission to cope with the projected growth in renewable electricity generation;
- supplying 11% of Scotland's heat needs from renewable sources by 2020.

This is already having a direct impact on the supply and consumption of energy. The Scottish legislation is on top of UK and European Community (EC) legislation and the United Nations' global agreement to reduce emissions.

UK legislation that has a particular impact on energy supply in Scotland includes the Utilities Act 2000, that deals with gas and electricity markets, and the Energy Act 2004, which, among other things, deals with road-transport fuel. The implementation of these two Acts has led to obligations being set for electricity generators and road-fuel suppliers in order to increase the amount of energy from renewable sources supplied to customers.

For private road transport in particular, taxes encourage people to use less fuel – for example, tax on fuel, and higher road tax on cars that are less efficient, and using income tax to eliminate the benefit-in-kind associated with driving a company car.

Policy

The Scottish Government's Electricity Generation Policy Statement 2013 (EGPS) examines the way in which Scotland generates electricity, and considers the changes necessary to meet a range of energy related targets, including the future energy generation mix required. It reflects views from both industry and other stakeholders and also developments in UK and EU electricity policy. It looks at where we get our electricity from, the amount of electricity we use and what we will need to do to meet our energy needs over the coming decade and beyond.

A Scottish Heat Generation Policy Statement is currently being developed and the potential for future generation sources such as geothermal and solar in Scotland are being assessed.

Improving energy efficiency

Individuals, organisations and businesses are being encouraged to reduce the amount of energy they use by installing insulation, energy-efficient lighting, modern heating controls, etc.

Reducing the amount of energy used in households has an important part to play in achieving the energy reduction, climate change and fuel poverty targets. The Scottish Government's Home Energy Scotland advice centres provide advice and support to help save energy, money and to reduce greenhouse gas emissions.

In addition, the advice centres deliver the Home Energy Efficiency Programmes for Scotland (HEEPS) and advice on sustainable transport.

Smart meters are currently limited to providing information about how much gas and electricity is being used, and at what cost. Although this is a useful tool in raising awareness and encouraging energy efficiency. Smart meters are currently being developed to allow energy suppliers to obtain accurate information on energy consumption. The new Energy Efficiency Directive requires estimated bills to be phased out by 2015 and smart meters will help to fulfil this requirement. Starting in 2015, every Scottish household will have the opportunity to take a smart meter. These will include an in-home display unit which will show how much energy is being used. These will show how changing behaviour can change the amount of energy used. Installation of smart meters should be complete by 2020.

The smart meter could even decide when to draw power from an electric vehicle connected to the household supply. Once these meters are in widespread use they could have a huge effect on smoothing out peaks in demand and remove the need for such a high level of spare 'quick response' capacity in the national electricity supply.

New cars and other road vehicles must be sold in the UK with information about their fuel efficiency under standard test conditions. These conditions have been set by various EC directives which first appeared in 1970 and have been frequently revised.

The Resource Efficient Scotland programme has been set up to help the public, businesses and organisations across Scotland save money by providing advice on how they can use their resources (including energy) more efficiently.

Decarbonising energy and heat supply

The Renewables Obligation Scotland (ROS) came into effect in 2002 and places an obligation on electricity suppliers to source an increasing proportion of the electricity they supply from renewable sources. Smaller-scale generation is mainly supported through the Feed-In Tariff scheme (FIT).

The ROS is driving large-scale renewable-energy projects in Scotland. A further 14 GW of planned and approved capacity could become operational in the coming years (Figure 4).

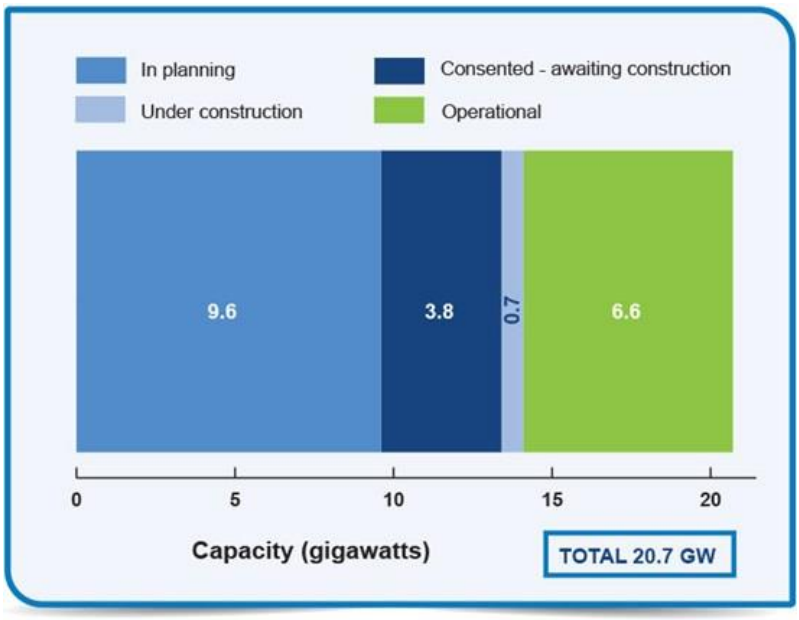

Figure 4: Renewable capacity in Scotland by planning stage, December 2013

Source: Scottish Government, Renewable Energy Statistics for Scotland

The Renewable Transport Fuel Obligation (RTFO) is one of the UK Government's main policies for reducing greenhouse gas emissions from road transport in the UK. The RTFO helps bring the UK into line with European Union Biofuels Directive. Scotland's target is for biofuels to make up 10% of transport fuel consumption by 2020.

The Renewable Heat Incentive (RHI) is a UK Government scheme set up to encourage the use of renewable energy to heat buildings by providing financial incentives. This is now available for households as well as industry, businesses and the public sector.

Supporting new technologies

Although good progress is being made in increasing the supply of de-carbonised electricity, the speed of this development is limited. The high costs of developing new technologies, such as offshore wind and wave, require more assistance than mature technologies, such as landfill gas or biomass co-firing. In order to help overcome these constraints, bandings of Renewable Obligation Certificates have been introduced.

Scotland has the potential to produce 25% of the total potential for tidal energy in Europe, and 10% of its waveenergy. Special support has been given to the development of marine renewables through the establishment of the European Marine Energy Centre (EMEC) in the sea around Caithness and Orkney.

More grid-connected marine-energy converters have been deployed at EMEC than at any other site in the world, and the centre is the world's only accredited marine-energy laboratory.

The sea around Orkney hosts the world's first commercial-scale leasing for marine energy. Leases have been awarded for just over 1.6 GW of marine-energy projects in the area. This alone could be enough to power 750,000 households.

Interest in using hydrogen as a fuel is growing in Scotland, and several research, development and demonstration projects have been supported by the public sector. To date, the provision of complete 'renewable energy – fuel cell – hydrogen storage' systems are rare, with operational examples limited to isolated projects such as the Project for Unst Renewable Energy (PURE) Energy Centre, Shetland and within the Hydrogen Office demonstration project in Fife.

In Shetland the project combines wind power with electrolysis to produce hydrogen, which can be stored, used as back-up power and also used for low-carbon transport. From late 2014, Aberdeen will be home to the largest fleet of hydrogen-powered buses in Europe.

Developing the technology for CCS is a priority in Scotland, and this is being taken forward with government support and expertise from the oil and gas sector and academics. However, CCS may not be available on a commercial scale for some years.

The Scottish Hydropower Resource Study found that there could be enough hydropower to supply a quarter of Scotland's homes. However, not all the resource that could be available will be harvested, as the need for drinking water, ecology and recreation (fishing, kayaking) must also be met.

Technology and Project Support

The Scottish Government provides funding to initiate and support renewables projects, to encourage technology development, and to stimulate private sector investment in infrastructure. Examples include:

- £103 million Renewable Energy Investment Fund (REIF), which prioritises marine renewables, renewable district heating and community renewable projects;
- £30 million through Wave and Tidal Energy Support Schemes and investment at the European Marine Energy Centre (EMEC) to support wave and tidal technologies.
- £18 million Marine Renewables Commercialisation Fund (MRCF);
- £35 million Prototyping for Offshore Wind Energy Renewables Scotland (POWERS) fund;
- Community and Renewable Energy Scheme (CARES) to support community investment / ownership of renewable energy;
- the District Heating Loans Fund will provide over £11 million between 2011/15.